

CONSISTENCY IN HEAD IMPACT EXPOSURE FROM YEAR TO YEAR AMONG HIGH SCHOOL AND DIVISION III COLLEGE FOOTBALL ATHLETES

Nicholas Stellpflug,^{1,3} Alok Shah,^{1,3} Alexa Wild,¹ Rachel Chiariello,^{1,3}
Michael McCrea,^{1,3} Brian D. Stemper^{1,2,3}

1: Department of Neurosurgery, Medical College of Wisconsin (MCW)

2: Joint Department of Biomedical Engineering, Marquette University and MCW

3: Clement J. Zablocki Veterans Affairs Medical Center
Milwaukee, WI

ABSTRACT

Identification of repetitive head impact exposure (RHIE) as a possible modulator for concussion [1] or clinical changes in non-concussed athletes [2] in amateur contact sports may have significant clinical and coaching implications. Athletes that sustain consistently elevated levels of RHIE may be at higher risk to sustain a concussion, and coaching intervention to change playing technique may be able to reduce the level of exposure. High levels of RHIE may carry over from year-to-year and have a cumulative effect of increased concussion susceptibility [3], and athletes with elevated concussion risk due to high levels of exposure during one season may be targeted for coaching intervention in subsequent seasons. To date, the level of annual consistency in RHIE for individual athletes has not been reported and factors affecting annual consistency have not been outlined. In this study, athletes from high school and NCAA Division III football teams were recruited to participate during the 2015, 2016, and 2017 football seasons. All enrolled athletes wore a Head Impact Telemetry System (HIT System) (Simbex, Lebanon, NH) sensor during games, scrimmages and contact practices throughout the season. Data were collected throughout the 2015, 2016, and 2017 football seasons. Position group, season, and level (high school versus college) were used as grouping variables for the data. The six position groups were defensive backs, defensive linemen, linebackers, offensive linemen, quarterbacks and wide receivers, and running backs. Median peak linear acceleration (PLA), median peak rotational acceleration (PRA), number of recorded impacts per season, and number of recorded impacts per day were calculated for all athletes as the primary exposure metrics. The values gathered for the different exposure metrics were consistent with previously published studies. All four metrics were analyzed using a repeated measures analysis of variance (ANOVA) to assess consistency between position group, season, and level. All four metrics were shown to be significantly different by position group ($p < 0.05$). Impacts per day was also significantly different by season, and median rotational acceleration was also significantly different by level. Total impacts per season was not significantly different from season to season and demonstrated a strong season-to-season correlation according to a linear regression analysis ($R^2 = 0.55$). Impacts per day demonstrated the strongest season-to-season correlation ($R^2 = 0.64$). Position group proved to be a significant factor in determining the number and magnitude of impacts, which supports the claim that athletes in different positions have a different exposure risk and is consistent with results published by Crisco and colleagues [4]. Although the average impacts per day were significantly different across the three seasons, season was not a significant factor for the other three exposure metrics, suggesting that an athlete's playing style is consistent.

Keywords: concussion, head impact exposure, American football, head impact measurement, biomechanics, injury

INTRODUCTION

Identification of repetitive head impact exposure (RHIE) as a possible modulator for concussion [1] or clinical changes in non-concussed athletes [2] in amateur contact sports may have significant clinical and coaching implications. For example, athletes that sustain consistently elevated levels of RHIE may be at higher risk to sustain a concussion and coaching intervention to change playing technique may be able to reduce the level of exposure. Additionally, rule changes by governing bodies to limit contact exposure in practice may also reduce exposure. For example, the NCAA acted in 2017 to eliminate two-a-day practices