The Opportunity Network: Student Science Research Program (SSRP)

Concussions and their impact on Athletes

An in-depth look at previously conducted research and studies on the cognitive deficits caused by concussions and other neural injuries in athletics…

Research Question: How do potential concussions, as sports injuries, correlate with the cognitive regression of athletes over time?

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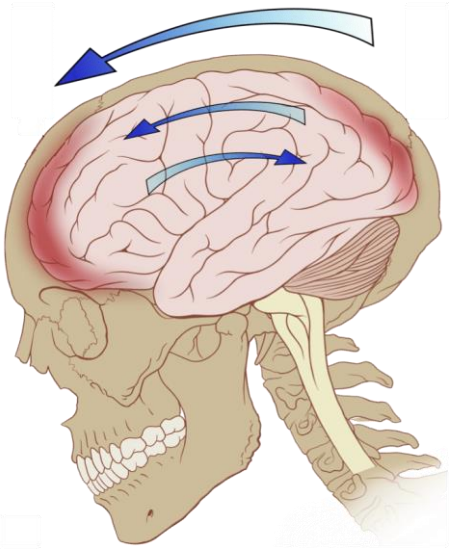

ABSTRACT:

Recently, both American and international sports leagues (including the NFL, CBL, and English Premier League) received questions regarding their ongoing legal proceedings with several firms commissioned by previously employed athletes. Apart from various misconduct issues, the overwhelming majority of athletes filed claims regarding the inability of their former employers to protect them from CTE or Chronic Traumatic Encephalopathy. This is a progressively degenerative neurological disease that was commonly seen in military veterans that sustained injuries to their head and neck injury. However, the actual concept of repetitive blows to the area causing several stages of symptomatic behaviors with the onsets beginning later on, was attributed to CTE in athletes. Rather, researchers logically understood that veterans would be subject to lack of balance, difficulty speaking, etc, because of the sheer volume of injuries they may have sustained to their brain/brain stem.

CTE Timeline:

The disease was first elaborated upon by Dr. Harrison Martland, famous for claiming that the repetitive damage sustained by boxers at an early age caused them to appear "drunk," in 1928. From this point, there were various other issues with veteran-related diseases that resembled the modern day "CTE," yet were not diagnosed due to the lack of information regarding concepts such as neuroplasticity or the ability of the brain to change in response to daily activities (researchers believed this was a related issue). However, in 2005, a neuropathologist, Bennet Omalu, came across former American football player, Mike Webster, which he diagnosed with CTE following his death. Following this, the Concussion Legacy Foundation found that it was actually the "low-level or acute" concussions that caused what Dr.Omalu described as "the brain choking itself." With the help of Boston University and the US Department of Veterans Affairs, they concluded that it was actually the repeated sub-concussive impacts that lead to the later onset of CTE.

How does a sub-concussive impact differ from a traumatic concussion?
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Most researchers compare sub-concussive impacts to a pitcher's progression throughout his career. In that way, a pitcher understands that with every pitch, he is slightly aggravating his throwing arm causing micro-tears in his ligaments that will later compromise his or her ability to continue to throw using the arm. In terms of CTE, however, every single pitch correlate to a "sub-concussive impact" that is a hit to an athlete's brain that is not enough to be labeled as a concussion, yet as seen with the case of Mike Webster, eventually caused the degradation

Various studies concluded prior to Dr.Omalu's findings had reported that patients that had high-level concussive experiences apparently had no apparent

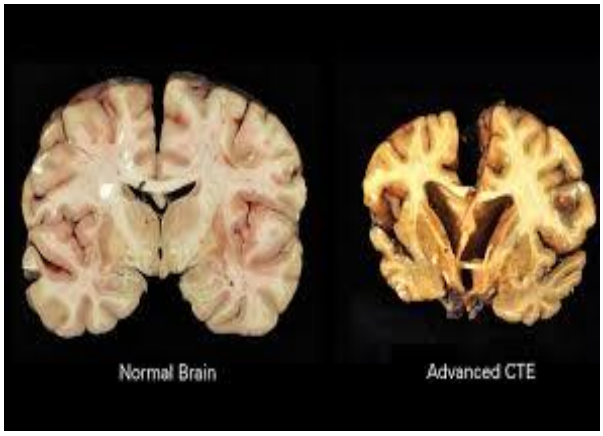

Figure 1: Researchers found that CTE causes physical shrinkage and visual deformed structures

determining the difference between such cases of impact, the Concussion Legacy Foundation stated "Every person diagnosed with CTE has one thing in common: a history of repetitive hits to the head. If you take the person who sustained the highest-level concussive impacts and compare them to those who sustained frequent (but low level) sub-concussive impacts, you will see a big difference." In other words, athletes participating in contact sports (especially football) are more susceptive to developmental disorders because of the timeline of their impacts, specifically because they were earlier and more frequent in their careers. More evidently, it later became obvious to the foundation that their methods for diagnosing such disorders were incorrect because of them holding such importance on finding individuals, including military veterans, who sustained the highest-level amount of force. They later concluded that "this high magnitude may impact the control group in the short-run, but they are immediately treated, and rarely are they sustaining such impacts repeatedly."

Concussive Impacts in different sports, and how they translate to CTE:

Following the publication of the aforementioned sub-concussive studies, several researchers (published in the Journal of Athletic Training) went on to examine the differences between sports and biological sex in terms of long-term effects of in-game impact and the relation to the development of CTE or other disorders. The following data was collected after measuring over 400 collegiate athletes from 1997-2000 (in lacrosse, soccer, and football):

Researchers found that while the frequency of athletes with CTE in high-impact sports was certainly higher than in lesser contact, the extent of the injury didn't always correlate. For example, with athletes that played over 100 professional lacrosse matches, they experienced various forms of blindness, cognition deficits (not knowing where you are, who you are, etc), and lack of balance. The majority of football and soccer athletes had similar issues, yet very few had the combined negative effects seen by alternate athletics including lacrosse and volleyball, where collisions may be less frequent, yet are overlooked (meaning no treatment for these athletes.

	Women			Men			
Year	Game Exposures	Total Concus-sions	Game Injury Rates*	Game Exposures	Total Concus-sions	Game Injury Rates*	χ^2 Value Between Sexes
1997–1998	24 981	51	2.04	30 966	34	1.10	12.99†
1998–1999	22 934	47	2.04	19 142	27	1.41	
1999–2000	27 167	60	2.21	25 636	40	1.56	
1997–1998	8762	12	1.37	13 486	19	1.41	1.63
1998–1999	7122	7	0.98	9514	15	1.58	
1999–2000	8531	7	0.82	12 177	17	1.39	
1997–1998	29 413	16	0.54	27 706	8	0.29	5.14†
1998–1999	38 174	30	0.78	39 367	21	0.53	
1999–2000	28 992	26	0.89	32 836	20	0.61	
1997–1998	26 834	9	0.34	51 351	22	0.43	0.99
1998–1999	44 280	10	0.23	49 207	6	0.12	
1999–2000	75 355	28	0.37	80 215	25	0.31	
1997–1998	8903	1	0.11	227	0	0	0.14
1998–1999	822	0	0	221	0	0	
1999–2000	2083	0	0	1179	0	0	
	354 353	304		393 230	254		

Figure 2: This table shows the number of impacts between three athletics

Future areas of potential research:

1. An inclusion of data on the increase of acute or mid-level concussions amongst soccer and football athletes. This will be valuable in accessing information such as: "What type of concussion affects motor skills most dramatically?" or "How do acute concussions affect balance ability in later stages of athletes?"[1]

2. Several data points on the issues that athletes may incur if they suffer high-level concussions in the developmental stages of adolescence[2]

3. A gender comparison that evaluates whether the thesis of "increased muscle mass, weight, or force leads unfavorable neural deficits. This may be useful to include as a comparison to other sports[3]

4. Including data regarding the effect of immediate treatment (following neuro-physical testing) that comes directly after an injury. There has been conflicting data on the importance of receiving neural aides (such as recently used radiation) after impact.

Bibliography:

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