

# Spreading the word on sports concussion: citation analysis of summary and agreement, position and consensus statements on sports concussion

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## ABSTRACT

**Background** The growing concern over concussion in sports has led to the publication of five major summary and agreement, position and consensus statements since 2000. The dissemination of information from these statements is largely unknown and difficult to quantify, but their impact on the research community can be quantified by analysing the number of citations to these key publications. The purpose of this review is to report the number and pattern of citations to the key published statements on sports concussion.

**Methods** Web of Science, Scopus and PubMed were searched from 2000 to mid-December 2009 using two different search strategies. The first strategy used the search terms 'concussion' and 'first author' of the statement article, while the second used the 'title' of the target article as the key search term.

**Results** The publications resulting from the three 'Concussion in Sport' (CIS) group conferences were cited by 532 journal articles, while the National Athletic Trainers' Association position statement was cited 123 times. The highest number of citations to each of the five identified statements was seen in 2009. *British Journal of Sports Medicine* was the most frequently cited journal.

**Conclusion** The citation analysis of the key statements on sports concussion has shown that the target papers have been widely cited in the research literature, with the highest number of citations being from the publications arising from the CIS group conferences. The authors have shown their preference to cite source articles published in the *British Journal of Sports Medicine*.

## INTRODUCTION

Sports concussion is a recognised public health problem and is of particular concern in major collision sports such as American football, rugby, ice hockey, skiing and boxing.<sup>1</sup> This, together with the need for evidence-based assessment and management strategies, has resulted in a number of major national and international, summary and agreement, position and consensus statements being published since 2000.

One of the hallmark international initiatives in the field of sports concussion was the formation of the 'Concussion in Sport' (CIS) group, which consisted of experts working in the field of sports concussion. The group sought to establish a global opinion on key aspects of sports concussion and its management. The first international meeting was held in Vienna in 2001,<sup>2-4</sup> organised by leading sports organisations including International

Ice Hockey Federation, International Olympic Committee and Fédération Internationale de Football Association. The group subsequently met in Prague in 2004<sup>5-8</sup> and Zurich in 2008 with the additional involvement of the International Rugby Board,<sup>9-16</sup> to revise and update key aspects of sports concussion. These conferences resulted in summary and agreement and consensus statements on key definitions, assessment and management strategies for sports concussion. In addition, the comprehensive evaluation tools, the Sport Concussion Assessment Tool (SCAT) and SCAT2, resulted from these conferences.

The National Athletic Trainers' Association (NATA) published a comprehensive position statement on CIS in 2004,<sup>17-19</sup> which summarised the best available clinical and scientific literature on sports concussion. The collaborative efforts of the American College of Sports Medicine (ACSM), American Academy of Family Physicians, American Academy of Orthopaedic Surgeons, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine and the American Osteopathic Academy of Sports Medicine resulted in a consensus statement on concussion (mild traumatic brain injury), which was published in 2005 and 2006.<sup>20,21</sup> The purpose of this consensus statement was to provide medical guidance to physicians on the diagnosis, assessment and management of sports concussion. Hereafter this statement is referred as 'ACSM's consensus statement' in this article.

These statements (summary and agreement, position and consensus) were directed towards improving the safety and health of an athlete following a concussion. However, they have utilised different methodologies in their approach including, most recently, a formal consensus model.<sup>14</sup> The role of these statements has been reviewed by Cantu,<sup>22</sup> who provided his personal comments on their use and contributions. These statements have been widely published<sup>2-5 14 20</sup> and/or copublished<sup>3 4 6-13 21</sup> in their original form or variants<sup>17-19</sup> in a number of international journals relevant to sports concussion. The idea behind copublication was to widely disseminate the key message to reach the widest number of clinicians and researchers. The dissemination of information from these statements is largely unknown and difficult to quantify, as it is targeted to individual clinicians; however, their impact on the research community can be quantified by analysing the number of citations (citation analysis) to these key statement journal articles.

Citation analysis is used in scientific literature to document information on the number of times an article or author is cited and to establish the influence of an article on the chosen field or its impact on the subsequent research.<sup>23 24</sup> Databases such as the ISI Web of Science, Scopus, Google Scholar and PubMed are widely used tools that can provide comprehensive information on citations. As each database includes a specific set of journals, a combined approach has proven to be more appropriate for citation analysis.<sup>25</sup> The purpose of this review is to report and track the number of citations to the key published statements on sports concussion.

## METHODOLOGY

The citations to the statements on sports concussion (journal articles) were searched in the following databases: Web of Science, Scopus and PubMed from 2000 to mid-December 2009. In order to deal with the issue of copublications of the same article in several journals, and to include the widest number of citations, we employed two different search strategies tailored to each database. The first strategy was to use the search terms 'concussion' and 'first author' of the article. The second strategy was to use the 'title' of the target article. The resulting citations from each database were combined to form an EndNote library (EndNote X2); duplicates were manually identified and removed. In cases of copublication, citing articles for each of the source journal (journal in which the 'statement' was published) articles were included in the search. Book citations, conference proceedings and abstracts were excluded from the search, as were articles not published in English.

The number of citations to each of the target articles was determined together with the citing journal (journal in which the 'statement' article was cited) and the year of citation. Summary statistics and a list of the 'top' citing journals were created.

## RESULTS

As shown in table 1, the 'summary and agreement statement of the 1st international symposium on concussion in sport, Vienna 2001' was cited by 265 articles (combined from three copublications) over the 8 years. The NATA's position statement was cited 123 times (combined from three copublications) over 6 years. The 'summary and agreement statement of the 2nd international conference on concussion in sport, Prague 2004,' which was widely published, was cited by 250 journal articles (combined from four copublications) over 5 years. The 'Concussion (mild traumatic brain injury) and the team physician: a consensus statement' was cited 24 times over 5 years in various journals. The most recent 'consensus statement on concussion in sport: the 3rd international conference on concussion in sport held in Zurich, November 2008' was extensively published in nine journals and, to date, has been cited 17 times (combined from nine copublications) over a period of 7 months. Table 1 also demonstrates the number of citations by year, with the highest number of citations to each of the five statements in 2009.

Table 2 presents the top five citing journals together with their impact factors. *The British Journal of Sports Medicine* was the most frequently cited (five statements combined) journal.

## DISCUSSION

This citation analysis of the five key statements on sports concussion resulted in a grand total of 679 citations in less than a decade, with the number of citations increasing from 6 in 2002 to 213 in 2009. The analysis also showed variations among key statements on sports concussion. In general, the overall citations to papers resulting from the CIS group conferences were higher compared with other statements, perhaps due to earlier publication dates.

While the CIS group statements were most widely cited, it cannot be determined if this is due to the perception that this

**Table 1** Total number of citations located from all published journals by year for statements on sports concussion

Origin	Source journal	Year of publication	Year of citation								Total	Grand total
			2002	2003	2004	2005	2006	2007	2008	2009		
First CIS, 2001 <sup>2-4</sup>	<i>Br J Sports Med</i>	2002	4	13	24	26	23	9	9	41	149	265
	<i>Clin J Sport Med</i>	2002	2	8	11	11	12	12	11	26	93	
	<i>Phys Sportsmed</i>	2002	0	1	3	9	4	4	0	2	23	
NATA, 2004 <sup>17-19</sup>	<i>J Athl Train</i>	2004			3	6	17	23	19	33	101	123
	<i>Neurosurgery</i>	2004			0	2	1	1	3	3	10	
	<i>Br J Sports Med</i>	2006					2	4	3	3	12	
Second CIS, 2004 <sup>5-8</sup>	<i>Br J Sports Med</i>	2005				4	26	38	27	53	148	250
	<i>Br J Sports Med Suppl</i>	2005				5	6	8	10	10	39	
	<i>Clin J Sport Med</i>	2005				4	15	13	11	11	54	
	<i>Phys Sportsmed</i>	2005				3	2	1	2	1	9	
ACSM, 2005 <sup>20 21</sup>	<i>Med Sci Sports Exerc</i>	2005				0	0	2	0	0	2	24
	<i>Med Sci Sports Exerc</i>	2006					0	5	4	13	22	
Third CIS, 2008 <sup>9-16</sup>	<i>Br J Sports Med Suppl</i>	2009								3	3	17
	<i>Clin J Sport Med</i>	2009								10	10	
	<i>J Clin Neurosci</i>	2009								1	1	
	<i>J Athl Train</i>	2009								0	0	
	<i>J Sci Med Sport</i>	2009								2	2	
	<i>Neurosurgery</i>	2009								0	0	
	<i>PM R</i>	2009								1	1	
	<i>Phys Sportsmed</i>	2009								0	0	
<i>Scand J Med Sci Sports</i>	2009								0	0		

ACSM, American College of Sports Medicine; CIS, Concussion in Sport; NATA, National Athletic Trainers' Association.

**Table 2** Top five citing journals and impact factors (2008)\* for the statements on sports concussion

Origin	Citing journal	No of citations	Impact factor (2008)
First CIS, 2001 <sup>2-4</sup>	<i>Br J Sports Med</i>	49	2.126
	<i>Clin J Sport Med</i>	31	1.595
	<i>Am J Sports Med</i>	15	3.646
	<i>J Athl Train</i>	14	1.651
	<i>Neurosurgery</i>	14	3.398
NATA, 2004 <sup>17-19</sup>	<i>J Athl Train</i>	20	1.651
	<i>Br J Sports Med</i>	14	2.126
	<i>Clin J Sport Med</i>	11	1.595
	<i>Neurosurgery</i>	08	3.398
	<i>Brain Injury</i>	06	1.116
Second CIS, 2004 <sup>5-8</sup>	<i>Br J Sports Med</i>	48	2.126
	<i>Clin J Sport Med</i>	24	1.595
	<i>J Athl Train</i>	16	1.651
	<i>Neurosurgery</i>	12	3.398
	<i>Brain Injury</i>	10	1.116
ACSM, 2005 <sup>20 21</sup>	<i>Med Sci Sports Exerc</i>	03	3.399
	<i>Neurosurgery</i>	03	3.398
	<i>Br J Sports Med</i>	02	2.126
	<i>J Athl Train</i>	02	1.651
	<i>Pediatrics</i>	02	4.789
Third CIS, 2008 <sup>9-16</sup>	<i>Clin J Sport Med</i>	05	1.595
	<i>Clin Sports Med</i>	02	1.298
	<i>J Fam Practice</i>	02	1.400
	<i>Br J Sports Med</i>	01	2.126
	<i>Br J Sports Med Suppl</i>	01	2.126

ACSM, American College of Sports Medicine; CIS, Concussion in Sport; NATA, National Athletic Trainers' Association.

\*Impact factors (2008) reported by journal citation reports.

group is the leading sports concussion authority or due to the prestige of the journal in which they are published, the target audience or a combination of these. Recent citation analysis<sup>26</sup> of major consensus statements on research methodologies, copublished in multiple journals, clearly indicated that there was a positive relationship between the prestige of the journal (as measured by its impact factor), where the article is published and the number of citations that the article will gather over time.

The ACSM's and NATA's statements were primarily developed to inform their members in sports medicine practice and targeted to a specific group. It must be noted that statements arising from the CIS meetings were copublished in a number of journals, and this may have resulted in wide dissemination<sup>27</sup> as indicated by a higher number of citations. Where statements have been copublished in a number of journals, there appears to be a preference to cite the version published in the *British Journal of Sports Medicine*. It has been reported that citing behaviour<sup>28</sup> can be influenced by scientific (eg, acknowledging intellectual and cognitive influences of colleague scientists, scientific field) and non-scientific factors (eg, type of article, accessibility to the article, personal preferences). The peak number of citations in 2009 indicates an increasing number of publications and a growing literature on sports concussion. It was noted that many articles referenced more than one statement.

There was considerable variability among databases in the reporting of citations. Overall, Scopus had the highest number of citations, followed by Web of Science and PubMed. Although some citations are unique to a particular database,

### What is already known on this topic

- ▶ There have been five major international summary and agreement, position and consensus statements published on sports concussion since 2000.
- ▶ These statements have been widely published and/or copublished in their original form or variants in a number of international journals relevant to sports medicine.

### What this study adds

- ▶ Citation-analysis strategies were used to document the number of citations to this key statement articles providing an indirect indication of their impact on the research community.
- ▶ The key statement articles are attracting increasing attention in the sports concussion scientific literature, as evidenced by the rising number of citations.

there was considerable overlap among databases. Each database used for citation tracking has some limitations. A more detailed description of the limitations of these databases can be found elsewhere.<sup>29 30</sup> The limitations specific to our search strategy included misspelling of author and journal names in the databases and the indexing of the journal names in capitals, which lead to a large number of duplicates. In addition, it was also observed that certain statements were not indexed in all these databases. Therefore, the importance of using multiple databases for citation analysis, reviews and scholarly publications should be stressed. While this analysis reflects the use of these statements in the published literature, it does not attempt to assess their importance and dissemination in the wider sports medicine field.

### CONCLUSION

The citation analysis of key statements on sports concussion showed that the target papers have been widely cited in the research literature, with the highest number of citations being from the publications arising from the CIS group conferences. The citing authors have shown their preference to cite source articles from the *British Journal of Sports Medicine*.

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