THE EFFECT OF CONCUSSION HISTORY ON LOWER EXTREMITY INJURY RISK IN HIGH SCHOOL AND COLLEGIATE ATHLETES: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction

- There is an overall concussion rate of 4.17 per 10,000 athletic exposures in high school athletics.[1]
- Collegiate athletes possess a higher rate of concussion than high school athletes.[2]
- Often athletes are cleared to return to play (RTP) but still have decreased sensory control.[3]
- Athletes who are still experiencing deficits and impairments after being cleared to return to play may be at increased risk of lower extremity injury.

Purpose

To conduct a systematic review and meta-analysis of studies examining risk of lower extremity musculoskeletal injury following a concussion in high school and collegiate athletes.

Methods

- A literature search was performed with the following databases: PubMed, CINAHL, MEDLINE, SPORTDiscus
- The following search terms were used: "concussion," "brain injury," AND "lower extremity."
- Studies were included if they:
  - -Possessed a study population consisting of high school or college athletes that experienced a concussion and subsequent lower extremity injury
  - -Were published between January 2000 and November 2019
  - -Calculated an odds ratio or other form of a probability or risk calculation.
- Methodological quality of included studies was performed with a modified Downs and Black Checklist.[4]
- A random-effects meta-analysis produced a pooled relative risk calculation and 95% confidence interval (CI) that represented the overall results.
- Relative risk was calculated with the following formula: [(number of individuals with a history of concussion who suffered a lower extremity injury/total number of individuals with a history of concussion)/(number of individuals who suffered a lower extremity injury without a history of a concussion/total number of individuals without a history of concussion)].

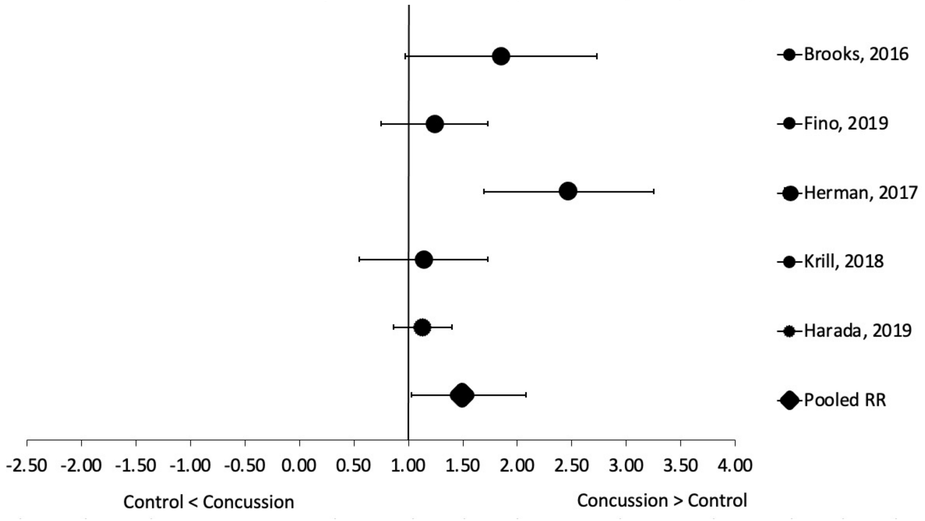
Results

Search and Quality Results:

Authors	Participant Characteristics	Results	Modified Downs and Black Score
Brooks et al.,[5] 2016	75 CONC, 182 CON	Athletes with a history of a concussion were 2.48 times more likely to sustain a LE MSK injury.	17/19
Fino et al.,[6] 2019	110 CONC, 110 CON	Athletes with a history of a concussion had a 67% greater relative risk of LE injury.	18/19
Gilbert et al.,[7] 2016	335 CONC	There was a positive association between concussion history and LE injury.	11/19
Harada et al.,[8] 2019	96 CONC, 48 CON	Athletes with a history of multiple concussions possessed significantly greater odds of suffering a LE injury than single concussions and matched controls.	16/19
Herman et al.,[9] 2017	73 CONC, 148 CON	Athletes with a history of a concussion had a 3.39 times greater risk of LE injury.	15/19
Houston et al.,[10] 2018	468 CONC	Athletes with a history of concussion were more likely to report a history of a LE injury.	16/19
Lynall et al.,[11] 2017	18,216 CONC	The odds of suffering a LE injury increased by 34% with a history of concussion.	14/19
Lynall et al.,[12] 2015	44 CONC, 58 CON	College athletes are almost two times more likely to suffer a LE MSK injury following a concussion.	17/19
Krill et al.,[13] 2018	12 CONC, 25 CON	There was an overall increase in LE injury rate in those with a history of a concussion compared to those without.	15/19

CONC = individuals with a history of a concussion; CON = controls; LE = lower extremity; MSK = musculoskeletal

Meta-Analysis Results: Athletes who sustained a concussion had greater risk of lower extremity musculoskeletal injury compared to athletes without a history of a concussion (RR = 1.49[1.04, 2.14]).



High heterogeneity was detected with an I^2 value of 66.8%. Egger's test (bias = 0.72[-8.31, 9.76]; P = 0.82) indicated that publication bias did not influence the results of this analysis.

Discussion

- High school and college athletes who suffered a concussion possessed a 49% greater risk of sustaining a lower extremity musculoskeletal injury than those who did not have a history of a concussion.
- Even after concussion symptoms resolve, there is a possibility that neuromuscular impairments are still present that may lead to increased injury risk.
- These impairments may be a cause for this increased injury risk and further research is needed to confirm this assertion.
- Current RTP assessments may not be sensitive enough to detect lingering impairments in concussed athletes.

Future Directions: Research should look for new ways to evaluate athletes during the RTP concussion protocol to ensure that they are fully prepared to return to their sport and are not experiencing subtle or lingering deficits when returning to participation.

Conclusions

Lower extremity injury risk is potentially increased in high school and college athletes following a concussion compared to those without a history of a concussion. Further research is needed to investigate the mechanism behind this increased risk. Research can look to investigate how long these deficits last and if there is any treatment that could help reduce them.

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