



A Literature Review: Sub Concussive Forces in Sport

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Introduction:

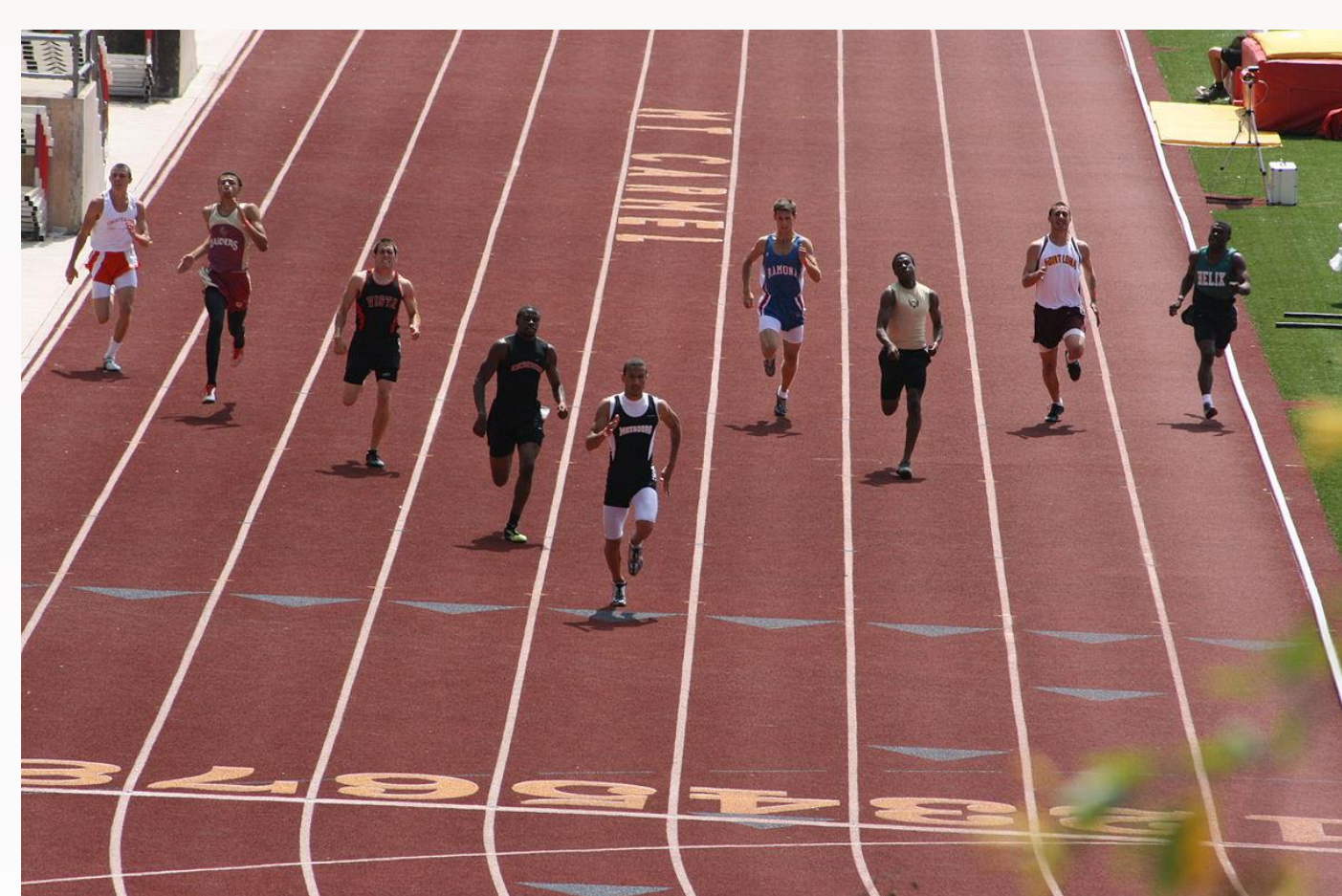
A sub concussive force is when the brain is shaken, but not violently enough to damage brain cells severe enough to elicit symptoms. Sub concussive forces are becoming more prominent in contact sports such as football, lacrosse, soccer, and hockey.

Demographics:

- Soccer
 - Male vs female
 - Male players experienced a higher percentage of impacts due to direct contact with the head (68% vs 38% of females)
 - Female players were observed to experience a larger percentage of body impacts (55% vs 30% for males)
 - The different styles of play are what are thought to attribute to the impacts they sustain
- Lacrosse
 - Games vs practices
 - Practices
 - 5,759 total impacts over 40 practices
 - Games
 - 5,644 total impacts over 17 games
 - Frequent locations of sub concussive forces to the head
 - GForce tracker sensor were inserted into their helmets to collect the data on the linear acceleration, rotational velocity and the location of the impact that were sustained
 - The most frequent locations on the head were the top, bottom, and front

Pathologies:

- Neurocognitive changes
 - Contact sports vs noncontact sports



- Athletes who participated prior to the age of 12 lead to neurological impairment in the future

- Postural stability
 - In a soccer study participants were instructed to head a ball that was shot from a JUGS machine. The participants stood 10 meters from the machine and were instructed to head the ball back in the air towards the machine.
 - Deficits appeared one hour after heading the ball
 - Symptoms dissipate after two days of rest
 - The deficits and symptoms are very similar to those of a concussion:
 - Headache
 - Postural swaying
 - Sensitivity to light
 - Sensitivity to sound
- Oculomotor function
 - Observed in high school football players during preseason practice, regular season games and postseason games
 - Near point convergence (the point to which visual lines are directed when convergence is at its maximum) observed after sub concussive impacts
 - Baseline recovery was observed between sub concussive impacts

Assessment Tools:

- ImPACT (Immediate Post Concussion Assessment and Cognitive Test)
 - Web based used to assess concussions
 - Tests cognitive function in these areas:
 - Attention span
 - Working memory
 - Sustained and selective attention
 - Response variability
 - Nonverbal problem solving
 - Reaction time
- BESS (Balance Error Scoring System)
 - Balance assessment
 - Participants do a series of six stances for 20 seconds with their hands on hips and eyes close
 - Three stances on a firm surface and three on a foam surface
 - Errors are recorded if the participant takes hands off hips, pens eyes, sways, or lifts heel off the ground
- King Devick
 - Elevates eye movement, attention and speech
 - Participant reads a series of six cards as fast as they can in two minutes
 - The numbers on the cards are randomly placed
 - Observing to see if the participant experiences malalignment and diplopia

Equipment:

- Sub concussive forces have been shown to be reduced by using football helmets and concussion headbands for soccer players. Both pieces of equipment reduces the linear and rotational acceleration force exerted to the head.
- Football helmets prevent the head from skull fractures, but don't prevent concussions. With concussions and sub concussive forces helmets only reduce the force. Helmets have been changing and developing new features to help reduce these forces.
- Concussion headbands are a more recent piece of equipment that came out to reduce the forces against the head for soccer players. They have shown to reduce the force by 12.5% compared to those who aren't wearing a concussion headband.



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Picture from <https://www.researchgate.net/publication/318484144>

Education:

- To further understand sub concussive forces more research must be done. Whether it be the signs and symptoms, diagnosis, or the affects that they have on the body.
- Once we understand what sub concussive forces are and how the forces effect our bodies, we can use that research to set rules and regulations in sports. A recent rule change in football is the number of contact days and contacts in a practice. Setting these rules and regulations can be critical to insure the health and safety of sport participants.
- Educate coaches, parents and athletes so they know what to look for when considering if an athlete is suffering from a sub concussive force.

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