

BACKGROUND

- American Football has the highest occurrence (47.3%) of sport-related concussion among collegiate sports and may lead to long-term neurocognitive degeneration^{1,2}
- Repetitive head impact exposure (RHIE) is greatest in linebackers, offensive linemen, and defensive linemen with 3 times more impacts sustained during practices than games^{3,4}
- RHIE is estimated using the Head Impact Telemetry (HIT) System at UNC, while physical load burden is estimated using the Catapult Vector GPS monitoring system
- The relationship between physical load burden and RHIE among positions and session types is unknown.

RESEARCH AIMS

Overall Goal

- Determine if physical load burden is associated with RHIE among Division I college football players
- Examine gameplay characteristics, including session type (practices vs. games) and player position (linemen vs. non-linemen)

Specific Aim 1

- Determine if physical load burden predicts RHIE during gameplay in Division-I college football players
- Hypothesis 1:** Higher physical load burden will be associated with an increased head impact burden during gameplay in college football athletes

Specific Aim 2

- Determine the effect of session type and player position on physical load burden and RHIE
- Hypothesis 2:** Offensive and defensive linemen (BIGS) endure greater head impact burden at both practices and games compared to linebackers and tight ends (BIG SKILL), and defensive backs, receivers, and running backs (SKILL)

METHODS

Participants

- Prospective cohort study of 41 Division I college football players over 4 seasons (Table 1)

Table 1. Participant Demographics (Mean \pm SD, n=41).

Position Groups	Height (cm)	Mass (kg)
BIGS (n=15)	194.9 \pm 4.4	136.9 \pm 7.7
BIG SKILL (n=11)	189.3 \pm 2.5	109.2 \pm 6.4
SKILL (n=15)	181.7 \pm 4.9	86.8 \pm 4.4

Measures & Instrumentation

- Head Impact Telemetry (HIT) System** utilizes an accelerometer array embedded into a player's helmet (see Figure below) to estimate RHIE
- Catapult Vector GPS Monitoring System** estimates **total player load**, a measurement of physical load burden, via small units embedded into halters worn by each player (see Figure below)



Procedures

- Participants were assigned both HIT System and Catapult units as part of their regular participation
- Quarterbacks, punters and kickers, in addition to all limited contact practice sessions were excluded

Statistical Analyses

- In Aim 1, PROC MIXED was conducted to determine if physical load predicts RHIE
- In Aim 2, PROC REG was conducted to examine the effect of session type and position group on physical load burden and RHIE

Independent variables:

- Position group (BIG, BIG SKILL, SKILL), session type (practices vs. games), and total player load

Dependent variables:

- RHIE

RESULTS

Aim 1

- Total player load significantly predicted in-session RHIE ($F_{1,1688}=15.99$; $p<0.0001$)
- Season-long cumulative player load significantly predicted season-long RHIE ($R^2=0.31$; $F_{1,39}=18.79$; $p<0.0001$)

Aim 2

- SKILL players exhibit significantly greater player load than BIGS ($t_{1689}=-2.45$; $p=0.038$)
- Competition load is significantly greater than player load in practices ($t_{1687}=20.63$; $p<0.001$)
- Position had no significant effect on in-session RHIE ($F_{2,1689}=1.07$; $p=0.343$)
- Competition RHIE is significantly greater than practice RHIE ($t_{1687}=5.97$; $p<0.001$)

Future Directions

- Consider alternate metrics of player physical load including distance traveled and player load rate
- Analyze the effect of session type and position group on season-long RHIE

CONCLUSION

- Several relationships exist between in-session player load and RHIE, however, there were no in-session differences among position groups
- Demonstrated a need to further investigate the effects of characteristics of gameplay on RHIE
- Tracking player load may be a potential method to infer RHIE and give sports medicine staff an alternate method to monitor RHIE in their athletes across a competitive season

REFERENCES

- Marar, M., McIlvain, N. M., Fields, S. K., & Comstock, R. D. (2012). Epidemiology of Concussions Among United States High School Athletes in 20 Sports. *The American Journal of Sports Medicine*, 40(4), 747–755.
- Mez, J., Daneshvar, D. H., Kiernan, P. T., McKee, A. C., et al. (2017). Clinicopathological Evaluation of Chronic Traumatic Encephalopathy in Players of American Football. *JAMA*, 318(4), 360–370.
- Mihalik, J. P., Bell, D. R., Marshall, S. W., & Guskiewicz, K. M. (2007). Measurement of head impacts in collegiate football players: an investigation of positional and event-type differences. *Neurosurgery*, 61(6), 1229–1235.
- Stemper, B. D., Shah, A. S., Mihalik, J. P., Harezlak, J., Rowson, S., Duma, et al. (2020). Head Impact Exposure in College Football after a Reduction in Preseason Practices. *Medicine and science in sports and exercise*, 52(7), 1629–1638.

