

Quantitative Analysis of Head Impacts in Collegiate Women's Flag Football

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Abstract

Flag football is a non-contact alternative to tackle football that is growing in popularity. Parents and participants choose flag football as a safer alternative to tackle football, but there has been limited research to quantify the risk in flag football. In this study, the head impact rate is calculated for women's collegiate NAIA flag football by reviewing video of 7 games from 5 different teams including 684 plays. The head impact rate in this cohort was measured to be 5.8 impacts per 1,000 player plays. This is 67% higher than the head impact rate previously reported for high school flag football. Consistent with previous flag football head impact research, the ground was the most common head impact source accounting for 58.9% of the 56 impacts recorded. The 5.8 head impacts per 1,000 player plays would result in a typical NAIA flag football player experiencing 0.56 head impacts per game or 12.9 head impacts in games during a season. This head impact rate per game was less than head impact rates reported for NFL players by position. The head impact rate in NAIA Flag Football was also found to be lower than the head impact rate in collegiate women's soccer (1.89). These data indicate that flag football does have a lower head impact rate than tackle football and is comparable to other non-contact sports. Further research should evaluate the severity of these impacts, track injury data, and evaluate the efficacy of protective headgear.

Introduction

Flag football is a growing sport in the United States and around the world. Parents and athletes perceive flag football as a safe alternative to tackle football. Instead of tackling a player to end a play, defenders pull a flag from a flag belt. Another difference in flag football is the lack of traditional blocking. In some flag leagues offensive players can obstruct another player (screen) but cannot use physical force to block a defender. Other leagues prevent both screening and blocking completely. In either case, the elimination of blocking eliminates the need for blocking positions. The typical flag game is played 7on7 with the elimination of blocking linemen. These changes to the game seem to limit the amount of contact and the number of head impacts in the sport, creating a sport with the excitement of football without the perceived risk of head impacts.

These changes eliminate the physical nature of tackle football. It makes flag football a speed, agility, and skill game, which further broadens the appeal of the sport. Many girls and women play flag football both in co-ed competitions and in female only competitions. There are leagues and competitions from youth to professional. Currently there is collegiate women's flag football, but no men's version. The National Association of Intercollegiate Athletics (NAIA) oversees women's flag football at 23 colleges across the country.

Previous research has evaluated youth and high school head impacts in flag football.¹ They found that high schooler flag football players experience a head impact 3.6 times every 1,000 plays.¹ They also found that the ground was the most common impact source, accounting for 70% of all head impacts.¹ The researchers also noted there were no recorded head to head impacts. Most importantly, this research found that as the age level increased, the number of head impacts increased. These data led us

to quantify the head impact rate in NAIA Flag Football. Since NAIA is a competition level above high school, we hypothesized that the head impact rate would be higher than previously reported for high school flag football.

Methods

The frequency of head impacts in NAIA Flag Football games was recorded by reviewing existing team videos through their Hudl account. The videos were recorded by each team at their home facility using existing equipment. The video review was conducted by the author according to methods that have been previously described by Lessley et al. that were employed to characterize head impacts by position in the NFL.² The video was typically a sideline view. There were no instances of multiple camera angles for the same portion of the play or game. The video was parsed into individual plays by team personnel prior to review. Each play was reviewed to determine if any head impact occurred or appeared to occur. Each play that had a noted head impact or apparent head impact was reviewed further. Additional data was collected for each impact including the player team, player position, impact partner, impact source, player activity, and impact partner activity. The player team is self-explanatory, but the other data fields will be explained in detail.

The player position includes quarterback (QB), running back (RB), wide receiver (WR), and center (C) on offense. These are consistent with tackle football positions with the exception of the center, who is also an eligible receiver after snapping the ball. The defensive positions include rusher (R), defensive back (DB), and line backer (LB). The R is typically 1 player who rushes the QB to limit the time to throw. They are typically screened by the C and/or the RB. The other positions are consistent with tackle football.

The impact partner is the person closest to the player with a head impact. Some times these players impact each other directly. However, even if they do not impact each other directly, an impact partner is included. For example, if a player has a head to ground impact while pulling the flag of another player, that player will be recorded as the impact partner. These data are collected to provide context to the head impact scenario.

The impact source is what the head makes contact with during the impact. There are a few items that a player can impact with their head: the ground, another player, or the ball. In this study, an impact with another player is split into head and body. Meaning a head to head impact is one type of impact and a head to any other body region of another player is simply head to body.

The player activity and impact partner activity categorize what the players are doing when the head impact occurs. The activities included in this study are flag pulling, jump ball, running with the ball, Screening, screened, and route running. Flag pulling is the flag football equivalent of tackling. A jump ball includes both offensive and defensive players who are vying for a pass. Players do not need to jump to be categorized as a jump ball. Any player vying for a pass, is in a jump ball, even if their intent is to knock it down. Running with the ball includes QB's scrambling or rushing, RB's running, and WR running after a catch. Screening and screened are the offensive and defensive activities around the line of scrimmage that replace blocking. An offensive can obstruct the path of a defensive player, but cannot use their hands to push them. Finally, route running is when a receiver is moving prior to the ball being passed.

Results

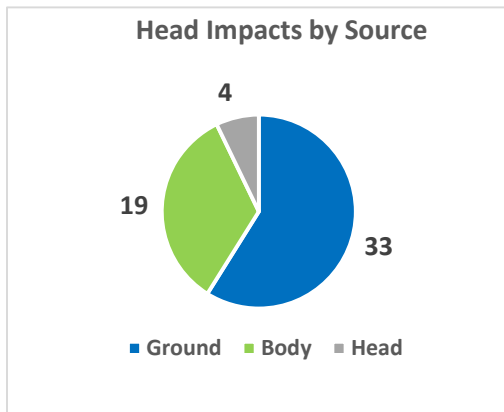
The videos reviewed include 7 games and 684 plays between 5 different NAIA teams. A total of 51 of the 684 plays had at least one head impact (7.5%). One play had 2 head impacts and two plays had 3 head impacts each. This equates to a head impact rate of 5.8 per 1,000 plays (Table 1). When the head impacts were categorized by impact source, ground impacts were the most common (59%), followed by body (34%), and head to head impacts (7%). Finally, the player activity when the head impact occurred data was tabulated. Flag pulling was the most common player activity during a head impact (43%). The next most common activity for players during a head impact was a jump ball (30%), followed by running with the ball (18%). Screening and being screened accounted for 5% of the head impacts recorded (Table 2).

Impacts	Count
0	633
1	48
2	1
3	2

Table 1 - Summation of plays with 0,1,2 & 3 head impacts per play.

Discussion

These data provide a preliminary quantification of the head impact exposure rate in NAIA Flag Football. The head impact rate of 5.8 impacts per 1,000 player plays is 67% higher than the head impact rate for high school flag football reported by Jadischke et al. proving our hypothesis that the head impact rate would increase as the level of competition increased. Future research should conduct a similar evaluation of professional flag football game video to determine the head impact rate at the professional level.



Activity	Count
Flag Pulling	25
Jump Ball	17
Running w ball	10
Screening/Screened	3
Route Running	1

Table 2 - Summation of head impacts by player activity.

The elimination of blocking in flag football is one of the rules developed to reduce head impacts. These data suggest there is still some risk in screening, but that it accounts for a small amount of the head impacts (5%) recorded in this study. The effectiveness of eliminating blocking can further be evaluated by measuring the percent of head impacts that linemen generate for a collegiate tackle football team. According to Mihalik et al. offensive and defensive linemen accounted for 57.5% of all head impacts recorded for a collegiate tackle football team.³ Flag football has nearly eliminated these head impacts by

eliminating blocking and blocking positions. This rule or game design is achieving the goal of reducing the number of head impacts in the sport compared to tackle. However, to better understand the head impact exposure rate comparison between flag and tackle football the head impact rate of skill positions in tackle football is the best comparison to flag football players.

In an article by Karton et al. they determined the number of impacts NFL players experience per game. In this study, WR were found to have an average of 3.3 head impacts per game and DB's had an average of 3.6 head impacts per game.⁴ The position with the lowest head impacts per game were QB's with 2.3. In the 7 games in this study, there were an average of 97 plays/game. Using this data we can convert the head impact rate per 1000 plays (5.8), to a risk per game of 0.56. This is much lower than any of the reported head impacts per game averages for NFL players by position. However, there are more plays in an average NFL game, 153 compared to the 97 in the current NAIA games evaluated. So the rate of head impacts for a flag football player in a 153 play game would be 0.89. This is still lower than anything reported by Karton et al. It is important to note that these calculations assume that a player will play all of the plays in a game. This is not the case, especially in the NFL with offensive, defensive, and special teams players. It is expected that the head impact rate per play for NFL players would further increase due to players not participating in all plays of a game. These data and comparisons demonstrate that flag football has less head impacts than tackle football.

Another interesting question is the comparison between head impact rates in flag football and other non-contact sports. A study by Press and Rowson of collegiate women's soccer athletes found a head impact rate of 1.86 per game or practice.⁵ Soccer includes the intentional heading of the ball, so it may not be a surprise that this value is higher than flag football. The same study categorized the head impacts by activity and found that 90% of head impacts were from heading the ball.⁵ Therefore, the unintentional head impact rate in women's NCAA soccer is 0.19 head impacts per game or practice. This is less than half the head impact rate measured in this study in flag football. This provides some perspective on the risk of unintentional head impacts in collegiate women's flag football compared to collegiate women's soccer. The intentional headers in soccer, however, should not be completely ignored. Researchers continue to try to understand the short-term and long-term effects these sub-concussive impacts have on athletes if any.

There were an average of 8 (± 2.7) head impacts per NAIA game included in this study. It is unknown if any of the head impacts observed in this study resulted in injury including lacerations, bruising, or concussions. Future research should pair video review with injury data to understand the injury risk in addition to the exposure rate. The data collected here can provide an insight into the head impact exposure rate of women's collegiate flag football athletes. There is a 0.56 rate of head impact per game, and the regular season includes 16 games. There are also post-season games including conference championships and an NAIA invitational tournament, which can account for another 7 games. A complete season and maximum post season would be 23 games. This would lead to an estimate of 12.9 head impacts for a player per NAIA flag season in games. This study did not evaluate any practice video, so it is unclear what the head impact risk is in flag football practices, and how that contributes to a complete season exposure risk. Another study using instrumented mouthguards found that the average head impacts experience by a player aged 6-14 during a season of flag football was 11.57.⁶ This risk of head impacts is leading some NAIA teams to purchase protective headgear for all of their players.

Currently there are no certification standards for flag football headgear. Virginia Tech has a test methodology and a 5-star rating system for flag headgear. The system ranks the headgear based on how much it lowers the head kinematics of head to head impacts at 4m/s compared to the same impact conditions without head protection. Some leagues and organizations have enacted rules requiring headgear in 7on7 and flag football. Typically these rules require participants to wear flag football headgear rated 4 or 5 stars in the Virginia Tech test protocol. The Virginia Tech 5-star rating is a reasonable starting point for evaluating flag football headgear. However, given the impact source defined in this study and others, head to head impacts may not be the best test condition for evaluating flag football headgear. Specifically, head to ground has been found to be the most common head impact source, followed by head to body. Other testing organizations have created a turf simulant for impact testing. Additional research should include testing existing flag football headgear in simulated head to ground impacts, which would better match the impacts experienced in the field by players.

There was insufficient data to compare exposure by position in this study. Additional research should compare the head impact rate by position in flag football and by activity to identify any areas of rule changes that could further reduce the rate of head impacts in the sport. As flag football grows in popularity, the need for research in this area will grow as well. This is especially true considering flag football is a coed sport. Other coed sports like soccer have shown females to have a higher concussion rate than males. This suggests researchers should be proactive in flag football as another non-contact coed sport. This study only evaluated the exposure rate. Quantifying the head impact severity will also be a critical area of research in the future.

References

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