

COMPARISON OF DIFFERENT MEASURES FOR HEAD IMPACT EXPOSURE IN CONCUSSED AMATEUR FOOTBALL ATHLETES

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ABSTRACT

Prior studies from our group and others identified a possible correlation between repetitive head impact exposure (RHIE) and concussion in contact sport athletes. However, our prior work focused on the specific comparison of Risk Weighted Exposure (RWE) between concussed athletes and controls matched by team and playing position. This analysis focused on two objectives: to identify whether other measures of RHIE produced similar results to our prior analysis of RWE and to determine whether RHIE in concussed athletes was elevated relative to the entire non-concussed population. Results demonstrated that athletes that were identified to have high RHIE according to RWE also had high exposure relative to cumulative HITsp, cumulative HIC15, and cumulative GSI. Furthermore, when compared to the entire non-concussed population, a subset of athletes were identified that had very high RHIE throughout the season prior to the date of the concussion. These findings add further support to the theory that RHIE may contribute to the eventual onset of concussion in the absence of a high magnitude head impact. Identification of RHIE as a concussion mechanism has significant clinical relevance in that ongoing monitoring of head impact exposure in contact sport athletes may identify a subset of athletes at higher risk of concussion. Coaching or athletic training staff intervention could then conceivably reduce exposure and the associated concussion risk.

INTRODUCTION

The biomechanical mechanism for concussion has long been understood to include a single head impact resulting in high rate head rotational acceleration [1]. This mechanism is consistent with injury biomechanics for motor vehicle environments [2,3], falls [4], and in contact sports [5,6], with each of those environments representing a primary share of all concussions in the civilian population [7]. However, participation in contact sports presents a unique environment from an injury biomechanics perspective. Contact sport athletes are often exposed to repetitive head impacts during practices, scrimmages, and games due to impacts with the ball, as in soccer headers, other athletes, or the ground. The frequency, number, and severity of head impacts varies between sports, where athletes may sustain over 2,000 head impacts over a single high school football season [8]. While the vast majority of those head impacts are below the threshold for injury, exposure to a significant number of head impacts naturally increases the likelihood that an athlete will eventually sustain a high magnitude concussive impact and may predispose an athlete to a lower threshold for injury associated with cumulative changes in the brain from an increasing number of head impacts.

Our group recently identified an association between repetitive head impact exposure and concussion in some college football athletes that may implicate repeated subconcussive head impacts over the course of a football season as a unique mechanism for concussion [9]. However, there is currently no consensus on the most accurate method to quantify the cumulative effects of