WHEN IS IT SAFE FOR A YOUNG ATHLETE TO BE IN CONTACT SPORTS?

JEFF WEBB, MD

DISCLOSURE

- I have no conflicts of interest

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THE BENEFITS OF YOUTH SPORTS

- Health
  - Childhood Obesity in US is at about 20%
  - Improved bone density, improved cardiovascular health
  - Lower incidence of Diabetes and other diseases, healthy habits into adulthood
- Moral/Emotional Development
  - Concept of “team”, leadership, socialization, improving talent
  - Improved self-image
  - Stress Relief

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CONCUSSION INCIDENCE

- 1.5-3.8 million concussions in US annually
- Concussions represent 8.9% of all high school athletic injuries
  - 5.8% of collegiate athletic injuries
- Girls 56% more likely than boys to sustain a concussion in sports with similar rules

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CONCUSSION EXPOSURE

- 2.5 million kids ages 5-13 play tackle football in US each year
- 2018 study found a concussion rate among football players age 5-14 of 5 in 100 (5%) each season
- Some exposure studies have shown that youth football players get hit in the head about 500 times over the course of a season
- Other studies have shown conflicting information with the above numbers
  - Jan 2020 article in *Neurosurgery* followed 20 youth football players over a season
    - No concussions
    - Averaged 41 head impacts over entire season with only 1 of these "high intensity"

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CONCUSSION INCIDENCE

- Overall risk across all sports is 0.23 per 1000 exposures
  - 3 sports with highest risk are:
    - Rugby (4.18)
    - Hockey (1.20)
    - American Football (0.53)
  - 3 sports with lowest risk are:
    - Volleyball (o.03)
    - Baseball (0.06)
    - Cheerleading (0.07)

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PEDIATRIC BRAIN

- Immature brain may be up to 60 times more sensitive to glutamate
- Decreased myelination compared to adult brain (myelination rate peaks age 11-12)
- Peak bloodflow in brain between Age 10-12
- Children may undergo longer more diffuse swelling following concussion
- Previous theories of the “plasticity” of the pediatric brain have been debunked

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YOUTH CHALLENGES

- Younger athletes often do not understand what constitutes a concussion
- Younger athletes are more reluctant to report concussions
  - May be afraid to tell coaches, teammates, parents their symptoms
- Only 45% of youth football coaches have any training
- No athletic trainers at youth events
- May play several games in a weekend "Jamboree"
- Odds of a HS football player making it to NFL=1 in 6000

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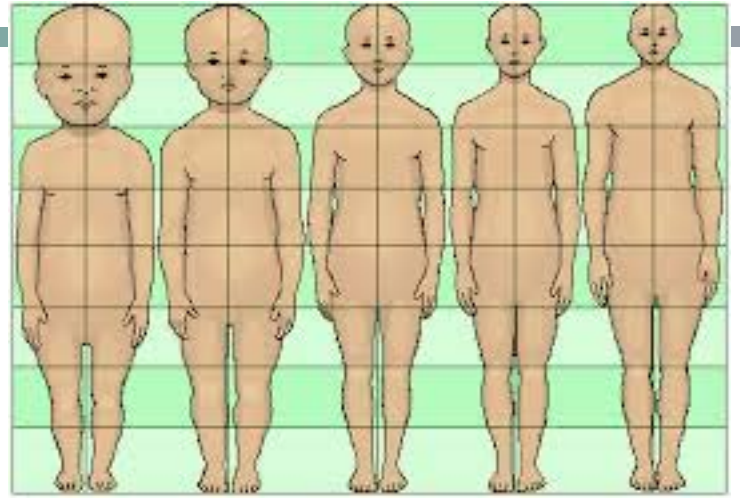
YOUTH BIOMECHANICAL RISKS



- Greater Head to Body Ratio
- Decreased Neck Strength

- Positive-less force/acceleration in youth football athletes

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YOUTH CONCUSSION RISK

Original Article | Open Access | Published: 28 October 2019

Development of a Concussion Risk Function for a Youth Population Using Head Linear and Rotational Acceleration

Eamon T. Campolettano, Ryan A. Gellner, Eric P. Smith, Srinidhi Bellamkonda, Casey T. Tierney, Joseph J. Crisco, Derek A. Jones, Mireille E. Kelley, Jillian E. Urban, Joel D. Stitzel, Amaris Genemaras, Jonathan G. Beckwith, Richard M. Greenwald, Arthur C. Maerlender, Per Gunnar Brolinson, Stefan M. Duma & Steven Rowson

Annals of Biomedical Engineering **48**, 92–103(2020) | Cite this article

- Virginia Tech Biomechanical Lab 10/2019
- Looked at Forces that caused concussion in Youth athletes (Age 9-14)
  - >100 Youth Football Players with Accelerometers in Helmets, 15 Athletes in Study Sustained Concussions
- The average values for impacts causing concussions for Youth Athletes was significantly less than high school/college or pro
  - Peak Linear Acceleration--Youth 62g vs HS 102g vs Pro 98g
  - Peak Rotational Acceleration—Youth 2609 rad/s vs HS 4412 rad/s vs Pro 6432 rad/s

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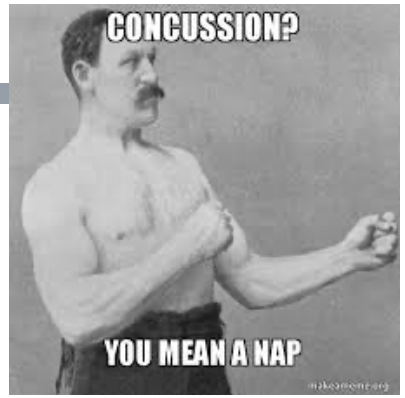

PEDIATRIC RESPONSE TO CONCUSSION

- Multiple studies have shown different response to concussion in youth vs. adult patients
- High school athletes who had less concussion history took longer to return to baseline than college athletes
- ***Concussion recovery time among high school and collegiate athletes: a systematic review and meta-analysis. 2015.***
  - Williams RM[1], Puetz TW, Giza CC, Broglio SP.
  - High school athletes have average symptom recovery at 15 days
  - College athletes have average symptom recovery at 6 days

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SECOND IMPACT SYNDROME

- When an athlete who has sustained a head injury sustains a second head injury before the first has fully resolved
- A significant increase in extracellular potassium concentration in the brain following a TBI, in addition to increased metabolism (for up to 10 days), renders the brain more vulnerable to less severe injuries and more prone to death
- Complete dysregulation of cerebral perfusion and pressure control leads to rapid swelling/herniation of the brain within 2-5 minutes
- This can result in death or coma (50% mortality, 100% morbidity)
- Some debate whether SIS exists and exact incidence is not known
- ALL cases have occurred in athletes under 20 years old

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N.J. parents file lawsuit for son being cleared after concussion

Story Highlights
- Ryne Dougherty's parents have
- The suit alleges Dougherty faile
- The family says he should not h

By David Epstein and Kevin Armstrong, SI.com

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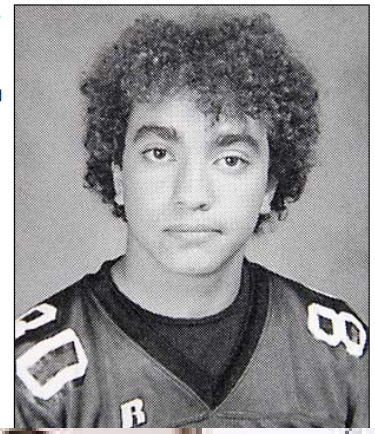
TEXT SIZE

On Oct. 13, 2008, Ryne Dougherty, a junior linebacker at Montclair High School in New Jersey, suffered a hit to his head and was taken off the field with bleeding in his brain. The hit came just three and half weeks after another on-field blow had left him with a concussion. Two days after the second hit, Dougherty was removed from life support.



Now, nearly a year after his death, Dougherty's parents have filed a lawsuit against Montclair High and their son's physician, who they say cleared him to play after the concussion. The lawsuit alleges that Dougherty failed a test that can detect lingering concussion symptoms -- a test that a Montclair High certified athletic trainer says was deemed invalid because a disruptive athlete distracted test-takers -- and that he should not have been allowed to return to play following the concussion.

The lawsuit, filed in Essex County civil court on Sept. 23, alleges that two weeks before he died -- after the first blow and before the second -- Dougherty failed an ImPACT test, a computer-based exam that tests

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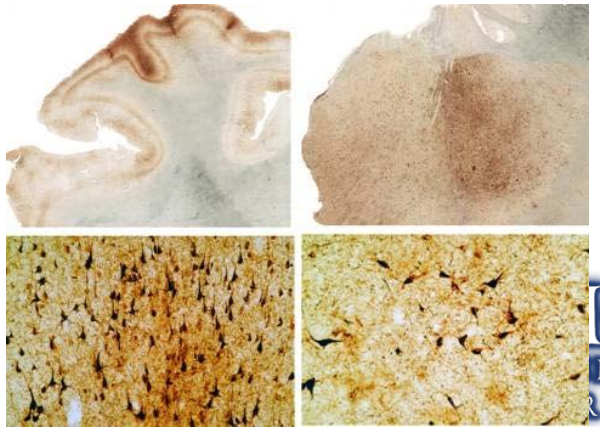
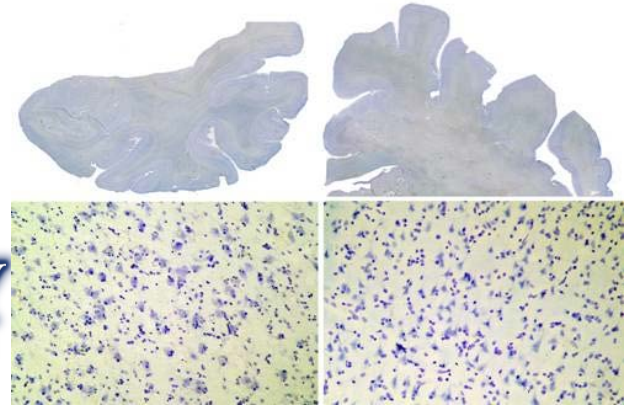
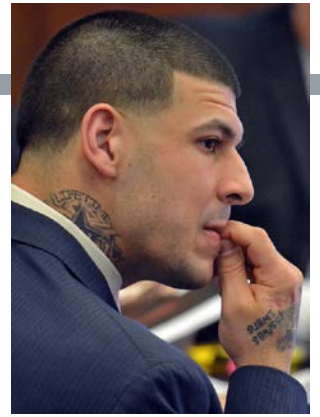
CHRONIC TRAUMATIC ENCEPHALOPATHY (CT

- Progressive degenerative disease of the brain following multiple mild TBI events resulting in cognitive changes, parkinsonism, depression, and ALS type symptoms
- Diagnosed on autopsy with tau proteins in brain
- Evidence of CTE in younger athletes now





CTE



- Uncertain clinical course
  - Exact cause and effect has yet to be established, but certainly seems to be related to repetitive brain injury
- No definitive tests available during life, only diagnosed on autopsy thus far but studies are emerging for possible PET scans or biomarkers
- Recent study of 111 former NFL players brains found evidence of CTE in 110 brains
  - Selection bias present, but certainly concerning numbers

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WHEN TO START FOOTBALL?

- Youth football may have long term cognitive effects
- *Stamm et al, Neurology, Jan 2015*
  - Looked at former NFL players
  - Those that started playing at <12yo performed poorly on memory and neuropsych testing compared to those who started playing football at >12yo, regardless of total number of years played
  - Could be due to injury during key time in brain development (peak myelination rates and cerebral blood flow 10-12yo)

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WHEN TO START FOOTBALL?

- A separate study by a different group (funded by NFL) in 2016 looked at 45 retired players and found no association between age of first exposure to football and long term neurocognitive findings
  - Participation in Pre-High School Football and Neurological, Neuroradiological, and Neuropsychological Findings in Later Life: A Study of 45 Retired National Football League Players.*Solomon GS, Kuhn AW, Zuckerman SL, Casson IR, Viano DC, Lovell MR, Sills AK*
  - *Am J Sports Med. 2016 May; 44(5):1106-15.*

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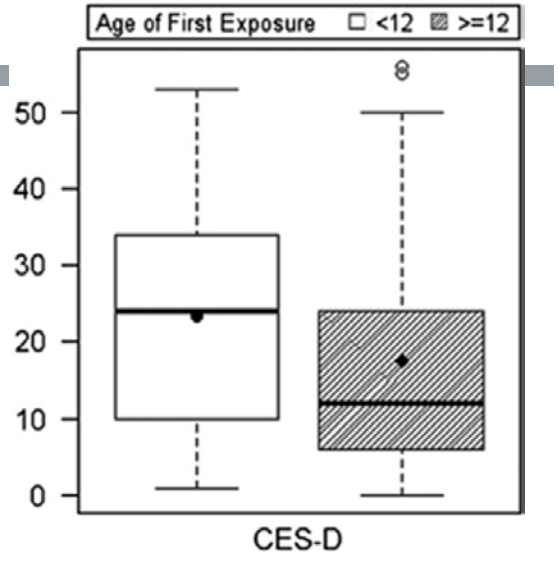
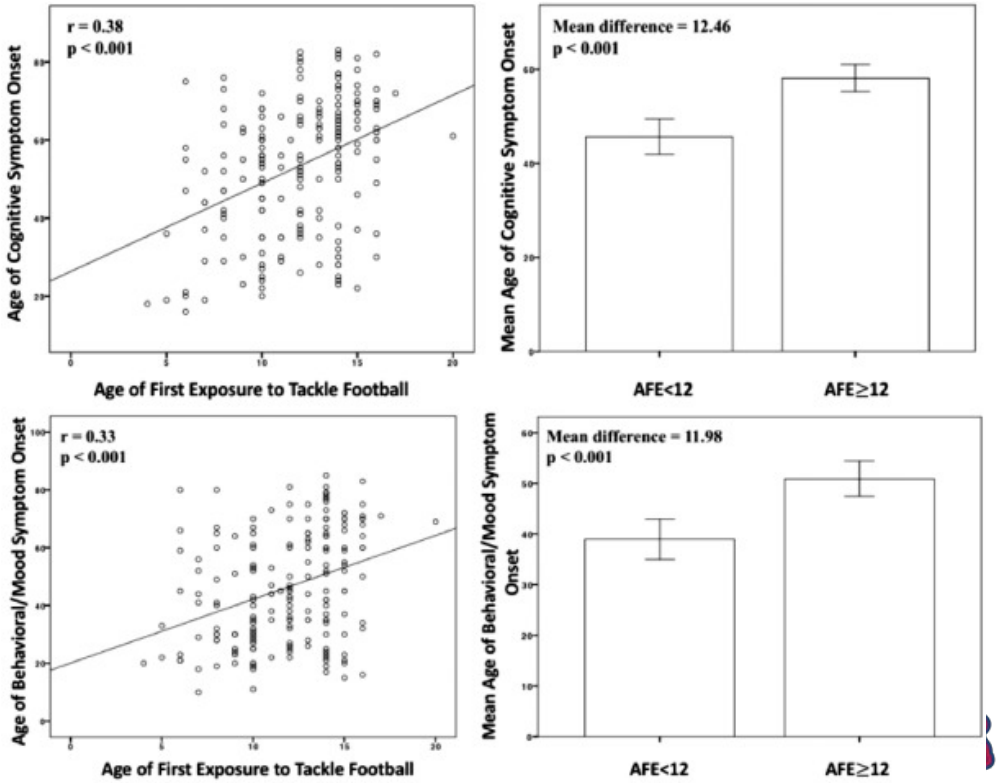
WHEN TO START FOOTBALL?

- But…newer study from Sept 2017 by *Alosco et al.* has further findings of association with age of first exposure to football
  - Increased odds ratio for adults with apathy and depression with younger age of exposure
  - Most dramatic difference at age <12yo





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RULE CHANGES

- Fewer contacts lead to fewer potential concussions
- Youth football programs have suggested limiting or banning contact (Flag Football til 12 or 14?)
- Youth hockey programs (12 and under) have removed checking
  - 67% reduction in concussion incidence with this one rule change
- Youth soccer programs have banned heading in 10 and under
  - Youth between the ages of 11 and 12 years (U-12, U-13) may engage in heading training for 'a maximum of 30 min per week with no more than 15–20 headers per player, per week
  - No restrictions for 14 and over

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EDUCATIONAL PROGRAMS

- Little evidence to say that educational programs such as Heads Up reduce concussion risk
- It may lead to better reporting though and therefore decreased incidence of second impact syndrome and long term problems

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NECK STRENGTH

- Movement of brain in skull may be dependent on neck musculature
- Can improvements in neck strength reduce concussion?
- Collins et al, Journal of Primary Prevention 2014
  - Studied 6,704 high school athletes in soccer, basketball, and lacrosse
  - Smaller mean neck circumference, smaller mean neck to head circumference ratio, and weaker mean overall neck strength were significantly associated with concussion
  - For every 1 pound increase in neck strength, odds of a concussion decreased by 5%

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LYSTEDT LAWS

- First enacted in Washington in 2009
- Now all 50 states have some sort of concussion legislation
  - Laws require education, consent of parents prior to season, immediate removal from game if diagnosed, clearance from medical professional before return to play
- Study done in Washington comparing year before Lystedt Law against 2 years following showed an increase in number of concussions diagnosed and time missed
  - Felt to be a result of better reporting and adherence

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LEGISLATION?

- Illinois has proposed the “Dave Duerson Act” to prevent children under 12 from playing tackle football-introduced January 2018

HB4341

LRB100 17054 AXK 32205 b

100TH GENERAL ASSEMBLY

State of Illinois

2017 and 2018

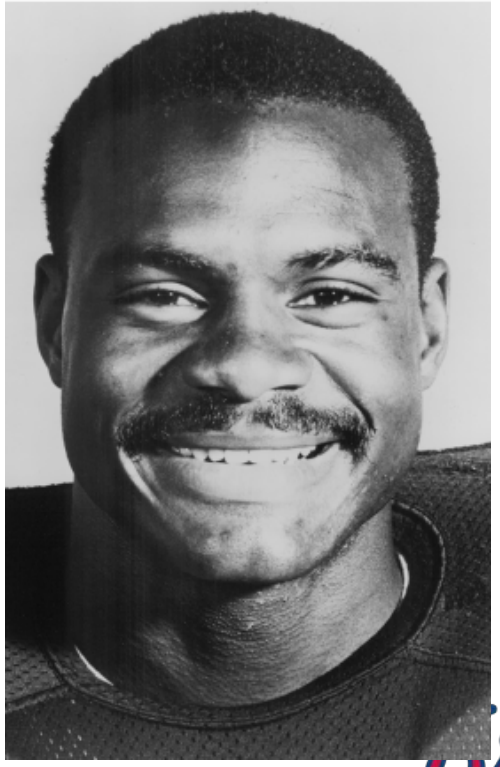
HB4341

by Rep. Carol Sente

SYNOPSIS AS INTRODUCED:

New Act

Creates the CTE Prevention Act. Defines terms. Provides that a child under the age of 12 may not participate in tackle football offered by an organized youth sports program. Provides that a child under the age of 12 may participate in all other athletic activities offered by an organized youth sports program.



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RULE CHANGES

- 2019 study in *Pediatrics* surveyed 1025 parents in US
  - 61% support age restrictions on tackling in football
  - Additional 20% said maybe they would support restrictions
  - Only 15% said they would not support restrictions

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SO WHAT AGE SHOULD KIDS START?

- Concussion Legacy Foundation is promoting 14 years old for contact football "Don't Hit Kids"

Youth tackle football will be considered unthinkable 50 years from now

I would know — I'm a CTE expert and former college football player.

By Chris Nowinski | Updated Apr 3, 2019, 9:35am EDT

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THE END

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