Youth football: How young athletes are exposed to high-magnitude head impacts

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The majority of football players in the US (70%) are elementary and middle school students. These young athletes enthusiastically put on their gear, learn strategy, acquire skills, and participate in games with their

peers. Unfortunately, like their professional counterparts these athletes sometimes get injured. Fairly often they sustain head impacts during tackling and blocking maneuvers. Exposure to head impacts in American football has become a national concern: neurocognitive and brain changes can occur from repeated head impacts, even when no evidence of concussion is found.

To gain a greater understanding of head impacts, researchers from the Department of Biomedical Engineering and Mechanics at Virginia Tech examined exposure to these blows in young athletes, 9 to 12 years of age, during football games and practice drills. Their goal was to determine under what circumstances high-magnitude head impacts (linear or rotational accelerations measuring more than 40g, which are more likely to cause concussions than lower-magnitude impacts) occur and how representative practice activities are of game activities with respect to these head impacts. This type of information can help coaches and league officials make informed decisions in structuring both practices and games to reduce risks in these young athletes.

The researchers focused on head impact exposures in 45 athletes from two youth football teams: Juniors (27 players, mean age 9.9 years) and Seniors (18 players, mean age 11.9 years). The researchers collected biomechanical data and videos during 14 games and 55 practice drills. All youths wore helmets equipped with accelerometer arrays that measure head impacts in terms of acceleration. Each time the arrays recorded a head impact greater than 14.4g, data collection was automatically triggered and the impact data were transmitted wirelessly to a sideline computer. Videos of games and practice activities were recorded to verify the occurrence of a high-magnitude head impact, provide evidence of circumstances surrounding the impact, and record the duration of the activity in which the high-magnitude impact occurred.

To define specific circumstances in which high-magnitude head impacts occur, the researchers characterized these impacts based on 1) the position of the team member who received the head impact, 2) the place in the field where the impact occurred, 3) the cause of the impact, and 4) whether the impact occurred during a game or practice drill.

The accelerometer arrays recorded 7590 head impacts, of which 571 (8%) were of high magnitude. Players in "Back" positions (quarterback, running back, and linebacker positions) sustained more head impacts than players in other positions. These players were more likely to experience high-magnitude head impacts during a tackling activity; players in offensive and defensive line positions were more likely to sustain head impacts during a blocking activity.

Not surprisingly, the more playing time an athlete had, the greater chance that particular youth would sustain a high-magnitude head impact. During games, high-magnitude head impacts occurred more often in the open field—where players in Back positions were often found—than in the line of scrimmage.

The authors found a higher rate of high-magnitude impacts during games than during practice sessions for both teams. Nevertheless, practice sessions occur more frequently than games, and thus subject players to more opportunities to receive head impacts. Twice as many high-magnitude head impacts occurred in Senior team members than in Junior team players. The researchers state that differences in age and weight alone cannot explain this difference. Video data indicated that practice intensity or coaching style may be another factor in this difference. This factor could be a focus of future studies.

When asked about the study, senior author Steven Rowson, PhD, said, "This study builds on a growing body of research on head impact exposure in youth football. These studies are important because they

allow you to make data-driven decisions when structuring changes to practice in football to reduce exposure to head impact. Purposeful reduction of exposure means less opportunity for concussion and a reduction in any potential consequences of cumulative exposure."

More information: Campolettano ET, Gellner RA, Rowson S. High-magnitude head impact exposure in youth football. *Journal of Neurosurgery: Pediatrics*, published online, ahead of print, October 17, 2017. DOI: 10.3171/2017.5.PEDS17185