Concussions, not repetitive head impacts, are linked to **white matter connectivity differences.** More lifetime concussions are associated with **lower brain network efficiency** and **connectivity strength.**

Structural Connectivity Alterations are Associated with Greater Concussion History in Former Collegiate Football Players at Midlife

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Introduction

- Concussions and head impact exposure from contact sport participation may increase risk for neurobehavioral disorders[1] and neurodegenerative diseases.[2]
- Physiological changes following concussion and head impact exposure may occur without symptoms or persist *beyond* symptom resolution.[3-4]
- Understanding how concussions and head impact exposure affect brain structure *before* chronic conditions develop is essential for early risk detection.

Purpose

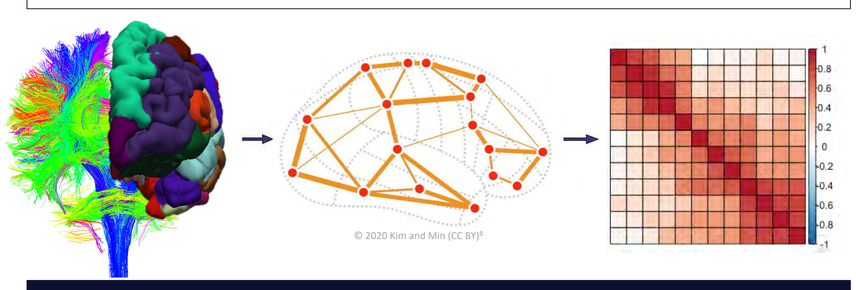
To assess structural brain network connectivity differences associated with concussion history and head impacts

Methods

- **Design:** Cross-Sectional
- **Participants:** Collegiate American football players ~15-years post-participation (n=36; age=37.8±1.4yrs)
- **Risk Factors:** Self-reported concussion history and Head Impact Exposure Estimate (HIEE)[5]
- **Outcome Measures:** Graph theorical measures computed from diffusion-weighted imaging tractography

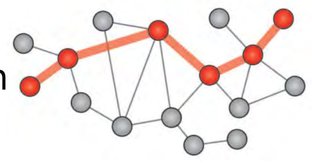
Brain Network Construction

Connectivity matrices were created using streamline-density weighted probabilistic tractography (probtrackX)[6] seeded with 82 cortical and subcortical regions from the Deskian-Killany atlas. Graph theory outcome measures were computed on matrices with brainGraph.[7]



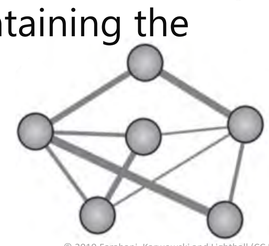
Graph Theory Measures

Global Efficiency: Average inverse shortest path length for all nodes



Local Efficiency: : Average global efficiency of subgraphs for each node containing the neighbors of that node

Connectivity Strength: Average sum of link weights connecting nodes



Statistics

Multiple linear regression models with stepwise selection were fit to estimate associations of structural network outcomes using concussion history, HIEE, and age.

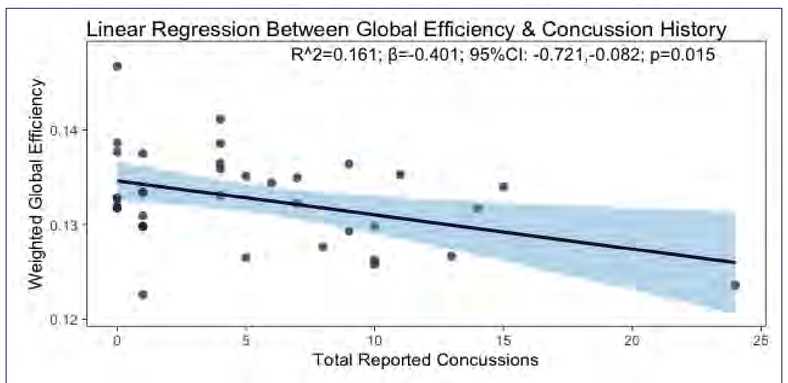
Model R^2, standardized parameter estimates (β), and 95% confidence intervals for significant terms ($\alpha \leq 0.05$) are reported.

Significant regression models are plotted.

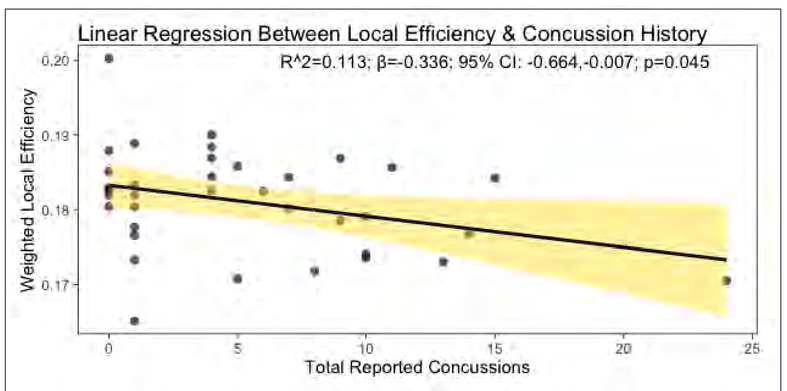
Results and Discussion

Concussion history ranged from 0-24 (mean=5.3±5.5; median=4 IQR=8).

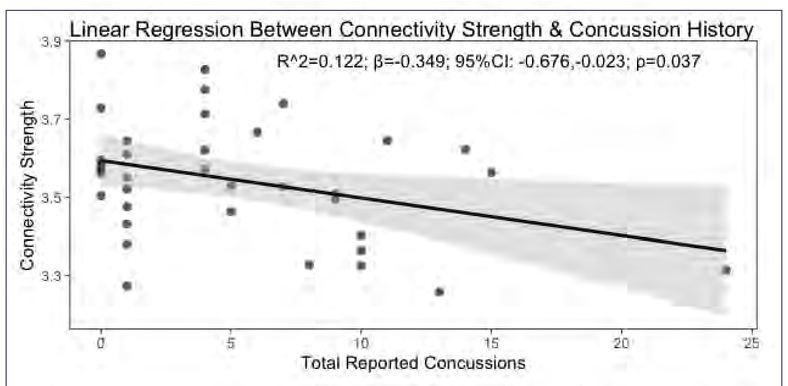
HIEE and age were not associated with graph theoretical outcomes and excluded from final models.



Lower global efficiency suggests overall information transfer is more difficult.



Lower local efficiency reflects decreased fault tolerance within a network system.



Lower connectivity strength indicates less dense white matter connections along existing paths.

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Acknowledgements:

This work was funded by the National Collegiate Athletic Association without their oversight of the study design, data analyses, preparation, or reporting.

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References