Under-representation of female athletes in research informing influential concussion consensus and position statements: an evidence review and synthesis

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ABSTRACT

Objective We aimed to quantify the female athlete composition of the research data informing the most influential consensus and position statements in treating sports-related concussions.

Design We identified the most influential concussion consensus and position statements through citation and documented clinician use; then, we analysed the percentage of male and female athletes from each statement's cited research.

Data sources We searched PubMed on 26 August 2021 with no date restrictions for English language studies using the terms 'concussion position statement' and 'concussion consensus statement.'

Eligibility criteria for selecting studies Based on each statement having multiple statement editions, documented clinician use, and substantial citation advantages, we selected the National Athletic Trainers' Association (NATA, 2014), International Conference on Concussion in Sport (ICCS, 2017) and the American Medical Society for Sports Medicine (AMSSM, 2019). We extracted all cited studies from all three papers for assessment. For each paper analysing human data, at least two authors independently recorded female athlete participant data.

Results A total of 171 distinct studies with human participants were cited by these three consensus and position papers and included in the female athlete analyses (93 NATA; 13 ICCS; 65 AMSSM). All three statements documented a significant under-representation of female athletes in their cited literature, relying on samples that were overall 80.1% male (NATA: 79.9%, ICCS: 87.8 %, AMSSM: 79.4%). Moreover, 40.4% of these studies include no female participants at all.

Conclusion Female athletes are significantly under-represented in the studies guiding clinical care for sport-related concussion for a broad array of sports and exercise medicine clinicians. We recommend intentional recruitment and funding of gender diverse participants in concussion studies, suggest authorship teams reflect diverse perspectives, and encourage consensus statements note when cited data under-represent non-male athletes.

WHAT IS ALREADY KNOWN ON THIS TOPIC?

⇒ Concussion presentation and recovery among male and female athletes have similarities, but also may differ in pathophysiology or health-related behaviours in ways that affect clinical care.

WHAT THIS STUDY ADDS?

⇒ Consensus and position statements outlining concussion management are critical to guiding clinical care; however, we show the studies that inform them have vastly under-represented female athletes. The three most influential consensus and position statements with three different writing methodologies each reflected a similar bias in the literature.

⇒ The most influential consensus and position papers average only 19.9% female participants in the human subjects research supporting their recommendations. Moreover, 40.4% of the studies cited in the most prominent consensus and position papers include no female participants at all.

⇒ Under-representation of female athletes in the data underlying concussion consensus and position papers may result in protocols that are more targeted for male athlete recovery.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Future research in sport-related concussion should intentionally recruit and fund gender diverse participants, include diverse authorship teams, and acknowledge when cited data under-represent non-male athletes.

INTRODUCTION

Each year, between 1.6 and 3.8 million Americans suffer sports and recreation-related concussions.[1] Recreational sports participation is a leading cause of concussion in the USA.[2] Accordingly, there has been an increased interest and available funding directed toward concussion research. Ongoing advancement through the International Conference on Concussion in Sport (ICCS)[3–5] and other medical organisations[6–8] have aimed to more effectively treat athletes through evidence based clinical care among other goals. These consensus and position statement processes form the standard of care used by clinicians treating patients with concussion.

The effort of these iterative consensus and position statements has helped crystallise gaps in our knowledge and set a clear agenda for advancing clinical care for concussion over the years. The ICCS started this trend for concussion consensus publication at the Vienna meeting in 2001, with four more subsequent iterations—most recently Berlin in 2017[3–5 9 10] and has been cited 1980 times across all editions. The National Athletic Trainer's Association (NATA) followed suit with a position statement in 2004,[11] updated in 2014,[6] which have been cited 256 times. The American Medical Society for Sports Medicine (AMSSM) published its first statement in 2013[7] with an update in 2019,[8] which have been cited 281 times. Concussion-related publications have dramatically increased since the introduction of the consensus process, necessitating periodic updating of the consensus and position statements. While the concussion literature is growing, there remains continuing clinical questions about how concussions may differ between male, female, transgender and non-binary athletes.[12] Anecdotally, gender-based clinical considerations of concussion are common, but to date no publication has quantified the gender composition of the clinical concussion literature in these consensus and position statements—or of the concussion literature more broadly. If female athletes are under-represented within the sports-related concussion (SRC) literature—particularly in key documents that inform clinical practices—clinicians would face considerable challenges in effectively treating female concussion patients.

Under-representation of female athletes in concussion research has practical consequences for their healthcare and the trajectory of concussion research. Concussion recovery differences in female athletes may be driven by sex (the biological differences between male and female) or by gender (the socially constructed roles of men and women.[13] Within medical research, this distinction has only more recently gained broader traction,[14] but considerable evidence shows that female athletes have different responses than male athletes to concussions on both the physiological and the psychosocial level.[15] Women are more likely to receive a concussion than male athletes playing the same sport (eg, male vs female soccer, ice hockey or rugby),[15–17] possibly resulting from lower cervical strength,[18–20] different hormone levels,[21 22] and/or social factors.[23] Lower cervical strength relative to head mass among female athletes suggests differing head impact biomechanics may influence concussion.[24] Hormone levels may even create concussion-specific vulnerability windows,[25] while also complicating the clinical assessment[26] and implicating biological sex as a factor in concussion vulnerability. Within the sociocultural realm, female athletes have generally shown greater willingness to report concussions or symptoms[27–29] that could impact nearly every self-report measure in concussion and implicates gender-driven acculturation as a factor in recovery. These factors may also individually or collectively influence injury recovery. Following concussion, female athletes show different—potentially longer—recovery trajectories when compared with men, with women taking roughly 10 more days to recover in some studies,[30–34] but others failing to find overall recovery differences at all.[35] Finally, female athletes have been shown to suffer abnormal menstrual cycles[22] and sexual dysfunction[36] after concussions, highlighting just two potential long-term health effects for women that have been identified with a completely different presentation.[36] in a male athlete population. In short, the combination of sex-based and gender-based differences in concussion are so pervasive that having an equitable representation of female athlete-focused studies would be essential for informing clinical practices in a way that ensures equitable treatment.

While this female athlete disparity in concussion research is often recognised,[12 37] it is difficult to quantify because of the breadth of the concussion literature and the rate at which this literature is growing. In order to ascertain the representation of female athlete data, our research team focused on analysing the female athlete composition of the three most cited consensus or position statements from three different organisations based on their influential roles within the SRC research and clinical care landscape: the NATA (2014),[6] International Consensus Conference on Concussion in Sport (ICCCS) who met in 2016—sometimes called the Concussion in Sport Group (CISG),[3] and the AMSSM (2019).[8] Each of these statements was assembled by a team of international experts and focused solely on the research that met the published inclusion criteria. While each organisation stated slightly different aims, our goal was to repurpose the output of these panels to examine the cited literature for male versus female participant balance. We are unaware of any publication that quantifies the gender imbalance in concussion research.

Our expectation was that historical bias towards male athletes would shape concussion research literature to under-represent female athletes. We specifically hypothesised that (1) a greater proportion of studies would focus predominantly on male participants and (2) the overall proportion of participants comprising the concussion sample population—across many studies—would be predominantly male.

METHODS

Selection of consensus statements

The NATA, ICCS and AMSSM organisations' papers were originally selected as the most influential consensus and position statements within SRC based on historical trends and clinician use.[38 39] Studies of clinician behaviour have shown that sports medicine staff tend to rely on their organisational position and consensus statement plus the most recent ICCCS paper in tandem to stay current on treating concussions. For example, certified athletic trainers (ATs) rely on the Berlin statement and the NATA statement[38] for concussion knowledge, while sports medicine physicians use the most recent AMSSM statement and ICCS statement.[39] Further, no other concussion statements have been published with multiple versions by any other organisation (see figure 1).

We aimed to ensure that we did not fail to include any similarly influential SRC consensus and position papers. To do this, we used PubMed to identify the most commonly cited consensus and position statements on concussion, searching 'concussion consensus statement' and 'concussion position statement' to determine viable consensus statements (see figure 1, selection diagram). Searches were restricted to English language publications with no date restrictions. For each assessed consensus paper or position statement, we summed citations across all versions to determine cumulative influence. The NATA, ICCS and AMSSM organisations' papers were confirmed as the most cited consensus and position statements within these search results with greater than 200 citations each. No other organisation's consensus or position statements had published multiple editions or a similar citation count. In short, citation patterns, publication of multiple versions and research on clinician behaviour all indicate that these are the most influential SRC statements.

We restricted our analysis to these three statements. The US Air Force Academy IRB designated this study as not human subjects research.

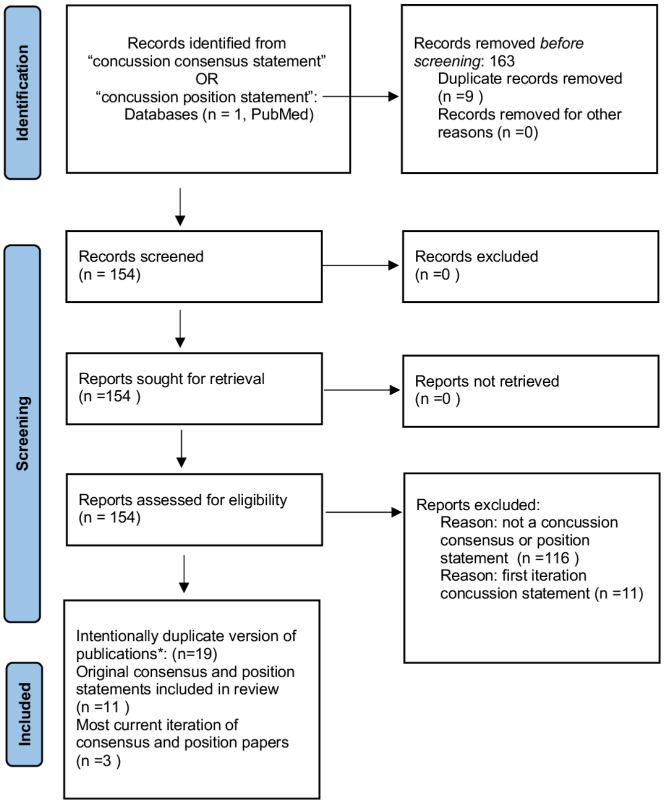

Figure 1 Selection diagram for identifying the influential concussion consensus and position papers. Consensus papers often have intentional copublication to maximise outreach to different communities—for example, to ensure that both neurologists and certified Athletic Trainers are aware of updated concussion guidelines. We summed citations to identical co-publications of consensus statements, but only analysed the most recent iteration of each statement.

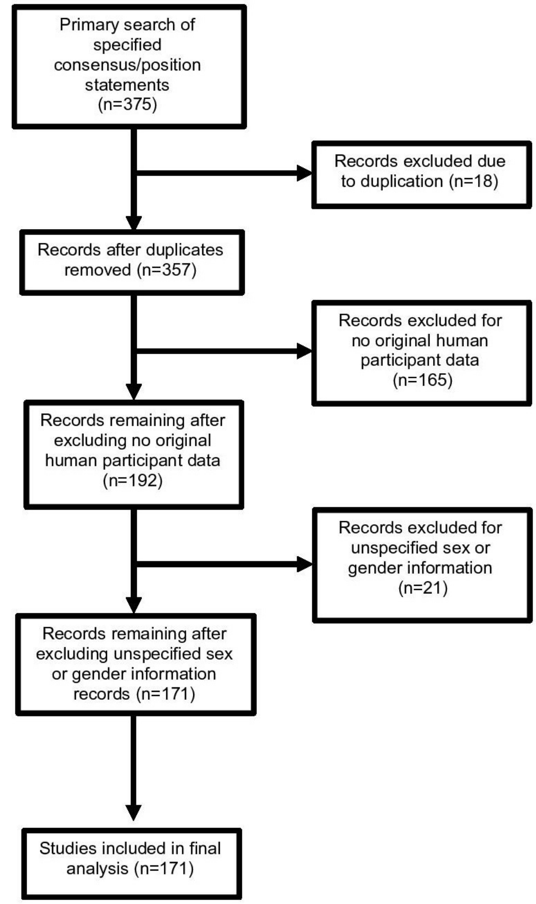

Figure 2 CONSORT flow chart for inclusion and exclusion of studies extracted from the three position and consensus papers. CONSORT, Consolidated Standards of Reporting Trials.

Statistical methods for quantifying male and female athlete data

For each statement, we aimed to capture the male and female athlete data comprising the research cited. Any reference that did not analyse human participant data was classified as non-human research (different from the IRB designation) and excluded from statistical analyses—including any review papers. For each study that recorded or implied gender information, we tallied the total number of male and female participants and computed the proportion of male athletes. Due to the wide temporal window of these studies, gender and biological sex were often conflated in older methods sections; our analyses recorded these values as the original investigators reported them. Research occasionally reported participants in all-male leagues (eg, National Football League, NFL) without any gender or sex information; we classified these study's participants as all male. Otherwise, when studies did not clearly state proportions for sex or gender, they were removed from analysis. To classify the sex/gendered composition of each study, we used two primary outcomes measures. First, we categorised the gender distributions reported by each cited study as either all male or all female, then we split the remaining studies with mixed participants into thirds: mostly male (99%–67% male), roughly equal (34%–66% male) or mostly female (67%–99% female). We also used descriptive statistics to show the number of studies that fell in each category both combined and individual by statement. We used Kolmogorov-Smirnov tests, and corresponding skewness values, to determine whether continuous outcomes of percentage of male participants were normally distributed both combined and individually by statement. We considered values <-1 or >1 to be highly skewed, values between −1 and −0.5 or between 0.5 and 1 as moderately skewed, and values >−0.5 or <0.5 to be approximately symmetrical.[40] Negative values indicated a skew towards male participants. We have included this spreadsheet as a supplement and will make this spreadsheet freely available on publication (see figure 2 for details).

RESULTS

Identification and descriptive information about consensus and position statements.

As each society has published multiple statement versions, we only analysed the most recent iterations here. Each method for producing the selected consensus and positions statements are described below.

National Athletic Trainers Association (2014)

The NATA statement's stated objective is to 'provide ATs, physicians and other healthcare professionals with best-practice guidelines for management of SRCs.' It has been cited 256 times across both editions. The statement notes that ATs are typically the first line of treatment for SRCs in the USA. This statement used SORT to rank the evidence for each study under review.[41] This statement cites 201 references.

International Conference on Concussion in Sport (2017)

The ICCS has evolved since its first consensus agreement into a standardised research integration process of considerable public health importance and has published a description of [42] AT the agenda for future research relevant to SRC by identifying knowledge gaps.' Its most recent statement was published in 2017 following the 2016 meeting in Berlin.[3] It has been cited 1980 times across all editions. It is sometimes referred to collectively as the CISG. For the Berlin meeting, a core scientific panel was convened alongside an expert panel of international experts. This premeeting process narrowed 45 possible questions to be answered by the Consensus meeting down to 12 questions through a modified Delphi process. As described in the methods publication,[42] the ICCS then designated lead authors to organise the systematic reviews in each sub-field matched to each author's expertise. Authors searched nearly 60 000 articles, selecting the best for review using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses and Enhancing the QUAlity and Transparency Of health Research guidelines.[43] These systematic reviews were then presented at the public meeting for expert comments and used to inform the consensus statement. This statement cites 46 references.

American Medical Society for Sports Medicine (2019)

The AMSSM review is stated 'to provide a narrative review of the existing literature and best practices to assist healthcare providers with the evaluation and management of SRC, and to establish the level of evidence, current knowledge gaps and areas requiring additional research.' It has been cited 281 times across both editions. The Board of Directors for this group nominated the chair and lead author, who then chose the writing group to represent diverse knowledge sets, including sideline and office-based care. This group of 13 authors collaborated across several conference calls and group communications before meeting in 2018 to collaboratively write the statement. Studies were judged by the SORT strength of evidence mechanism.[41] This statement cites 128 references.

Analysis of athlete data

Across all three consensus and position statements, a total of 375 cited publications were reviewed. Our initial screening removed citations with (1) no human participants (2) no indication of gender or sex if there were human participants and (3) duplicate references. This filtering step removed 204 citations, leaving 171 for combined analyses of female and male athlete data (figure 2 and online supplemental figure 1). Duplicate citations were included for individual analyses of each position statement, but included only once when all three documents were evaluated together. Individual analyses included 93 from the NATA, 17 from the ICCS and 68 from the AMSSM. Eighteen (18) papers were cited in two of the consensus documents, while none were cited in all three.

Studies cited by the three consensus/position statements analysed relied on samples that were overall 80.1% male (NATA: 79.9%, AMSSM: 79.4%, ICCS: 87.8 %). These were all significantly skewed towards male participants both overall ($p<0.001$) and for each individual statement ($p<0.001$ for all), with moderate skewness of −0.911 overall (NATA: −0.866, moderately skewed; AMSSM: −0.950, moderately skewed; ICCS: −1.257, highly skewed). Of the 171 studies analysed across the three statements, 69 (40.3%) had all-male samples, but only two (2, 1.2%) had all-female samples (figures 3 and 4).

DISCUSSION

We found that female athletes are significantly under-represented in the highest impact concussion documents that outline clinical care, as represented by three expert-curated position and consensus statements on concussion from the NATA, ICCS and AMSSM. Clinicians rely on these documents to guide their medical practice, but they may be based on scientific evidence that is not sufficiently representative of female athletes. This disparity may lead to inequitable treatment of female athletes who suffer concussions.

Our results show a profound under-representation of female participants in the concussion consensus literature, matching the imbalances others have documented in the broader sport and exercise medicine literature.[44] Samples within studies published in three prominent sport and exercise medicine journals we analysed were just 19.9% female. Each statement mentioned female athletes only briefly, typically when describing sex as a modifying factor for return-to-play time.[3 6 8] It may be expected to have some imbalance in gender representation in concussion research, but the drastic differences are likely due to multiple nested factors. First, current concussion research originated from the 'sport as a laboratory' model, whereby researchers use sport as a controlled environment to conduct studies. With the scarcity of research dollars and resources in early concussion funding, researchers had to use their resources in environments where concussion incidence is high and rosters are large. For example, a football roster with 105 participants could be expected to produce 5.63 concussions per season, while a women's volleyball team with a standard roster of 12 would produce only 0.46, meaning researchers would need to follow roughly 12 women's teams for the same amount of data as one football team despite similar roughly risk. With football being the largest single source of concussions, early sport concussion research in the late 1990s began with college and professional football[45–49] before expanding to other sports.[50] Large roster, high incidence sports—primarily collision sports—are therefore the most efficient study model.

Historically, women's opportunity to play sports was limited in the US until Title IX was enacted, and once in place athletics programmes gradually increased participation to equal numbers.[51] Even so, contact/collision sports continue to be largely male-oriented, potentially reducing the perceived need for female-based research. The historical trend in inequity has similarly reduced opportunity for female-focused retrospective research. Several large studies of postconcussion mental health in retired NFL, NCAA and other male professional athletes[46 52–55] have no parallel female cohort. As one example, Mayo Clinic researchers were able to assess hundreds of former high school football players for neurological testing after identifying them through decades of Rochester, Minnesota high school yearbooks[56] while simultaneously noting, 'female sports programmes were not consistently offered' during this time.

Similarly, disproportionate male participation in, and support for, athletics ensures that many sponsor organisations supporting concussion research are male-dominated or all male—such as International Federation of Association Football, the International Ice Hockey Federation and the NFL. The NCAA-US Department of Defense Grand Alliance is one of the few relatively gender-balanced efforts to support clinical concussion research by funding the CARE Consortium.[57 58] Recent efforts by the CARE Consortium make significant strides towards correcting this imbalance[58] with females representing roughly 50% of the NCAA athlete sample. Epidemiological databanks,

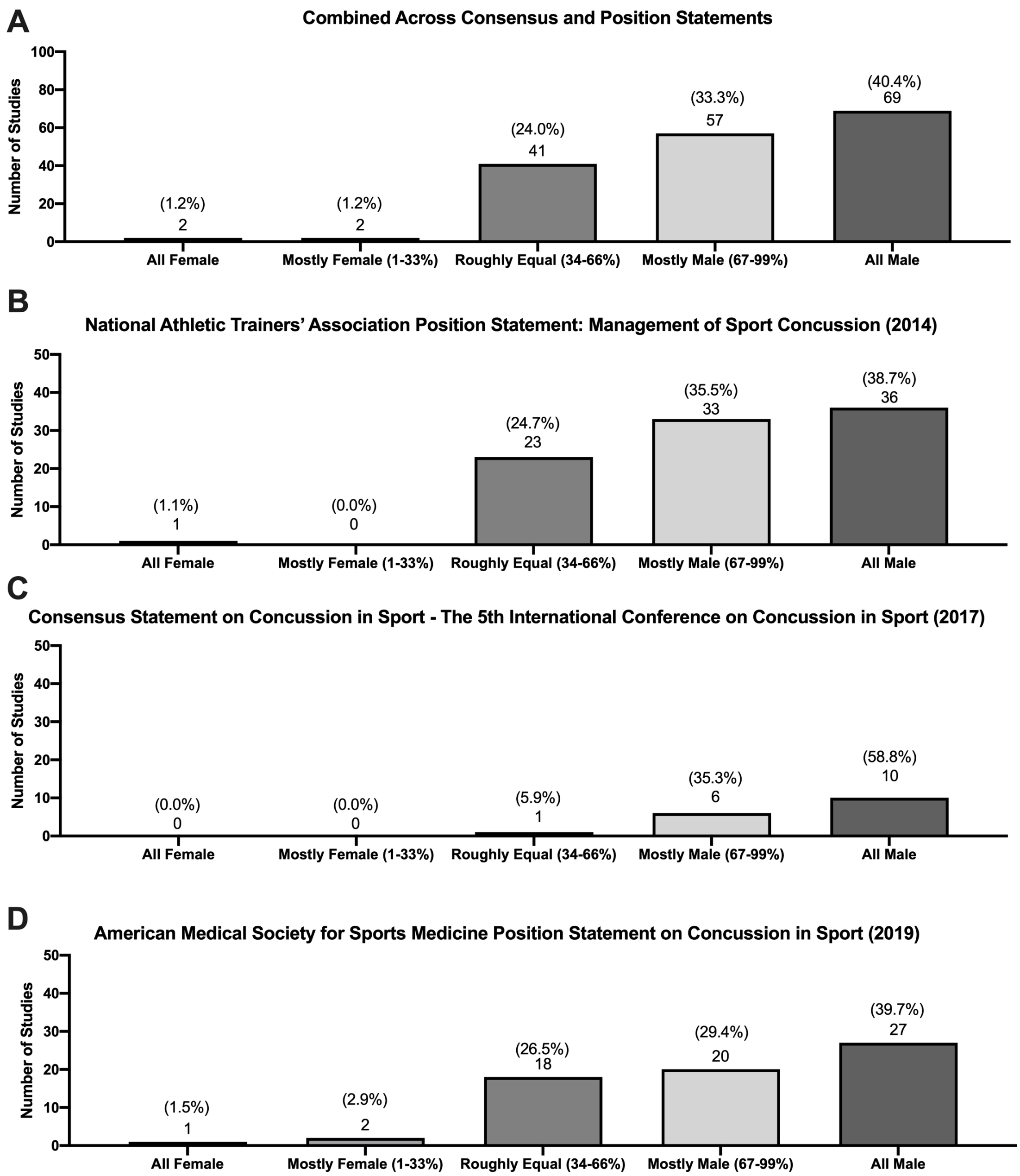

Figure 3 Studies included in the three statements as binned into different male and female athlete compositions. Each column indicates the number of cited studies in that group as well as the percentage it represents (in parentheses).

such as the NCAA Injury Surveillance program[51] and the high school RIO database,[59 60] have also made substantial strides towards equal representation by sex. Consensus and position statements rely on the evidence available at the time, which naturally lags behind some of these efforts. Still, financial support and logistical assistance for concussion research originating from heavily male sports organisations may continue to influence the concussion research gender composition. As new areas of concussion research emerge, we must consider targeted efforts towards preventing these imbalances in new subfields.

Other systemic influences outside sport may also encourage more focus on men in concussion research to the detriment of women's concussion care. Across the sciences, there is a preponderance of male faculty,[61] especially in research roles,[62 63] which may bias the selection of male athletes included in research as it has in other domains.[64 65] Both the Centers for Disease Control and Prevention and the National Institutes of Health (NIH) have instituted guidelines for inclusion of women and female sex model organisms in animal research to ameliorate past inequities.[66 67] Research samples that contain insufficient diversity to inform care for diverse populations[68] may lead to poorer care for undersampled populations (eg, African-American children and asthma).[69] Along these lines, men and women clinically differ in adverse drug responses,[70] substance abuse,[71] and even susceptibility to multiple sclerosis[72 73]—the last of these raising the possibility that long-term effects of concussions on white matter may also differ between male, female, transgender or non-binary athletes.[74] Given the considerable known differences in concussions between male and female athletes, only more consistent inclusion of women in ongoing research will create the commensurate evidence base for equitable clinical care.

Funding agencies, researchers, clinicians and other stakeholders should collectively extend efforts toward supporting

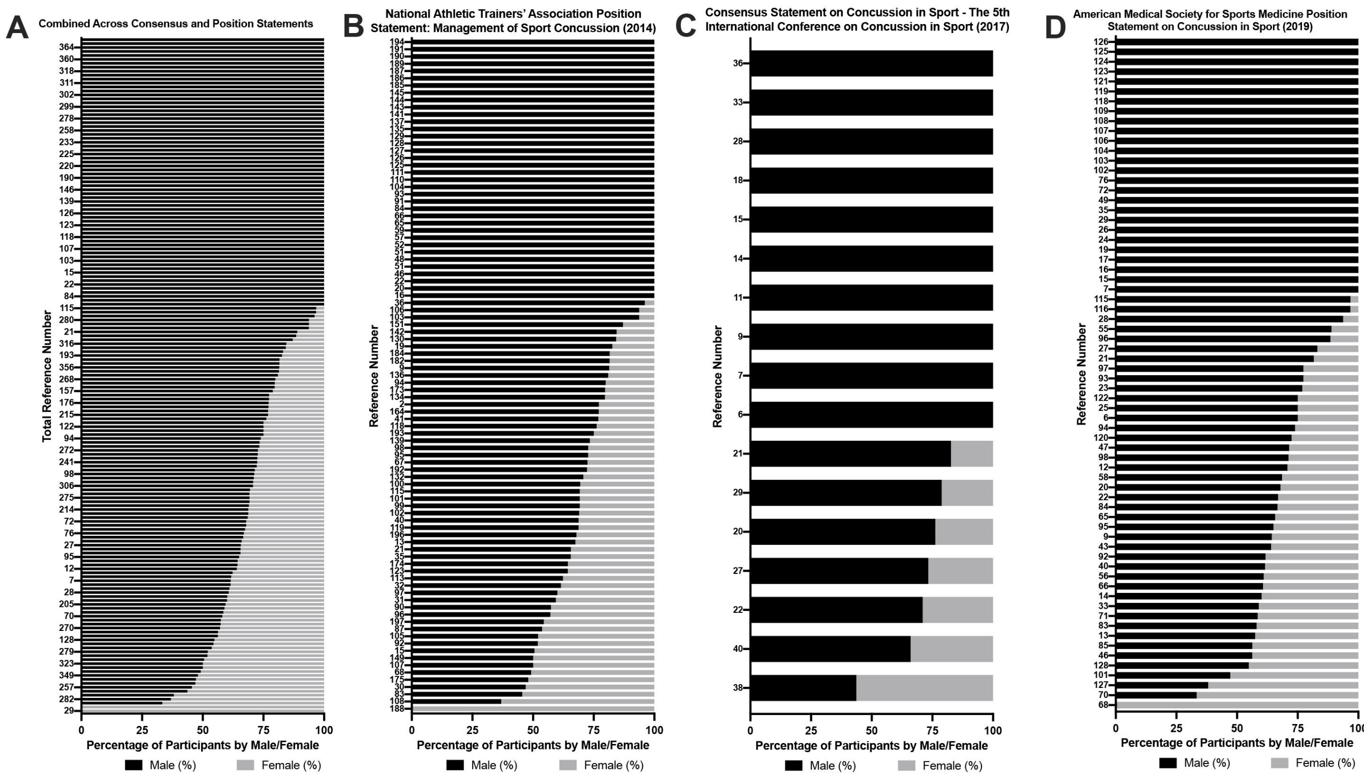

Figure 4 Percentage of male and female participants across individual studies cited across all statements (A) and in the three organisational statements (B–D). Each statement was ranked by percentage of female/male athletes for facilitated visual comparison, starting with 0% female athlete studies at the top. Each column represents one study referred to by that consensus statement's reference number on the left axis (eg, reference #191 in NATA 2014). Reference numbers for each study in the combined graph are available in online supplemental file 2. NATA, National Athletic Trainers' Association.

female athletes in concussion research. We have identified several strategies:

1. Balancing the representation of female, male, transgender and non-binary authors on consensus and position statement voting and authorship teams—as well as within editorial boards and research programme management.
2. Female athlete-focused sections of consensus and position statements should be included until the literature is robust enough for a standalone document for this population.
3. Consensus and position statements should acknowledge when predominantly male athlete samples inform recommendations.
4. Include a checkpoint within consensus/position statement processes for ensuring that cited research is as balanced as possible (similar toNIH's 'Inclusion of Women and Minorities' requirements).
5. Create research funding opportunities that focus solely on women or non-binary and transgender athletes or, at a minimum, include a better balance between male and female athlete data.

Limitations

A sample of the concussion literature based on the consensus statements may capture the most clinically relevant literature but also incurs certain limitations. First, this analysis spans a wide temporal window—including a time period where biological sex and gender were persistently conflated; our analysis must accommodate this inconsistency between self-reported gender and biologically determined sex but crucial differences could be missed with this oversight. Second, these statements, by definition, lag behind the most current work and could misrepresent the current state of research. Third, research outside of the consensus-cited literature could show systemically less (or more) inclusion of female athletes into the concussion literature which would not be reflected in our study. In addition, while these statements all include recommendations for paediatric populations, they are not specifically aimed at that population and a paediatric-specific study on male-female athlete bias may find significant differences from the current document. Finally, this analysis includes an assessment of female athlete inclusion in the general concussion literature, but does not perform this task with paediatric or geriatric populations, general traumatic brain injury, non-binary athletes, athletes with disabilities, athletes of colour, lower socioeconomic status (SES) athletes, athletes outside of Western industrialised nations, native and First Nations athletes, or any other number of different athlete demographics. Further work should seek to create greater inclusion among all demographic dimensions within the concussion literature to assure just distribution of the benefits of research. The current method of this paper—analysing the data from systematic expert-authored reviews—may be an efficient way to assess broader scientific trends as the drastic increase in the research literature makes repeated systematic reviews less feasible.

CONCLUSION

Researchers and funding agencies should acknowledge that passive approaches to concussion research recruitment will result in continued under-representation of female athletes. Instead, concerted inclusion efforts must be made to sample athlete populations in a way that allows an equitable representation of diverse athletes in concussion research. Better female and non-binary athlete-focused concussion research data will narrow the knowledge gap between male and female athletes and ultimately allow better data-driven care for all athletes.

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45 Guskiewicz KM, Mihalik JP, Shankar V, *et al*. Measurement of head impacts in collegiate football players. *Neurosurgery* 2007;61:1244–53.
46 Guskiewicz KM, Marshall SW, Bailes J, *et al*. Recurrent concussion and risk of depression in retired professional football players. *Med Sci Sports Exerc* 2007;39:903–9.
47 McCrea M, Hammeke T, Olsen G, *et al*. Unreported concussion in high school football players: implications for prevention. *Clin J Sport Med* 2004;14:13–17.
48 Pellman EJ, Lovell MR, Viano DC, *et al*. Concussion in professional football: recovery of NFL and high school athletes assessed by computerized neuropsychological testing-part 12. *Neurosurgery* 2006;58:263–74.
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54 McCrory P, Meeuwisse WH, Kutcher JS, *et al*. What is the evidence for chronic concussion-related changes in retired athletes: behavioural, pathological and clinical outcomes? *Br J Sports Med* 2013;47:327–30.
55 Mackay DF, Russell ER, Stewart K, *et al*. Neurodegenerative disease mortality among former professional soccer players. *N Engl J Med* 2019;381:1801–8.
56 Janssen PHH, Mandrekar J, Mielke MM, *et al*. High school football and late-life risk of neurodegenerative syndromes, 1956-1970. *Mayo Clin Proc* 2017;92:66–71.
57 Zuckerman SL, Kerr ZY, Yengo-Kahn A, *et al*. Epidemiology of sports-related concussion in NCAA athletes from 2009-2010 to 2013-2014: incidence, recurrence, and mechanisms. *Am J Sports Med* 2015;43:2654–62.
58 Broglio SP, McCrea M, McAllister T, *et al*. A national study on the effects of concussion in collegiate athletes and US military service academy members: the NCAA-DoD concussion assessment, research and education (CARE) consortium structure and methods. *Sports Med* 2017;47:1437–51.
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60 Bryan MA, Rowhani-Rahbar A, Comstock RD. On behalf of the Seattle sports concussion research collaborative. Sports- and recreation-related concussions in US youth. *Pediatrics* 2016;138:e20154635.
61 Huang J, Gates AJ, Sinatra R, *et al*. Historical comparison of gender inequality in scientific careers across countries and disciplines. *Proc Natl Acad Sci U S A* 2020;117:4609–16.
62 Hechtman LA, Moore NP, Schulkey CE, *et al*. NIH funding longevity by gender. *Proc Natl Acad Sci U S A* 2018;115:7943–8.
63 YJ X. Gender disparity in stem disciplines: a study of faculty attrition and turnover intentions. *Res High Educ* 2008;49:607–24.
64 Moss-Racusin CA, Dovidio JF, Brescoll VL, *et al*. Science faculty's subtle gender biases favor male students. *Proc Natl Acad Sci U S A* 2012;109:16474–9.
65 Sheltzer JM, Smith JC. Elite male faculty in the life sciences employ fewer women. *Proc Natl Acad Sci U S A* 2014;111:10107–12.
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67 Clayton JA. Applying the new SABV (sex as a biological variable) policy to research and clinical care. *Physiol Behav* 2018;187:2–5.
68 Cassell EJ. The principles of the Belmont report revisited. How have respect for persons, beneficence, and justice been applied to clinical medicine? *Hastings Cent Rep* 2000;30:12.
69 Wechsler ME, Szefler SJ, Ortega VE, *et al*. Step-up therapy in black children and adults with poorly controlled asthma. *N Engl J Med* 2019;381:1227–39.
70 Mogil JS, Chanda ML. The case for the inclusion of female subjects in basic science studies of pain. *Pain* 2005;117:1–5.
71 Franconi F, Brunelleschi S, Steardo L, *et al*. Gender differences in drug responses. *Pharmacol Res* 2007;55:81–95.
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73 Wisdom AJ, Cao Y, Itoh N. Estrogen receptor-β ligand treatment after disease onset is neuroprotective in the multiple sclerosis model: ERβ ligand is neuroprotective in EAE. *J Neurosci Res* 2013;91:901–8.
74 Bachmann GA, Mussman B. The aging population: imperative to uncouple sex and gender to establish "gender equal" health care. *Maturitas* 2015;80:421–5.

Alphabetical (within Statement) Female Athlete Papers Table

Citation	Statement	Percentage Male Participants	Reference Number	Combined Reference Number
Asken, B. M., Bauer, R. M., Guskiewicz, K. M., McCrea, M. A., Schmidt, J. D., Giza, C. C., et al. (2018). Immediate Removal From Activity After Sport-Related Concussion Is Associated With Shorter Clinical Recovery and Less Severe Symptoms in Collegiate Student-Athletes. The American Journal of Sports Medicine, 46(6), 363546518757984–1474. http://doi.org/10.1177/0363546518757984	AMSSM	61.71%	92	92
Asken, B. M., McCrea, M. A., Clugston, J. R., Snyder, A. R., Houck, Z. M., & Bauer, R. M. (2016). "Playing Through It": Delayed Reporting and Removal From Athletic Activity After Concussion Predicts Prolonged Recovery. Journal of Athletic Training, 51(4), 329–335. http://doi.org/10.4085/1062-6050-51.5.02	AMSSM	77.32%	93	93
Barr, W. B., & McCrea, M. (2001). Sensitivity and specificity of standardized neurocognitive testing immediately following sports concussion. Journal of the International Neuropsychological Society, 7(6), 693–702. http://doi.org/10.1017/s1355617701766052	AMSSM	100.00%	15	15
Barr, W. B., Prichep, L. S., Chabot, R., Powell, M. R., & McCrea, M. (2012). Measuring brain electrical activity to track recovery from sport-related concussion. Brain Injury : [BI], 26(1), 58–66. http://doi.org/10.3109/02699052.2011.608216	AMSSM	100.00%	16	16
Black AM, Macpherson AK, Hagel BE, et al. Policy change eliminating body checking in non-elite ice hockey leads to a threefold reduction in injury and concussion risk in 11- and 12-year-old players. British Journal of Sports Medicine. 2016;50(1):55-61. doi:10.1136/bjsports-2015-095103.	AMSSM	96.73%	115	115
Bretzin, A. C., Covassin, T., Fox, M. E., Petit, K. M., Savage, J. L., Walker, L. F., & Gould, D. (2018). Sex Differences in the Clinical Incidence of Concussions, Missed School Days, and Time Loss in High School Student-Athletes: Part 1. The American Journal of Sports Medicine, 46(9), 2263–2269. http://doi.org/10.1177/0363546518778251	AMSSM	60.09%	14	14
Broglio SP, Lapointe A, O'Connor KL, et al. Head impact density: a model to explain the elusive concussion threshold. J Neurotrauma. 2017;34:2675–2683.	AMSSM	100.00%	49	49
Broglio SP, Sosnoff JJ, Ferrara MS. The relationship of athlete-reported concussion symptoms and objective measures of neurocognitive function and postural control. Clin J Sport Med. 2009;19(5):377-382. doi:10.1097/JSM.0b013e3181b625fe.	AMSSM	75.00%	122	122
Broglio, S. P., Katz, B. P., Zhao, S., McCrea, M., McAllister, T., CARE Consortium Investigators. (2018). Test-Retest Reliability and Interpretation of Common Concussion Assessment Tools: Findings from the NCAA-DoD CARE Consortium. Sports Medicine, 48(5), 1255–1268. http://doi.org/10.1007/s40279-017-0813-0	AMSSM	58.92%	33	33
Brooks, M. A., Peterson, K., Biese, K., Sanfilippo, J., Heiderscheit, B. C., & Bell, D. R. (2016). Concussion Increases Odds of Sustaining a Lower Extremity Musculoskeletal Injury After Return to Play Among Collegiate Athletes. The American Journal of Sports Medicine, 44(3), 742–747. http://doi.org/10.1177/0363546515622387	AMSSM	77.33%	97	97
Chin, E. Y., Nelson, L. D., Barr, W. B., McCrory, P., & McCrea, M. A. (2016). Reliability and Validity of the Sport Concussion Assessment Tool-3 (SCAT3) in High School and Collegiate Athletes. The American Journal of Sports Medicine, 44(9), 2276–2285. http://doi.org/10.1177/0363546516648141	AMSSM	76.91%	23	23

Clausen M, Pendergast DR, Willer B, et al. Cerebral blood flow during treadmill exercise is a marker of physiological postconcussion syndrome in female athletes. J Head Trauma Rehabil. 2016;31:215–224	AMSSM	0.00%	68	68
Deshpande, S. K., Hasegawa, R. B., Rabinowitz, A. R., Whyte, J., Roan, C. L., Tabatabaei, A., et al. (2017). Association of Playing High School Football With Cognition and Mental Health Later in Life. JAMA Neurology, 74(8), 909–918. http://doi.org/10.1001/jamaneurol.2017.1317	AMSSM	100.00%	104	104
Dhawan, P. S., Leong, D., Tapsell, L., Starling, A. J., Galetta, S. L., Balcer, L. J., et al. (2017). King-Devick Test identifies real-time concussion and asymptomatic concussion in youth athletes. Neurology. Clinical Practice, 7(6), 464–473. http://doi.org/10.1212/CPJ.0000000000000381	AMSSM	100.00%	29	29
Dompier, T. P., Kerr, Z. Y., Marshall, S. W., Hainline, B., Snook, E. M., Hayden, R., & Simon, J. E. (2015). Incidence of Concussion During Practice and Games in Youth, High School, and Collegiate American Football Players. JAMA Pediatrics, 169(7), 659–665. http://doi.org/10.1001/jamapediatrics.2015.0210	AMSSM	75.00%	25	25
Echlin PS, Tator CH, Cusimano MD, et al. A prospective study of physician-observed concussions during junior ice hockey: implications for incidence rates. Neurosurg Focus. 2010;29(5):E4. doi:10.3171/2010.9.FOCUS10186.	AMSSM	100.00%	121	121
Eckner JT, Chandran S, Richardson JK. Investigating the role of feedback and motivation in clinical reaction time assessment. PM R. 2011;3(12):1092-1097. doi:10.1016/j.pmrj.2011.04.022.	AMSSM	54.84%	128	128
Eckner, J. T., Kutcher, J. S., Broglio, S. P., & Richardson, J. K. (2013). Effect of sport-related concussion on clinically measured simple reaction time. British Journal of Sports Medicine, 48(2), 112–118. http://doi.org/10.1136/bjsports-2012-091579	AMSSM	71.43%	47	47
Eddy R, Goetschius J, Hertel J, Resch J. Test-Retest Reliability and the Effects of Exercise on the King-Devick Test. Clin J Sport Med. 2020;30(3):239-244. doi:10.1097/JSM.0000000000000586.	AMSSM	38.10%	127	127
Elbin, R. J., Sufrinko, A., Schatz, P., French, J., Henry, L., Burkhart, S., et al. (2016). Removal From Play After Concussion and Recovery Time. Pediatrics, 138(3). http://doi.org/10.1542/peds.2016-0910	AMSSM	73.91%	94	94
Erickson KI, Voss MW, Prakash RS, et al. Exercise training increases size of hippocampus and improves memory. Proc Natl Acad Sci USA. 2011;108(7):3017-3022. doi:10.1073/pnas.1015950108.	AMSSM	33.33%	70	70
Fuller GW, Cross MJ, Stokes KA, et al. King-Devick concussion test performs poorly as a screening tool in elite rugby union players: a prospective cohort study of two screening tests versus a clinical reference standard. Br J Sports Med. 2018. doi:10.1136/bjsports-2017-098560.	AMSSM	100.00%	125	125
Galetta, K. M., Brandes, L. E., Maki, K., Dziemianowicz, M. S., Laudano, E., Allen, M., et al. (2011). The King-Devick test and sports-related concussion: study of a rapid visual screening tool in a collegiate cohort. Journal of the Neurological Sciences, 309(1-2), 34–39. http://doi.org/10.1016/j.jns.2011.07.039	AMSSM	83.11%	27	27
Galetta, K. M., Morganroth, J., Moehringer, N., Mueller, B., Hasanaj, L., Webb, N., et al. (2015). Adding Vision to Concussion Testing: A Prospective Study of Sideline Testing in	AMSSM	81.63%	21	21

Youth and Collegiate Athletes. Journal of Neuro-Ophthalmology:35(3), 235–241. http://doi.org/10.1097/WNO.0000000000000226				
Garcia, G.-G. P., Broglio, S. P., Lavieri, M. S., McCrea, M., McAllister, T., CARE Consortium Investigators. (2018). Quantifying the Value of Multidimensional Assessment Models for Acute Concussion: An Analysis of Data from the NCAA-DoD Care Consortium. Sports Medicine, 48(7), 1739–1749. http://doi.org/10.1007/s40279-018-0880-x	AMSSM	61.52%	40	40
Grool AM, Aglipay M, Momoli F, et al. Association Between Early Participation in Physical Activity Following Acute Concussion and Persistent Postconcussive Symptoms in Children and Adolescents. JAMA. 2016;316(23):2504-2514. doi:10.1001/jama.2016.17396.	AMSSM	60.71%	66	66
Hecimovich M, King D, Dempsey AR, Murphy M. The King-Devick test is a valid and reliable tool for assessing sport-related concussion in Australian football: A prospective cohort study. J Sci Med Sport. 2018;21(10):1004-1007. doi:10.1016/j.jsams.2018.03.011.	AMSSM	100.00%	126	126
Herman, D. C., Jones, D., Harrison, A., Moser, M., Tillman, S., Farmer, K., et al. (2017). Concussion May Increase the Risk of Subsequent Lower Extremity Musculoskeletal Injury in Collegiate Athletes. Sports Medicine, 47(5), 1003–1010. http://doi.org/10.1007/s40279-016-0607-9	AMSSM	71.23%	98	98
Hoffman, N. L., Weber, M. L., Broglio, S. P., McCrea, M., McAllister, T. W., & Schmidt, J. D. (2017). Influence of Postconcussion Sleep Duration on Concussion Recovery in Collegiate Athletes. Clinical Journal of Sport Medicine, Publish Ahead of Print, 1–7. http://doi.org/10.1097/JSM.0000000000000538	AMSSM	56.29%	85	85
Houck, Z., Asken, B., Bauer, R., Pothast, J., Michaudet, C., & Clugston, J. (2016). Epidemiology of Sport-Related Concussion in an NCAA Division I Football Bowl Subdivision Sample. The American Journal of Sports Medicine, 44(9), 2269–2275. http://doi.org/10.1177/0363546516645070	AMSSM	100.00%	26	26
Howell, D. R., O'Brien, M. J., Fraser, J., & Meehan, W. P. (2018). Continuing Play, Symptom Severity, and Symptom Duration After Concussion in Youth Athletes. Clinical Journal of Sport Medicine, Publish Ahead of Print, 1–5. http://doi.org/10.1097/JSM.0000000000000570	AMSSM	64.97%	95	95
Hugentobler JA, Vegh M, Janiszewski B, et al. Physical therapy intervention strategies for patients with prolonged mild traumatic brain injury symptoms: A case series. Int J Sports Phys Ther 2015;10:676–89	AMSSM	66.67%	84	84
Janssen PH, Mandrekar J, Mielke MM, et al. High school football and late-life risk of neurodegenerative syndromes, 1956–1970. Mayo Clin Proc. 2017;92:66–71.	AMSSM	100.00%	109	109
Kerr ZY, Yeargin S, Valovich McLeod TC, et al. Comprehensive Coach Education and Practice Contact Restriction Guidelines Result in Lower Injury Rates in Youth American Football. Orthop J Sports Med. 2015;3(7):232596711559457-232596711559458. doi:10.1177/2325967115594578.	AMSSM	100.00%	118	118
Kerr ZY, Yeargin SW, Valovich McLeod TC, Mensch J, Hayden R, Dompier TP. Comprehensive Coach Education Reduces Head Impact Exposure in American Youth Football. Orthop J Sports Med. 2015;3(10):2325967115610545. doi:10.1177/2325967115610545.	AMSSM	100.00%	119	119
Kerr, Z. Y., Evenson, K. R., Rosamond, W. D., Mihalik, J. P., Guskiewicz, K. M., & Marshall, S. W. (2014). Association between concussion and mental health in former collegiate athletes. Injury Epidemiology, 1(1), 28. http://doi.org/10.1186/s40621-014-0028-x	AMSSM	47.18%	101	101
Kerr, Z. Y., Roos, K. G., Djoko, A., Dalton, S. L., Broglio, S. P., Marshall, S. W., & Dompier, T. P. (2017). Epidemiologic Measures for Quantifying the Incidence of Concussion in	AMSSM	70.77%	12	12

National Collegiate Athletic Association Sports. Journal of Athletic Training, 52(3), 167–174. http://doi.org/10.4085/1062-6050-51.6.05				
King, D., Gissane, C., Hume, P. A., & Flaws, M. (2015). The King–Devick test was useful in management of concussion in amateur rugby union and rugby league in New Zealand. Journal of the neurological sciences, 351(1-2), 58-64.	AMSSM	100.00%	124	124
Krolikowski MP, Black AM, Palacios-Derflingher L, Blake TA, Schneider KJ, Emery CA. The Effect of the “Zero Tolerance for Head Contact” Rule Change on the Risk of Concussions in Youth Ice Hockey Players. Am J Sports Med. 2017;45(2):468-473. doi:10.1177/0363546516669701.	AMSSM	96.71%	116	116
Lawrence DW, Richards D, Comper P, Hutchison MG. Earlier time to aerobic exercise is associated with faster recovery following acute sport concussion. Janigro D, ed. PLoS ONE. 2018;13(4):e0196062–12. doi:10.1371/journal.pone.0196062.	AMSSM	58.50%	71	71
Leddy JJ, Haider MN, Hinds AL, Darling S, Willer BS. A Preliminary Study of the Effect of Early Aerobic Exercise Treatment for Sport-Related Concussion in Males. Clin J Sport Med. 2019;29(5):353-360. doi:10.1097/JSM.0000000000000663.	AMSSM	100.00%	72	72
Leddy, J. J., Hinds, A. L., Miecznikowski, J., Darling, S., Matuszak, J., Baker, J. G., et al. (2018). Safety and Prognostic Utility of Provocative Exercise Testing in Acutely Concussed Adolescents: A Randomized Trial. Clinical Journal of Sport Medicine : Official Journal of the Canadian Academy of Sport Medicine, 28(1), 13–20. http://doi.org/10.1097/JSM.0000000000000431	AMSSM	68.52%	58	58
Lehman EJ, Hein MJ, Gersic CM. Suicide mortality among retired National Football League players who played 5 or more seasons. Am J Sports Med. 2016;44:2486–2491.	AMSSM	100.00%	103	103
Leong DF, Balcer LJ, Galetta SL, et al. The King-Devick test for sideline concussion screening in collegiate football. J Optom. 2015;8:131–139.	AMSSM	93.70%	28	28
Leong DF, Balcer LJ, Galetta SL, Liu Z, Master CL. The King-Devick test as a concussion screening tool administered by sports parents. J Sports Med Phys Fitness. 2014;54(1):70-77.	AMSSM	100.00%	123	123
Marinides, Z., Galetta, K. M., Andrews, C. N., Wilson, J. A., Herman, D. C., Robinson, C. D., et al. (2015). Vision testing is additive to the sideline assessment of sports-related concussion. Neurology. Clinical Practice, 5(1), 25–34. http://doi.org/10.1212/CPJ.0000000000000060	AMSSM	67.87%	20	20
Maugans, T. A., Farley, C., Altaye, M., Leach, J., & Cecil, K. M. (2012). Pediatric sports-related concussion produces cerebral blood flow alterations. Pediatrics, 129(1), 28–37. http://doi.org/10.1542/peds.2011-2083	AMSSM	75.00%	6	6
McCrea M, Guskiewicz K, Randolph C, et al. Incidence, clinical course, and predictors of prolonged recovery time following sport-related concussion in high school and college athletes. J Int Neuropsychol Soc. 2013;19:22–33.	AMSSM	88.95%	55	55
McCrea, M., Guskiewicz, K., Randolph, C., Barr, W. B., Hammeke, T. A., Marshall, S. W., & Kelly, J. P. (2009). Effects of a symptom-free waiting period on clinical outcome and risk of reinjury after sport-related concussion. Neurosurgery, 65(5), 876–82– discussion 882–3. http://doi.org/10.1227/01.NEU.0000350155.89800.00	AMSSM	88.50%	96	96
McCrea, M., Kelly, J. P., Randolph, C., Cisler, R., & Berger, L. (2002). Immediate neurocognitive effects of concussion. Neurosurgery, 50(5), 1032–40– discussion 1040–2. http://doi.org/10.1097/00006123-200205000-00017	AMSSM	100.00%	17	17

McKee AC, Stein TD, Nowinski CJ, et al. The spectrum of disease in chronic traumatic encephalopathy. Brain. 2013;136:43–64.	AMSSM	100.00%	106	106
Meier, T. B., Bellgowan, P. S. F., Singh, R., Kuplicki, R., Polanski, D. W., & Mayer, A. R. (2015). Recovery of cerebral blood flow following sports-related concussion. JAMA Neurology, 72(5), 530–538. http://doi.org/10.1001/jamaneurol.2014.4778	AMSSM	100.00%	7	7
Mucha, A., Collins, M. W., Elbin, R. J., Furman, J. M., Troutman-Enseki, C., DeWolf, R. M., et al. (2014). A Brief Vestibular/Ocular Motor Screening (VOMS) Assessment to Evaluate Concussions. The American Journal of Sports Medicine, 42(10), 2479–2486. http://doi.org/10.1177/0363546514543775	AMSSM	56.25%	46	46
Norheim, N., Kissinger-Knox, A., Cheatham, M., & Webbe, F. (2018). Performance of college athletes on the 10-item word list of SCAT5. BMJ Open Sport & Exercise Medicine, 4(1), e000412. http://doi.org/10.1136/bmjsem-2018-000412	AMSSM	64.01%	43	43
Oliver JM, Jones MT, Kirk KM, et al. Effect of docosahexaenoic acid on a biomarker of head trauma in American football. Med Sci Sports Exerc. 2016;48:974–982.	AMSSM	100.00%	76	76
Putukian, M., Echemendia, R., Dettwiler-Danspeckgruber, A., Duliba, T., Bruce, J., Furtado, J. L., & Murugavel, M. (2015). Prospective clinical assessment using Sideline Concussion Assessment Tool-2 testing in the evaluation of sport-related concussion in college athletes. Clinical Journal of Sport Medicine : Official Journal of the Canadian Academy of Sport Medicine, 25(1), 36–42. http://doi.org/10.1097/JSM.0000000000000102	AMSSM	66.92%	22	22
Resch JE, Brown CN, Schmidt J, et al. The sensitivity and specificity of clinical measures of sport concussion: three tests are better than one. BMJ Open Sport Exerc Med. 2016;2:e000012.	AMSSM	72.50%	120	120
Savica R, Parisi JE, Wold LE, et al. High school football and risk of neurodegeneration: a community-based study. Mayo Clin Proc. 2012; 87:335–340.	AMSSM	100.00%	108	108
Schneider KJ, Meeuwisse WH, Nettel-Aguirre A, et al. Cervicovestibular rehabilitation in sport-related concussion: a randomised controlled trial. Br J Sports Med 2014;48:1294–8.	AMSSM	58.06%	83	83
Seidman, D. H., Burlingame, J., Yousif, L. R., Donahue, X. P., Krier, J., Rayes, L. J., et al. (2015). Evaluation of the King-Devick test as a concussion screening tool in high school football players. Journal of the Neurological Sciences, 356(1-2), 97–101. http://doi.org/10.1016/j.jns.2015.06.021	AMSSM	100.00%	24	24
Stein TD, Alvarez VE, McKee AC. Chronic traumatic encephalopathy: a spectrum of neuropathological changes following repetitive brain trauma in athletes and military personnel. Alzheimers Res Ther. 2014;6(1):4-11. doi:10.1186/alzrt234.	AMSSM	100.00%	107	107
Thomas DG, Apps JN, Hoffmann RG, McCrea M, Hammeke T. Benefits of strict rest after acute concussion: a randomized controlled trial. Pediatrics. 2015;135(2):213-223. doi:10.1542/peds.2014-0966.	AMSSM	65.66%	65	65
Tsushima, W. T., Siu, A. M., Ahn, H. J., Chang, B. L., & Murata, N. M. (2019). Incidence and Risk of Concussions in Youth Athletes: Comparisons of Age, Sex, Concussion History, Sport, and Football Position. Archives of Clinical Neuropsychology : the Official Journal of the National Academy of Neuropsychologists, 34(1), 60–69. http://doi.org/10.1093/arclin/acy019	AMSSM	57.46%	13	13
Tucker, R., Raftery, M., Fuller, G. W., Hester, B., Kemp, S., & Cross, M. J. (2017). A video analysis of head injuries satisfying the criteria for a head injury assessment in professional Rugby Union: a prospective cohort study. British Journal of Sports Medicine, 51(15), 1147–1151. http://doi.org/10.1136/bjsports-2017-097883	AMSSM	100.00%	35	35

Zemek, R., Barrowman, N., Freedman, S. B., Gravel, J., Gagnon, I., McGahern, C., et al. (2016). Clinical Risk Score for Persistent Postconcussion Symptoms Among Children With Acute Concussion in the ED. JAMA: the Journal of the American Medical Association, 315(10), 1014–12. http://doi.org/10.1001/jama.2016.1203	AMSSM	60.99%	56	56
Bleiberg J, Cernich AN, Cameron K, et al. Duration of cognitive impairment after sports concussion. Neurosurgery 2004;54:1073–78–78–80.	ICCCS	100.00%	18	146
Collie A, Maruff P, McStephen M, et al. Psychometric issues associated with computerised neuropsychological assessment of concussed athletes. Br J Sports Med 2003;37:556–9.	ICCCS	100.00%	14	142
Collins MW, Grindel SH, Lovell MR, et al. Relationship between concussion and neuropsychological performance in college football players. Jama 1999;282:964–70	ICCCS	100.00%	15	143
Delaney J, Lacroix V, Leclerc S, et al. Canadian football league season.. Clin J Sport Med 1997;2000:9–14.	ICCCS	100.00%	28	156
Delaney JS, Lacroix VJ, Leclerc S, et al. Concussions among university football and soccer players. Clin J Sport Med 2002;12:331–8.	ICCCS	78.85%	29	157
Gioia G, Janusz J, Gilstein K, et al. Neuropsychological management of consussion in children and adolescents: effects of age and gender on ImPact. abstract). Br J Sp Med 2004;38:657.	ICCCS	71.02%	22	150
Guilmette TJ, Malia LA, McQuiggan MD. Concussion understanding and management among new England high school football coaches. Brain Inj 2007;21:1039–47.	ICCCS	100.00%	33	161
Johnston KM, Lassonde M, Ptito A. A contemporary neurosurgical approach to sport-related head injury: the McGill concussion protocol. J Am Coll Surg2001;192:515–24.	ICCCS	73.33%	27	155
Kashluba S, Paniak C, Blake T, et al. A longitudinal, controlled study of patient complaints following treated mild traumatic brain injury. Arch Clin Neuropsychol 2004;19:805–16.	ICCCS	43.64%	38	166
Kaut KP, DePompei R, Kerr J, et al. Reports of head injury and symptom knowledge among college athletes: implications for assessment and educational intervention. Clin J Sport Med 2003;13:213–21.	ICCCS	66.04%	40	168
Maddocks D, Dicker G. An objective measure of recovery from concussion in Australian rules footballers. Sport Health 1989;7:6–7.	ICCCS	100.00%	6	134
McCrea, M., Kelly, J. P., Kluge, J., Ackley, B., & Randolph, C. (1997). Standardized assessment of concussion in football players. Neurology, 48(3), 586-588.	ICCCS	100.00%	11	139
Barbic D, Pater J, Brison RJ. Comparison of mouth guard designs and concussion prevention in contact sports: a multicenter randomized controlled trial. Clin J Sport Med. 2005;15(5):294–298	NATA	80.96%	136	310
Bazarian JJ, Zhu T, Blyth B, Borrino A, Zhong J. Subject-specific changes in brain white matter on diffusion tensor imaging after sports-related concussion. Magn Reson Imaging. 2012;30(2):171–	NATA	100.00%	191	365
Breedlove EL, Robinson M, Talavage TM, et al. Biomechanical correlates of symptomatic and asymptomatic neurophysiological impairment in high school football. J Biomech. 2012;45(7):1265– 1272.	NATA	100.00%	189	363
Broglio SP, Eckner JT, Surma T, Kutcher JS. Post-concussion cognitive declines and symptomatology are not related to concussion biomechanics in high school football players. J Neurotrauma. 2011;28(10):2061–2068.	NATA	100.00%	128	302

Broglio SP, Ferrara MS, Piland SG, Anderson RB, Collie A. Concussion history is not a predictor of computerized neurocognitive performance. Br J Sports Med. 2006;40(9):802–805.	NATA	81.56%	184	358
Broglio SP, Ferrara MS, Sopiarz K, Kelly MS. Reliable change of the sensory organization test. Clin J Sport Med. 2008;18(2):148– 154.	NATA	68.99%	102	276
Broglio SP, Macciocchi SN, Ferrara MS. Neurocognitive performance of concussed athletes when symptom free. J Athl Train. 2007;42(4):504–508.	ICCCS/NATA	76.19%	20/118	292
Broglio SP, Macciocchi SN, Ferrara MS. Sensitivity of the concussion assessment battery. Neurosurgery. 2007;60(6):1050–7-8	ICCCS/NATA	82.67%	21/19	193
Broglio SP, Monk A, Sopiarz K, Cooper ER. The influence of ankle support on postural control. J Sci Med Sport. 2009;12(3):388–392.	NATA	36.84%	108	282
Broglio SP, Pontifex MB, O'Connor P, Hillman CH. The persistent effects of concussion on neuroelectic indices of attention. J Neurotrauma. 2009;26(9):1463–1470.	NATA	72.22%	192	366
Broglio SP, Schnebel B, Sosnoff JJ, et al. Biomechanical properties of concussions in high school football. Med Sci Sports Exerc. 2010;42(11):2064–2071.	NATA	100.00%	126	300
Broglio SP, Zhu W, Sopiarz K, Park Y. Generalizability theory analysis of balance error scoring system reliability in healthy young adults. J Athl Train. 2009;44(5):497–502.	NATA	52.08%	105	279
Catena RD, Van Donkelaar P, Chou LS. Cognitive task effects on gait stability following concussion. Exp Brain Res. 2007;176(1):23–31.	NATA	57.14%	96	270
Collie A, Maruff P, Makdissi M, McCrory P, McStephen M, Darby D. CogSport: reliability and correlation with conventional cognitive tests used in postconcussion medical evaluations. Clin J Sport Med. 2003;13(1):28–32	NATA	100.00%	84	258
Collie A, McCrory P, Makdissi M. Does history of concussion affect current cognitive status? Br J Sports Med. 2006;40(6):550–551.	NATA	100.00%	185	359
Covassin T, Elbin RJ, Harris W, Parker T, Kontos A. The role of age and sex in symptoms, neurocognitive performance, and postural stability in athletes after concussion. Am J Sports Med. 2012;40(6):1303–1312.	NATA	70.72%	132	306
Davidson JA. Epidemiology and outcome of bicycle injuries presenting to an emergency department in the United Kingdom.Eur J Emerg Med. 2005;12(1):24–29.	NATA	65.53%	35	209
De Beaumont L, Theoret H, Mongeon D, et al. Brain function decline in healthy retired athletes who sustained their last sports concussion in early adulthood. Brain. 2009;132(pt 3):695–708.	NATA	100.00%	187	361
De Monte VE, Geffen GM, May CR, McFarland K, Heath P, Neralic M. The acute effects of mild traumatic brain injury on finger tapping with and without word repetition. J Clin Exp Neuropsychol. 2005;27(2):224–239.	NATA	69.23%	101	275
Delaney JS, Al-Kashmiri A, Drummond R, Correa JA. The effect of protective headgear on head injuries and concussions in adolescent football (soccer) players. Br J Sports Med. 2008;42(2):110–115.	NATA	50.00%	149	323
Elbin RJ, Schatz P, Covassin T. One-year test-retest reliability of the online version of ImPACT in high school athletes. Am J Sports Med. 2011;39(11):2319–2324.	NATA	45.53%	83	257
Ellemberg D, Leclerc S, Couture S, Daigle C. Prolonged neuropsychological impairments following a first concussion in female university soccer athletes. Clin J Sport Med. 2007;17(5):369–374.	NATA	0.00%	188	362

Fazio VC, Lovell MR, Pardini JE, Collins MW. The relation between post concussion symptoms and neurocognitive perfor- mance in concussed athletes. NeuroRehabilitation. 2007;22(3):207–216.	NATA	68.75%	119	293
Field M, Collins MW, Lovell MR, Maroon J. Does age play a role in recovery from sports-related concussion? A comparison of high school and collegiate athletes. J Pediatr. 2003;142(5):546–553.	NATA	96.04%	36	210
Finch C, Braham R, McIntosh A, McCrory P, Wolfe R. Should football players wear custom fitted mouthguards? Results from a group randomised controlled trial. Inj Prev. 2005;11(4):242–246.	NATA	100.00%	137	311
Fox ZG, Mihalik JP, Blackburn JT, Battaglini CL, Guskiewicz KM. Return of postural control to baseline after anaerobic and aerobic exercise protocols. J Athl Train. 2008;43(5):456–463.	NATA	50.00%	107	281
Gaetz M, Goodman D, Weinberg H. Electrophysiological evidence for the cumulative effects of concussion. Brain Inj. 2000;14(12):1077–1088.	NATA	100.00%	194	368
Gessel LM, Fields SK, Collins CL, Dick RW, Comstock RD. Concussions among United States high school and collegiate athletes. J Athl Train. 2007;42(4):495–503.	NATA	72.44%	67	241
Greenwald RM, Gwin JT, Chu JJ, Crisco JJ. Head impact severity measures for evaluating mild traumatic brain injury risk exposure.Neurosurgery. 2008;62(4):789–798.	NATA	100.00%	125	299
Guskiewicz KM, Marshall SW, Bailes J, et al. Association between recurrent concussion and late-life cognitive impairment in retired professional football players. Neurosurgery. 2005;57(4):719–726.	NATA	100.00%	52	226
Guskiewicz KM, Marshall SW, Bailes J, et al. Recurrent concussion and risk of depression in retired professional football players. Med Sci Sports Exerc. 2007;39(6):9	AMSSM/NATA	100.00%	102/51	221
Guskiewicz KM, Ross SE, Marshall SW. Postural stability and neuropsychological deficits after concussion in collegiate athletes. J Athl Train. 2001;36(3):263–273	NATA	69.44%	100	274
Hagel BE, Pless IB, Goulet C, Platt RW, Robitaille Y. Effectiveness of helmets in skiers and snowboarders: case-control and case crossover study. BMJ. 2005;330(7486):281.	NATA	46.94%	30	204
Hinton-Bayre AD, Geffen G. Severity of sports-related concussion and neuropsychological test performance. Neurology. 2002;59(7):1068–1070.	NATA	100.00%	129	303
Hunt TN, Ferrara MS. Age-related differences in neuropsycho-logical testing among high school athletes. J Athl Train 2009;44(4):405–409.	NATA	100.00%	16	190
Iverson GL, Brooks BL, Ashton VL, Lange RT. Interview versus questionnaire symptom reporting in people with the postconcus-sion syndrome. J Head Trauma Rehabil. 2010;25(1):23–30.	NATA	57.38%	90	264
Iverson GL, Brooks BL, Lovell MR, Collins MW. No cumulative effects for one or two previous concussions. Br J Sports Med. 2006;40(1):72–75.	NATA	100.00%	186	360
Kahanov L, Dusa MJ, Wilkinson S, Roberts J. Self-reported headgear use and concussions among collegiate men's rugby union players. Res Sports Med. 2005;13(2):77–89.	NATA	100.00%	145	319
Kemp SP, Hudson Z, Brooks JH, Fuller CW. The epidemiology of head injuries in English professional rugby union. Clin J Sport Med. 2008;18(3):227–234.	NATA	100.00%	143	317
Labella CR, Smith BW, Sigurdsson A. Effect of mouthguards on dental injuries and concussions in college basketball. Med Sci Sports Exerc. 2002;34(1):41–44.	NATA	100.00%	141	315
Lovell MR, Collins MW, Iverson GL, Johnston KM, Bradley JP. Grade 1 or "ding" concussions in high school athletes. Am J Sports Med. 2004;32(1):47–54.	NATA	81.40%	18/9	183

Lovell MR, Iverson GL, Collins MW, et al. Measurement of symptoms following sports-related concussion: reliability and normative data for the post-concussion scale. Appl Neuropsychol. 2006;13(3):166–174.	NATA	79.67%	173	347
Maddocks DL, Dicker GD, Saling MM. The assessment of orientation following concussion in athletes. Clin J Sport Med. 1995;5(1):32–35.	ICCCS/NATA	100.00%	7/111	285
Majerske CW, Mihalik JP, Ren D, et al. Concussion in sports: postconcussive activity levels, symptoms, and neurocognitive performance. J Athl Train. 2008;43(3):265–274.	NATA	84.21%	130	304
Marshall SW, Loomis DP, Waller AE, et al. Evaluation of protective equipment for prevention of injuries in rugby union. Int J Epidemiol. 2005;34(1):113–118.	NATA	73.39%	139	313
Martini DN, Sabin MJ, DePesa SA, et al. The chronic effects of concussion on gait. Arch Phys Med Rehabil. 2011;92(4):585–589.	NATA	54.41%	197	371
McCrea M, Barr WB, Guskiewicz K, et al. Standard regression-based methods for measuring recovery after sport-related concussion. J Int Neuropsychol Soc. 2005;11(1):58–69.	AMSSM/NATA	100.00%	20/19	194
McCrea M, Guskiewicz KM, Marshall SW, et al. Acute effects and recovery time following concussion in collegiate football players: the NCAA concussion study. JAMA. 2003;290(19):2556– 2563.	NATA	100.00%	65	239
McCrea M, Hammeke T, Olsen G, Leo P, Guskiewicz K. Unreported concussion in high school football players: implica- tions for prevention. Clin J Sport Med. 2004;14(1):13–17.	NATA	100.00%	57	231
McCrea M. Standardized mental status testing on the sideline after sport-related concussion. J Athl Train. 2001;36(3):274–279.	AMSSM/NATA	100.00%	18/22	196
McGrath N, Dinn WM, Collins MW, Lovell MR, Elbin RJ, Kontos AP. Post-exertion neurocognitive test failure among student-athletes following concussion. Brain Inj. 2013;27(1):103–113.	NATA	79.63%	134	308
McIntosh AS, McCrory P. Effectiveness of headgear in a pilot study of under 15 rugby union football. Br J Sports Med. 2001;35(3):167–169.	NATA	100.00%	144	318
Mihalik JP, McCaffrey MA, Rivera EM, et al. Effectiveness of mouthguards in reducing neurocognitive deficits following sports- related cerebral concussion. Dent Traumatol. 2007;23(1):14–20.	NATA	84.44%	142	316
Moser, R. S., Schatz, P., Neidzwski, K., & Ott, S. D. (2011). Group versus individual administration affects baseline neurocognitive test performance. The American Journal of Sports Medicine, 39(11), 2325–2330. http://doi.org/10.1177/0363546511417114	NATA	65.56%	21	195
Mueller BA, Cummings P, Rivara FP, Brooks MA, Terasaki RD. Injuries of the head, face, and neck in relation to ski helmet use.Epidemiology. 2008;19(2):270–276.	NATA	59.38%	31	205
Mueller, B. A., Cummings, P., Rivara, F. P., Brooks, M. A., & Terasaki, R. D. (2008). Injuries of the head, face, and neck in relation to ski helmet use. Epidemiology (Cambridge, Mass.), 19(2), 270–276. http://doi.org/10.1097/EDE.0b013e318163567c	NATA	61.45%	32	206
O'Donoghue EM, Onate JA, Van Lunen B, Peterson CL. Assessment of high school coaches' knowledge of sport-related concussions. Athl Train Sports Health. 2009;1(3):120–132.	NATA	100.00%	66	240
Parker TM, Osternig LR, Van Donkelaar P, Chou LS. Gait stability following concussion. Med Sci Sports Exerc. 2006;38(6):1032–1040.	NATA	60.00%	97	271
Patel AV, Mihalik JP, Notebaert AJ, Guskiewicz KM, Prentice WE. Neuropsychological performance, postural stability, and symptoms after dehydration. J Athl Train. 2007;42(1):66–75.	NATA	100.00%	91	265

Peterson CL, Ferrara MS, Mrazik M, Piland S, Elliot R. Evaluation of neuropsychological domain scores and postural stability following cerebral concussion in sports. Clin J Sport Med. 2003;13(4):230–237.	NATA	69.23%	99	273
Piland SG, Motl RW, Ferrara MS, Peterson CL. Evidence for the factorial and construct validity of a self-report concussion symptoms scale. J Athl Train. 2003;38(2):104–112.	NATA	79.93%	94	268
Pontifex MB, O'Connor PM, Broglio SP, Hillman CH. The association between mild traumatic brain injury history and cognitive control. Neuropsychologia. 2009;47(14):3210–3216.	NATA	75.00%	193	367
Powell JW, Barber-Foss KD. Traumatic brain injury in high school athletes. JAMA. 1999;282(10):958–963.	NATA	87.06%	151	325
Randolph C, Millis S, Barr WB, et al. Concussion symptom inventory: an empirically derived scale for monitoring resolution of symptoms following sport-related concussion. Arch Clin Neuropsychol. 2009;24(3):219–229.	NATA	72.70%	95	269
Riemann BL, Guskiewicz KM, Shields EW. Relationship between clinical and forceplate measures of postural stability. J Sport Rehabil. 1999;8(2):71–82.	NATA	100.00%	104	278
Riemann BL, Guskiewicz KM. Effects of mild head injury on postural stability as measured through clinical balance testing. J Athl Train. 2000;35(1):19–25.	NATA	93.75%	103	277
Sabin MJ, Van Boxtel BA, Nohren MW, Broglio SP. Presence of headache does not influence sideline neurostatus or balance in high school football athletes. Clin J Sport Med. 2011;21(5):411–	NATA	100.00%	93	267
Saunders RL, Harbaugh RE. The second impact in catastrophic contact-sports head trauma. JAMA. 1984;252(4):538–539.	NATA	100.00%	48	222
Schatz P, Pardini JE, Lovell MR, Collins MW, Podell K. Sensitivity and specificity of the ImPACT test battery for concussion in athletes. Arch Clin Neuropsychol. 2006;21(1):91– 99.	NATA	62.32%	113	287
	NATA		87	261
Schmidt JD, Register-Mihalik JK, Mihalik JP, Kerr ZY, Guskiewicz KM. Identifying impairments after concussion: normative data versus individualized baselines. Med Sci Sports Exerc. 2012;44(9):1621–1628.	NATA	67.45%	13	187
Schulz MR, Marshall SW, Mueller FO, et al. Incidence and risk factors for concussion in high school athletes, North Carolina, 996–1999. Am J Epidemiol. 2004;160(10):937–944.	NATA	81.55%	182	356
Sim A, Terrberry-Spohr L, Wilson KR. Prolonged recovery of memory functioning after mild traumatic brain injury in adolescent athletes. J Neurosurg. 2008;108(3):511–516.	NATA	77.09%	164	338
Sosnoff JJ, Broglio SP, Shin S, Ferrara MS. Previous mild traumatic brain injury and postural control dynamics. J Athl Train. 2011;46(1):85–91.	NATA	67.86%	196	370
Sye G, Sullivan SJ, McCrory P. High school rugby players' understanding of concussion and return to play guidelines. Br J Sports Med. 2006;40(12):1003–1005.	NATA	100.00%	59	233
Talavage TM, Nauman E, Breedlove EL, et al. Functionally- detected cognitive impairment in high school football players without clinically-diagnosed concussion. J Neurotrauma. http://online.liebertpub.com/doi/full/10.1089/neu.2010.1512. Published online ahead of print April 11, 2013. Accessed August 30, 2013.	NATA	100.00%	190	364
Vagnozzi R, Signoretti S, Cristofori L, et al. Assessment of metabolic brain damage and recovery following mild traumatic brain injury: a multicentre, proton magnetic resonance spectro- scopic study in concussed patients. Brain. 2010;133(11):3232– 3242	NATA	77.14%	2	176

Vagnozzi R, Signoretti S, Tavazzi B, et al. Temporal window of metabolic brain vulnerability to concussion: a pilot 1H-magnetic resonance spectroscopy study in concussed athletes, part III. Neurosurgery. 2008;62(6):1286–1295.	AMSSM/NATA	64.29%	9/123	297
Valovich McLeod TC, Barr WB, McCrea M, Guskiewicz KM. Psychometric and measurement properties of concussion assess- ment tools in youth sports. J Athl Train. 2006;41(4):399–408.	NATA	48.00%	175	349
Valovich TC, Perrin DH, Gansneder BM. Repeat administration elicits a practice effect with the Balance Error Scoring System but not with the Standardized Assessment of Concussion in high school athletes. J Athl Train. 2003;38(1):51–56.	NATA	93.75%	106	280
Valovich-Mcleod TC, Bay RC, Lam KC, Chhabra A. Representative baseline values on the Sport Concussion Assessment Tool 2 (SCAT2) in adolescent athletes vary by gender, grade, and concussion history. Am J Sports Med. 2012;40(4):927–933.	NATA	76.90%	41	215
Van Kampen DA, Lovell MR, Pardini JE, Collins MW, Fu FH. The ''value added'' of neurocognitive testing after sports-related concussion. Am J Sports Med. 2006;34(10):1630–1635.	NATA	69.27%	115	289
Wilkins JC, Valovich McLeod TC, Perrin DH, Gansneder BM. Performance on the Balance Error Scoring System decreases after fatigue. J Athl Train. 2004;39(2):156–161.	NATA	100.00%	110	284
Williams SJ, Nukada H. Sport and exercise headache, part 2: diagnosis and classification. Br J Sports Med. 1994;28(2):96–100.	NATA	51.94%	92	266
Wisniewski JF, Guskiewicz KM, Trope M, Sigurdsson A. Incidence of cerebral concussions associated with type of mouthguard used in college football. Dent Traumatol. 2004;20(3):143–149.	NATA	100.00%	135	309
Wood RL, McCabe M, Dawkins J. The role of anxiety sensitivity in symptom perception after minor head injury: an exploratory study. Brain Inj. 2011;25(13–14):1296–1299.	NATA	49.21%	68	242
Yakovlev PI, Lecours AR. The myelogenetic cycles of regional maturation of the brain. In: Minkowski A, ed. Regional Development of the Brain in Early Life. Philadelphia, PA: FA Davis; 1967:3–70	NATA	50.56%	15	189
Yeates KO, Kaizer E, Rusin J, et al. Reliable change in postconcussive symptoms and its functional consequences among children with mild traumatic brain injury. Arch Pediatr Adolesc Med. 2012;166(7):615–622.	NATA	68.77%	40	214
Yeates KO, Luria J, Bartkowski H, Rusin J, Martin L, Bigler ED. Postconcussive symptoms in children with mild closed head injuries. J Head Trauma Rehabil. 1999;14(4):337–350.	NATA	64.36%	174	348
Total average		***80.09%***		

All Papers from All Three Statements (Citation Order)

Citation	Reference Number	Running Total Reference Number	Statement
Harmon KG, Drezner JA, Gammons M, et al. American Medical Society for Sports Medicine position statement: concussion in sport. Br J Sports Med. 2013;47:15–26.	1	1	AMSSM
Ebell MH, Siwek J, Weiss BD, et al. Strength of recommendation taxonomy (SORT): a patient-centered approach to grading evidence in the medical literature. Am Fam Physician. 2004;69:548–556.	2	2	AMSSM
McCrory P, Meeuwisse W, Dvorak J, et al. Consensus statement on concussion in sport-the 5(th) international conference on concussion in sport held in Berlin. Br J Sports Med 2016;51:838–47.	3	3	AMSSM
McCrory P, Feddermann-Demont N, Dvorˇa´k J, et al. What is the definition of sports-related concussion: a systematic review. Br J Sports Med. 2017;51:877–887.	4	4	AMSSM
Barkhoudarian G, Hovda DA, Giza CC. The molecular pathophysiol- ogy of concussive brain injury. Clin Sports Med. 2011;30:33–48, vii–iii.	5	5	AMSSM
Maugans, T. A., Farley, C., Altaye, M., Leach, J., & Cecil, K. M. (2012). Pediatric sports-related concussion produces cerebral blood flow alterations. Pediatrics, 129(1), 28–37. http://doi.org/10.1542/peds.2011-2083	6	6	AMSSM
Meier, T. B., Bellgowan, P. S. F., Singh, R., Kuplicki, R., Polanski, D. W., & Mayer, A. R. (2015). Recovery of cerebral blood flow following sports-related concussion. JAMA Neurology, 72(5), 530–538. http://doi.org/10.1001/jamaneurol.2014.4778	7	7	AMSSM
Vagnozzi, R., Tavazzi, B., Signoretti, S., Amorini, A. M., Belli, A., Cimatti, M., et al. (2007). Temporal window of metabolic brain vulnerability to concussions: mitochondrial-related impairment--part I. Neurosurgery, 61(2), 379–88– discussion 388–9. http://doi.org/10.1227/01.NEU.0000280002.41696.D8	8	8	AMSSM
Vagnozzi, R., Signoretti, S., Tavazzi, B., Floris, R., Ludovici, A., Marziali, S., et al. (2008). Temporal window of metabolic brain vulnerability to concussion: a pilot 1H-magnetic resonance spectroscopic study in concussed athletes--part III. Neurosurgery, 62(6), 1286–95– discussion 1295–6. http://doi.org/10.1227/01.neu.0000333300.34189.74	9	9	AMSSM
Longhi, L., Saatman, K. E., Fujimoto, S., Raghupathi, R., Meaney, D. F., Davis, J., … McIntosh, T. K. (2005). Temporal Window of Vulnerability to Repetitive Experimental Concussive Brain Injury. Neurosurgery, 56(2), 364–374.doi:10.1227/01.neu.0000149008.73513.44	10	10	AMSSM
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Tsushima, W. T., Siu, A. M., Ahn, H. J., Chang, B. L., & Murata, N. M. (2019). Incidence and Risk of Concussions in Youth Athletes: Comparisons of Age, Sex, Concussion History, Sport, and Football Position. Archives of Clinical Neuropsychology : the Official Journal of the National Academy of Neuropsychologists, 34(1), 60–69. http://doi.org/10.1093/arclin/acy019	13	13	AMSSM
Bretzin, A. C., Covassin, T., Fox, M. E., Petit, K. M., Savage, J. L., Walker, L. F., & Gould, D. (2018). Sex Differences in the Clinical Incidence of Concussions, Missed School Days, and Time Loss in High School Student-Athletes: Part 1. The American Journal of Sports Medicine, 46(9), 2263–2269. http://doi.org/10.1177/0363546518778251	14	14	AMSSM
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McCrea, M., Kelly, J. P., Randolph, C., Cisler, R., & Berger, L. (2002). Immediate neurocognitive effects of concussion. Neurosurgery, 50(5), 1032–40– discussion 1040–2. http://doi.org/10.1097/00006123-200205000-00017	17	17	AMSSM
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McCrea, M., Barr, W. B., Guskiewicz, K., Randolph, C., Marshall, S. W., Cantu, R., et al. (2005). Standard regression-based methods for measuring recovery after sport-related concussion. Journal of the International Neuropsychological Society, 11(1), 58–69. http://doi.org/10.1017/S1355617705050083	19	19	AMSSM
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Galetta, K. M., Morganroth, J., Moehringer, N., Mueller, B., Hasanaj, L., Webb, N., et al. (2015). Adding Vision to Concussion Testing: A Prospective Study of Sideline Testing in Youth and Collegiate Athletes. Journal of Neuro-Ophthalmology : the Official Journal of the North American Neuro-Ophthalmology Society, 35(3), 235–241. http://doi.org/10.1097/WNO.0000000000000226	21	21	AMSSM

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Seidman, D. H., Burlingame, J., Yousif, L. R., Donahue, X. P., Krier, J., Rayes, L. J., et al. (2015). Evaluation of the King-Devick test as a concussion screening tool in high school football players. Journal of the Neurological Sciences, 356(1-2), 97–101. http://doi.org/10.1016/j.jns.2015.06.021	24	24	AMSSM
Dompier, T. P., Kerr, Z. Y., Marshall, S. W., Hainline, B., Snook, E. M., Hayden, R., & Simon, J. E. (2015). Incidence of Concussion During Practice and Games in Youth, High School, and Collegiate American Football Players. JAMA Pediatrics, 169(7), 659–665. http://doi.org/10.1001/jamapediatrics.2015.0210	25	25	AMSSM
Houck, Z., Asken, B., Bauer, R., Pothast, J., Michaudet, C., & Clugston, J. (2016). Epidemiology of Sport-Related Concussion in an NCAA Division I Football Bowl Subdivision Sample. The American Journal of Sports Medicine, 44(9), 2269–2275. http://doi.org/10.1177/0363546516645070	26	26	AMSSM
Galetta, K. M., Brandes, L. E., Maki, K., Dziemianowicz, M. S., Laudano, E., Allen, M., et al. (2011). The King-Devick test and sports-related concussion: study of a rapid visual screening tool in a collegiate cohort. Journal of the Neurological Sciences, 309(1-2), 34–39. http://doi.org/10.1016/j.jns.2011.07.039	27	27	AMSSM
Leong DF, Balcer LJ, Galetta SL, et al. The King-Devick test for sideline concussion screening in collegiate football. J Optom. 2015;8:131–139.	28	28	AMSSM
Dhawan, P. S., Leong, D., Tapsell, L., Starling, A. J., Galetta, S. L., Balcer, L. J., et al. (2017). King-Devick Test identifies real-time concussion and asymptomatic concussion in youth athletes. Neurology. Clinical Practice, 7(6), 464–473. http://doi.org/10.1212/CPJ.0000000000000381	29	29	AMSSM
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National Collegiate Athletic Association (NCAA). Interassociation Consensus: Diagnosis and Management of Sport-Related Concussion Best Practices. Indianapolis, IN; 2016.	31	31	AMSSM
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Fuller, G. W., Kemp, S. P. T., & Raftery, M. (2017). The accuracy and reproducibility of video assessment in the pitch-side management of concussion in elite rugby. Journal of Science and Medicine in Sport / Sports Medicine Australia, 20(3), 246–249. http://doi.org/10.1016/j.jsams.2016.07.008	36	36	AMSSM
Echemendia, R. J., Bruce, J. M., Meeuwisse, W., Hutchison, M. G., Comper, P., & Aubry, M. (2018). Can visible signs predict concussion diagnosis in the National Hockey League? British Journal of Sports Medicine, 52(17), 1149–1154. http://doi.org/10.1136/bjsports-2016-097090	37	37	AMSSM
Patricios, J., Fuller, G. W., Ellenbogen, R., Herring, S., Kutcher, J. S., Loosemore, M., et al. (2017). What are the critical elements of sideline screening that can be used to establish the diagnosis of concussion? A systematic review. British Journal of Sports Medicine, 51(11), 888–894. http://doi.org/10.1136/bjsports-2016-097441	38	38	AMSSM
Randolph, C., McCrea, M., & Barr, W. B. (2005). Is neuropsychological testing useful in the management of sport-related concussion? Journal of Athletic Training, 40(3), 139–152.	39	39	AMSSM
Garcia, G.-G. P., Broglio, S. P., Lavieri, M. S., McCrea, M., McAllister, T., CARE Consortium Investigators. (2018). Quantifying the Value of Multidimensional Assessment Models for Acute Concussion: An Analysis of Data from the NCAA-DoD Care Consortium. Sports Medicine, 48(7), 1739–1749. http://doi.org/10.1007/s40279-018-0880-x	40	40	AMSSM
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Leddy, J. J., Hinds, A. L., Miecznikowski, J., Darling, S., Matuszak, J., Baker, J. G., et al. (2018). Safety and Prognostic Utility of Provocative Exercise Testing in Acutely Concussed Adolescents: A Randomized Trial. Clinical Journal of Sport Medicine : Official Journal of the Canadian Academy of Sport Medicine, 28(1), 13–20. http://doi.org/10.1097/JSM.0000000000000431	58	58	AMSSM
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Schneider KJ, Iverson GL, Emery CA, et al. The effects of rest and treatment following sport-related concussion: a systematic review of the literature. Br J Sports Med. 2013;47:304–307.	60	60	AMSSM
Griesbach GS, Hovda DA, Molteni R, Wu A, Gomez-Pinilla F. Voluntary exercise following traumatic brain injury: brain-derived neurotrophic factor upregulation and recovery of function. Neuroscience. 2004;125(1):129-139. doi:10.1016/j.neuroscience.2004.01.030.	61	61	AMSSM
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Griesbach GS, Tio DL, Nair S, et al. Recovery of stress response coincides with responsiveness to voluntary exercise after traumatic brain injury. J Neurotrauma. 2014;31:674–682.	63	63	AMSSM
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Thomas DG, Apps JN, Hoffmann RG, McCrea M, Hammeke T. Benefits of strict rest after acute concussion: a randomized controlled trial. Pediatrics. 2015;135(2):213-223. doi:10.1542/peds.2014-0966.	65	65	AMSSM

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Clausen M, Pendergast DR, Willer B, et al. Cerebral blood flow during treadmill exercise is a marker of physiological postconcussion syndrome in female athletes. J Head Trauma Rehabil. 2016;31:215–224	68	68	AMSSM
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Leddy JJ, Haider MN, Hinds AL, Darling S, Willer BS. A Preliminary Study of the Effect of Early Aerobic Exercise Treatment for Sport-Related Concussion in Males. Clin J Sport Med. 2019;29(5):353-360. doi:10.1097/JSM.0000000000000663.	72	72	AMSSM
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Ashbaugh, A., & McGrew, C. (2016). The Role of Nutritional Supplements in Sports Concussion Treatment. Current Sports Medicine Reports, 15(1), 16–19. http://doi.org/10.1249/JSR.0000000000000219	75	75	AMSSM
Oliver JM, Jones MT, Kirk KM, et al. Effect of docosahexaenoic acid on a biomarker of head trauma in American football. Med Sci Sports Exerc. 2016;48:974–982.	76	76	AMSSM
Makdissi M, Schneider KJ, Feddermann-Demont N, et al. Approach to investigation and treatment of persistent symptoms following sport-related concussion: a systematic review. Br J Sports Med. 2017;51:958–968.	77	77	AMSSM

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Ellis, M. J., Leddy, J., & Willer, B. (2016). Multi-Disciplinary Management of Athletes with Post-Concussion Syndrome: An Evolving Pathophysiological Approach. Frontiers in Neurology, 7, 136. http://doi.org/10.3389/fneur.2016.00136	80	80	AMSSM
Leddy, J. J., Haider, M. N., Ellis, M., & Willer, B. S. (2018). Exercise is Medicine for Concussion. Current Sports Medicine Reports, 17(8), 262–270. http://doi.org/10.1249/JSR.0000000000000505	81	81	AMSSM
Broglio, S. P., Collins, M. W., Williams, R. M., Mucha, A., & Kontos, A. P. (2015). Current and emerging rehabilitation for concussion: a review of the evidence. Clinics in Sports Medicine, 34(2), 213–231. http://doi.org/10.1016/j.csm.2014.12.005	82	82	AMSSM
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Hugentobler JA, Vegh M, Janiszewski B, et al. Physical therapy intervention strategies for patients with prolonged mild traumatic brain injury symptoms: A case series. Int J Sports Phys Ther 2015;10:676–89	84	84	AMSSM
Hoffman, N. L., Weber, M. L., Broglio, S. P., McCrea, M., McAllister, T. W., & Schmidt, J. D. (2017). Influence of Postconcussion Sleep Duration on Concussion Recovery in Collegiate Athletes. Clinical Journal of Sport Medicine, Publish Ahead of Print, 1–7. http://doi.org/10.1097/JSM.0000000000000538	85	85	AMSSM
McCarty CA, Zatzick D, Stein E, et al. Collaborative care for adolescents with persistent postconcussive symptoms: a randomized trial. Pediatrics 2016;138:e20160459.	86	86	AMSSM
O'Neill, J. A., Cox, M. K., Clay, O. J., Johnston, J. M., Jr., Novack, T. A., Schwebel, D. C., & Dreer, L. E. (2017). A review of the literature on pediatric concussions and return-to-learn (RTL): Implications for RTL policy, research, and practice. Rehabilitation Psychology, 62(3), 300–323. https://doi.org/10.1037/rep0000155	87	87	AMSSM
Halstead, M. E., McAvoy, K., Devore, C. D., Carl, R., Lee, M., Logan, K., et al. (2013). Returning to learning following a concussion. Pediatrics, 132(5), 948–957. http://doi.org/10.1542/peds.2013-2867	88	88	AMSSM
McAvoy, K., Eagan-Johnson, B., & Halstead, M. (2018). Return to learn: Transitioning to school and through ascending levels of academic support for students following a concussion. NeuroRehabilitation, 42(3), 325–330. http://doi.org/10.3233/NRE-172381	89	89	AMSSM

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Schmidt, J. D., Hoffman, N. L., Ranchet, M., Miller, L. S., Tomporowski, P. D., Akinwuntan, A. E., & Devos, H. (2017). Driving after Concussion: Is It Safe To Drive after Symptoms Resolve? Journal of Neurotrauma, 34(8), 1571–1578. http://doi.org/10.1089/neu.2016.4668	91	91	AMSSM
Asken, B. M., Bauer, R. M., Guskiewicz, K. M., McCrea, M. A., Schmidt, J. D., Giza, C. C., et al. (2018). Immediate Removal From Activity After Sport-Related Concussion Is Associated With Shorter Clinical Recovery and Less Severe Symptoms in Collegiate Student-Athletes. The American Journal of Sports Medicine, 46(6), 363546518757984–1474. http://doi.org/10.1177/0363546518757984	92	92	AMSSM
Asken, B. M., McCrea, M. A., Clugston, J. R., Snyder, A. R., Houck, Z. M., & Bauer, R. M. (2016). "Playing Through It": Delayed Reporting and Removal From Athletic Activity After Concussion Predicts Prolonged Recovery. Journal of Athletic Training, 51(4), 329–335. http://doi.org/10.4085/1062-6050-51.5.02	93	93	AMSSM
Elbin, R. J., Sufrinko, A., Schatz, P., French, J., Henry, L., Burkhart, S., et al. (2016). Removal From Play After Concussion and Recovery Time. Pediatrics, 138(3). http://doi.org/10.1542/peds.2016-0910	94	94	AMSSM
Howell, D. R., O'Brien, M. J., Fraser, J., & Meehan, W. P. (2018). Continuing Play, Symptom Severity, and Symptom Duration After Concussion in Youth Athletes. Clinical Journal of Sport Medicine, Publish Ahead of Print, 1–5. http://doi.org/10.1097/JSM.0000000000000570	95	95	AMSSM
McCrea, M., Guskiewicz, K., Randolph, C., Barr, W. B., Hammeke, T. A., Marshall, S. W., & Kelly, J. P. (2009). Effects of a symptom-free waiting period on clinical outcome and risk of reinjury after sport-related concussion. Neurosurgery, 65(5), 876–82– discussion 882–3. http://doi.org/10.1227/01.NEU.0000350155.89800.00	96	96	AMSSM
Brooks, M. A., Peterson, K., Biese, K., Sanfilippo, J., Heiderscheit, B. C., & Bell, D. R. (2016). Concussion Increases Odds of Sustaining a Lower Extremity Musculoskeletal Injury After Return to Play Among Collegiate Athletes. The American Journal of Sports Medicine, 44(3), 742–747. http://doi.org/10.1177/0363546515622387	97	97	AMSSM
Herman, D. C., Jones, D., Harrison, A., Moser, M., Tillman, S., Farmer, K., et al. (2017). Concussion May Increase the Risk of Subsequent Lower Extremity Musculoskeletal Injury in Collegiate Athletes. Sports Medicine, 47(5), 1003–1010. http://doi.org/10.1007/s40279-016-0607-9	98	98	AMSSM
Stovitz, S. D., Weseman, J. D., Hooks, M. C., Schmidt, R. J., Koffel, J. B., & Patricios, J. S. (2017). What Definition Is Used to Describe Second Impact	99	99	AMSSM

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Cooney, G., Dwan, K., & Mead, G. (2014). Exercise for depression. JAMA : the Journal of the American Medical Association, 311(23), 2432–2433. http://doi.org/10.1001/jama.2014.4930	100	100	AMSSM
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Buzzini SR, Guskiewicz KM. Sport-related concussion in the young athlete. Curr Opin Pediatr. 2006;18(4):376–382.	156	330	NATA
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Levin HS. Neuroplasticity following non-penetrating traumatic brain injury. Brain Inj. 2003;17(8):665–674.	160	334	NATA
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Moser RS, Schatz P, Jordan BD. Prolonged effects of concussion in high school athletes. Neurosurgery. 2005;57(2):300–306.	163	337	NATA
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Yeates KO, Luria J, Bartkowski H, Rusin J, Martin L, Bigler ED. Postconcussive symptoms in children with mild closed head injuries. J Head Trauma Rehabil. 1999;14(4):337–350.	174	348	NATA
Valovich McLeod TC, Barr WB, McCrea M, Guskiewicz KM. Psychometric and measurement properties of concussion assess- ment tools in youth sports. J Athl Train. 2006;41(4):399–408.	175	349	NATA
McCrory PR, Collie A, Anderson V, Davis G. Can we manage sport related concussion in children the same as in adults? Br J Sports Med. 2004;38(5):516–519.	176	350	NATA
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Canadian Paediatric Society. Identification and management of children with sport-related concussion. Paediatr Child Health. 2006;11(7):420–428.	178	352	NATA
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Valovich-Mcleod TC, Bay RC, Lam KC, Chhabra A. Represen- tative baseline values on the Sport Concussion Assessment Tool 2 (SCAT2) in adolescent athletes vary by gender, grade, and concussion history. Am J Sports Med. 2012;40(4):927–933.	180	354	NATA

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Schulz MR, Marshall SW, Mueller FO, et al. Incidence and risk factors for concussion in high school athletes, North Carolina, 996–1999. Am J Epidemiol. 2004;160(10):937–944.	182	356	NATA
Cantu RC, Register-Mihalik JK. Considerations for return-to-play and retirement decisions after concussion. PM R. 2011;3(10 suppl 2):S440–S444.	183	357	NATA
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Ellemberg D, Leclerc S, Couture S, Daigle C. Prolonged neuropsychological impairments following a first concussion in female university soccer athletes. Clin J Sport Med. 2007;17(5):369–374.	188	362	NATA
Breedlove EL, Robinson M, Talavage TM, et al. Biomechanical correlates of symptomatic and asymptomatic neurophysiological impairment in high school football. J Biomech. 2012;45(7):1265– 1272.	189	363	NATA
Talavage TM, Nauman E, Breedlove EL, et al. Functionally- detected cognitive impairment in high school football players without clinically-diagnosed concussion. J Neurotrauma. http:// online.liebertpub.com/doi/full/10.1089/neu.2010.1512. Published online ahead of print April 11, 2013. Accessed August 30, 2013.	190	364	NATA
Bazarian JJ, Zhu T, Blyth B, Borrino A, Zhong J. Subject-specific changes in brain white matter on diffusion tensor imaging after sports-related concussion. Magn Reson Imaging. 2012;30(2):171–	191	365	NATA
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Dupuis F, Johnston KM, Lavoie M, Lepore F, Lassonde M. Concussion in athletes produce brain dysfunction as revealed by event-related potentials. Neuroreport. 2000;11(18):4087–4092.	195	369	NATA
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Martini DN, Sabin MJ, DePesa SA, et al. The chronic effects of concussion on gait. Arch Phys Med Rehabil. 2011;92(4):585–589.	197	371	NATA
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Omalu BI, DeKosky ST, Hamilton RL, et al. Chronic traumatic encephalopathy in a National Football League player, part II. Neurosurgery. 2006;59(5):1086—1092.	199	373	NATA
Omalu BI, DeKosky ST, Minster RL, Kamboh MI, Hamilton RL, Wecht CH. Chronic traumatic encephalopathy in a National Football League player. Neurosurgery. 2005;57(1):128–134.	200	374	NATA
Broglio SP, Eckner JT, Paulson H, Kutcher JS. Cognitive decline and aging: the role of concussive and sub-concussive impacts. Exerc Sport Sci Rev. 2012;40(3):138–144.	201	375	NATA

BJSM Multiple Choice Questions:

Multiple Choice Questions

1.)The three organizations with the most cited consensus and position statements on concussion are – in their most current edition:
   a) International Conference on Concussion in Sport (ICCS, 2017)
   b) National Athletic Trainers' Association (NATA, 2014)
   c) American Medical Society for Sports Medicine (AMSSM, 2019)
   d) All of the above.

2.) The consensus and position statements from these three organizations currently cite 171 studies that use human subjects data. Roughly what percentage of these studies use ALL MALE data:
   a) 20%
   b) 25%
   c) 30%
   d) 35%
   e) 40%

3.) The consensus and position statements from these three organizations currently cite 171 studies that use human subjects data. Roughly what percentage of these studies use ALL FEMALE data:
   a) 0%
   b) 1%
   c) 2%
   d) 3%
   e) 4%

4.) Which of the following are recommendations from the authorship group on how to foster greater inclusivity of women in concussion research data:
   a) Balancing the representation of females and males on consensus and position statement voting and authorship teams – as well as within editorial boards and program management.
   b) Female athlete-focused sections of consensus and position statements should be included until the literature is robust enough for a standalone document for this population.
   c) Consensus and position statements should acknowledge when predominantly male samples inform recommendations.
   d) Include a checkpoint within consensus/position statement processes for ensuring that cited research is as balanced as possible (similar to NIH's "Inclusion of Women & Minorities" requirements).
   e) All of the above

5.)Which of the three concussion consensus and position statements included studies that *showed a statistically-significant skew* to represent fewer women in concussion data?
   a) International Conference on Concussion in Sport (ICCS, 2017),
   b) National Athletic Trainers' Association (NATA, 2014)
   c) American Medical Society for Sports Medicine (AMSSM, 2019)

d) All of the above.