SHORT REPORT

Does history of concussion affect current cognitive status?

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The association between self reported history of concussion and current neurocognitive status is controversial. Some football studies suggest that athletes with a history of concussion display cognitive impairment relative to athletes with no history of concussion, but other studies have not been able to reproduce such findings. This study shows that there is no relation between the number of previous self reported episodes of concussion and current cognitive state, directly contradicting the findings of previous research.

The acute consequences of sports related concussion include physical signs and symptoms[1] and cognitive dysfunction,[2] which typically resolve within 7–10 days of the injury.[3 4] The vast majority of research in this area has focused on the short term effects of concussion. This has led to the development of evidence based approaches for the management of these injuries and returning athletes to play within the days and weeks after injury.[5] There is a vast literature showing that neuropsychological testing is sensitive to the chronic effects of moderate and severe traumatic brain injury.[2] However, much less is known about the long term consequences of sports related concussion, an injury conventionally thought to fall at the very mild end of the brain injury spectrum.[3] In particular, the association between self reported history of concussion and current neurocognitive status remains controversial.[6]

A series of studies conducted in Dutch soccer players reported a dose-response relation between history of concussion/heading exposure and neuropsychological test performance.[7–9] Athletes reporting a greater number of previous concussions, or a greater frequency of heading the ball, were found to have poorer performance on a series of neurocognitive tests. Other authors have found that athletes who reported at least three previous concussions are at greater risk of future concussion and recover more slowly when another concussion occurs.[10] Other soccer studies have not been able to reproduce these findings.[11–15]

This study examines the association between self reported history of concussion and current neurocognitive status in a large sample of professional athletes participating in a contact sport.

METHODS

A sample of elite Australian rules footballers completed a brief clinical history questionnaire and performed a series of six cognitive tasks assessing reaction time, decision making, attention, learning, and memory. All participants gave informed consent, and the study protocol was approved by the institutional ethics committee.

These cognitive tasks have shown sensitivity to the effects of sports related concussion.[16 17] A complete description of this cognitive test battery can be found elsewhere.[18–21] In all cases, the computerised examination was administered by a doctor, neuropyschologist, or trained research assistant. All participants were required to perform a full practice test before completing the baseline assessment.

For each cognitive task, outcome variables were defined as the average speed of response in milliseconds and the total number of errors. Errors were defined as false positive responses, false negative responses, anticipatory responses (faster than 100 milliseconds), and failure to make a response.

As part of the clinical history questionnaire, all participants were required to recall the number of previous concussions they had suffered while participating in sport. For the purposes of this analysis, the sample was divided into five distinct subgroups: no history of concussion (n = 244); one concussion (n = 95); two concussions (n = 72); three concussions (n = 48); four or more concussions (n = 62).

One way analysis of variance was performed on each outcome variable to determine whether baseline cognitive task performance differed between groups.

RESULTS

A total of 521 male Australian rules footballers completed a computerised examination (CogSport) before the beginning of the 2002 and 2003 sporting seasons. Table 1 (reaction time) and table 2 (total errors) show the baseline cognitive test performance of all groups. Comparison between groups using analysis of variance failed to identify any significant between group differences.

This finding is supported by qualitative analysis of the data in tables 1 and 2. For example, group mean performance deviated by less than 14 milliseconds on the simple reaction time and choice reaction time tasks.

What is already known on this topic

- Previous studies have proposed that athletes with a self reported history of concussion display cognitive impairment relative to athletes with no history of concussion
- These impairments have been purported to correspond to de facto measures of exposure to sports related head trauma, including length of playing career and position on the field of play

What this study adds

- This study shows that there is no relation between the number of episodes of concussion (as measured by self report) and current cognitive state
- This study directly contradicts the findings of previous research

Table 1 Reaction times on CogSport computerised tasks

Number of concussions	N	Age		SRT		CHRT		CXRT		OBK		MON		LEARN	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
0	244	21.7	3.6	288.5	67.4	438.3	106.7	582.2	99.0	636.8	185.0	351.6	75.1	1032.5	220.1
1	95	22.3	3.8	279.4	48.1	427.5	70.0	581.1	93.4	637.3	190.0	343.8	65.8	1044.7	257.2
2	72	23.9	4.2	275.2	36.6	429.8	61.7	560.6	74.1	631.7	138.2	337.2	54.8	1080.2	204.9
3	48	23.6	3.8	276.5	41.3	425.1	46.8	558.9	81.6	585.6	97.3	335.3	57.1	1078.0	197.7
4+	62	24.1	4.2	286.1	58.2	429.9	64.9	589.1	96.5	652.6	190.3	344.5	65.0	1103.8	215.1

SRT, Simple reaction time task; CHRT, choice reaction time task; CXRT, complex reaction time task; OBK, one back task; MON, monitoring task; LEARN, continuous learning task.

Table 2 Total error rates on CogSport computerised tasks

Number of concussions	N	Age		SRT		CHRT		CXRT		OBK		MON		LEARN	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
0	244	21.7	3.6	5.7	6.7	3.1	3.1	2.8	2.4	3.4	4.7	5.1	3.7	15.3	6.9
1	95	22.3	3.8	5.6	6.6	3.4	3.4	2.4	3.0	2.8	2.8	4.6	2.8	16.9	8.9
2	72	23.9	4.2	3.4	3.6	2.0	1.6	2.1	2.1	2.3	1.9	4.6	3.1	13.1	5.4
3	48	23.6	3.8	4.1	3.9	2.4	2.2	2.1	2.0	2.1	1.7	4.8	2.8	15.7	6.5
4+	62	24.1	4.2	4.9	6.5	3.0	2.5	2.6	2.2	2.7	2.0	5.1	4.1	15.3	8.8

SRT, Simple reaction time task; CHRT, choice reaction time task; CXRT, complex reaction time task; OBK, one back task; MON, monitoring task; LEARN, continuous learning task.

DISCUSSION

No association was observed between the number of previous concussions and current performance on a series of cognitive tests assessing motor function, decision making, attention, learning, and memory. This finding is in contrast with that reported by Matser and colleagues,[8 9] who examined similar associations in a smaller sample of Dutch soccer players.

Such studies are limited by their reliance on the athlete's own recall as the basis for determining number of concussions. Evidence based reviews of the literature suggest that sustaining several concussions over a sporting career does not necessarily result in permanent neurological damage or increase risk of future concussion.[22]

These findings support the current consensus management guidelines proposing that return to play should be determined by clinical evaluation of the individual athlete, rather than by categorisation of the athlete according to their self reported history of concussion or the retrospective application of ''grading scales''.[5 7]

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