

POTENTIAL RISK FACTORS FOR CONCUSSION IN VOLLEYBALL; HIGH VELOCITY ATTACKS AND HEAD EXPOSURES



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BACKGROUND

- The primary mechanism of concussion is any linear or rotational biomechanical force that causes the brain tissue to deform as a response.¹
- The leading causes of concussions in all people are football, soccer, and motor vehicle accidents.¹
- There are 3.8 million concussions a year in the United States from sports and physical activity.²
- In 2016, Bryan et al. estimated that each year between 1.1 and 1.9 million sport and recreation-related concussions occur in children 18 and younger.²
- In Volleyball, the most common injured areas are the knee, shoulder, ankle, lower back, and head.³
- Concussion rates in high school volleyball are 4.8% and in collegiate volleyball are 5% and are more frequent in competition rather than practice.³
- The most common mechanism of concussion is a collision with the ball.⁴
- The average velocity of a women's elite college athlete kill can be between 50 to 70 mph.⁴
- The potential reason for the ball creating concussions is due to the high velocity in which the ball is traveling during attempted kills used to score points.⁴

PURPOSE

To determine player concussion risk, the purpose of this study was to analyze the opportunities created during a match that could result in a concussion.

METHODS

- Participants:
 - 2016: Oct. 14-16th, 21st-23rd and 2022: Oct 14th, 16th, 21st, and 23rd
 - 48 Mid-season ACC volleyball matches, 20 in 2016 and 28 in 2022
- Data collection:
 - VolleyMetrics, video software dating back to 2016, filtering out attack events
 - Games were coded for high-velocity attacks, number of blockers, heads over the net, players hit in the head, and position of players hit
 - Six talliers total, each paired an equal amount of times
 - Every game was tallied by 2 different talliers, all talliers coded 16 games
- Data Analysis
 - The number of high-velocity attacks and heads over the net were represented by a percentage per game.
 - A Kruskal Wallis H Test was conducted to find if these were different between 2016 and 2022 through SPSS Version 29.
 - The number of times the ball hit a player's head in the front and back row, and the total number of times, were compared by converting the number to the occurrence per every 1000 exposures.

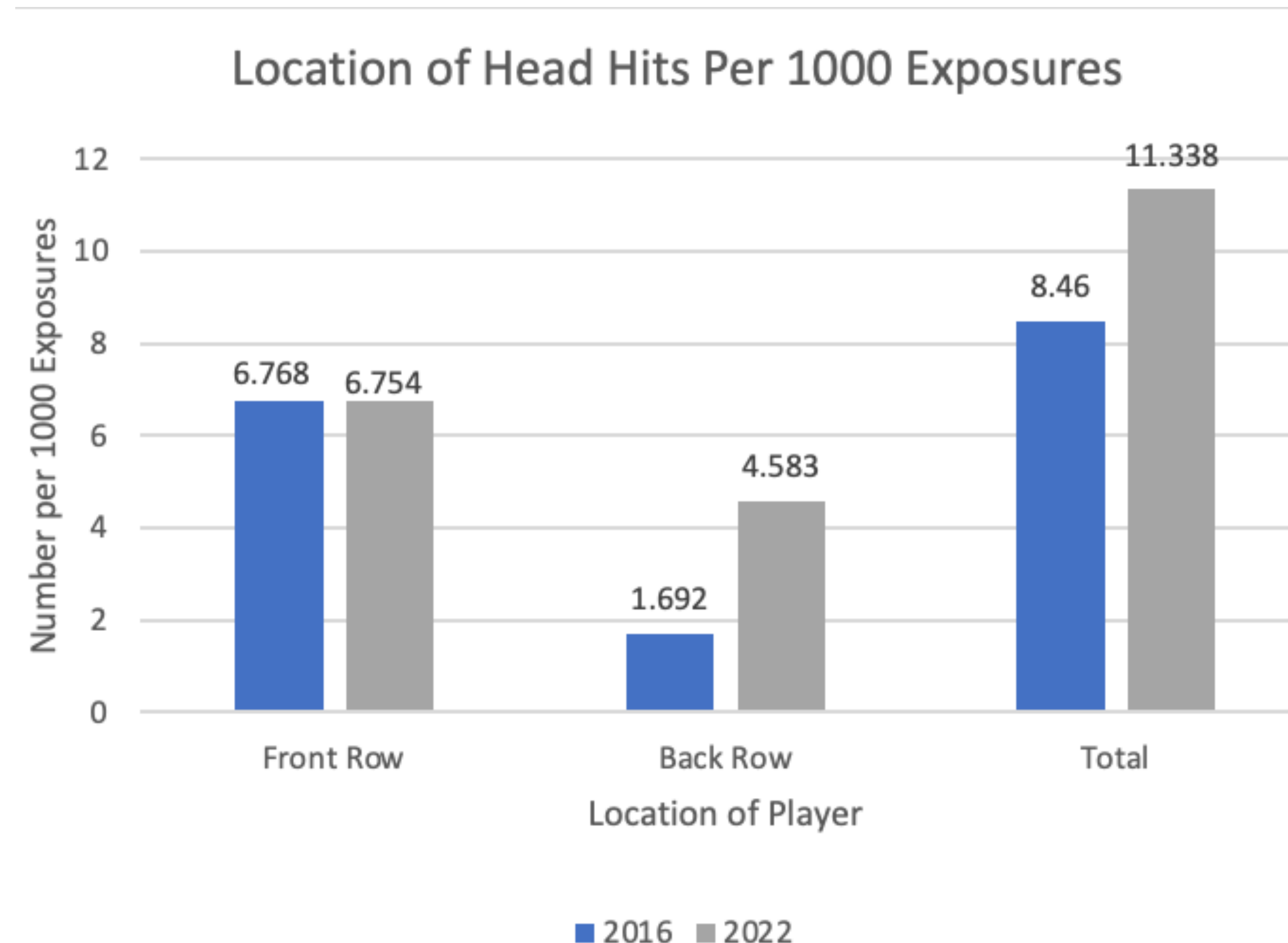
RESULTS

Table 4.1: Descriptive and Test Statistics

	Percentage of High Velocity Attacks			Percentage of Heads Over the Net		
	2016	2022	Total	2016	2022	Total
N	20	28	48	20	26	46
Mean	0.5753	0.604	0.5921	0.4614	0.3922	0.4162
Std. Deviation	0.0766	0.0709	0.0739	0.1484	0.1123	0.1379
Minimum	0.4556	0.4553	0.4553	0.1698	0.1003	0.1003
Maximum	0.6995	0.7278	0.7278	0.7634	0.5596	0.7634
Kruskal-Wallis H			1.574			2.762
Asymp. Sig			0.21			0.097

- The Kruskal-Wallis H test did not indicate a significant difference between high-velocity attacks in 2016 and 2022 (H value 1.574, p = 0.210).
- The Kruskal-Wallis H test did not indicate a significant difference between heads over the net in 2016 and 2022 (H value 2.762, p=0.097).

Graph 4.3: Location of Head Hits per Every 1000 Exposures



CONCLUSIONS

- Average percentage of high-velocity attacks was 59.21%
 - Equivalent to 148 HVA for a game with 250 attacks
- Back row incidence rate of 4.5 heads hit/1000 exposures
 - Likelihood of a back row player being hit in the head by a HVA every 2 games
- Front row was able to avoid getting hit if got their hands up in time
 - Back row players prepare to dig the ball and hands were much lower than their heads so they should start preparing with their hands in a higher position
- 2/3 of games analyzed had at least one player get hit in the head with the ball
 - Games with most had six instances
- Can't determine if head hits resulted in concussion but there were still many opportunities for athletes to sustain one
- The overall injury rate for volleyball from the literature was 6.6/1000 in 2016-17 and increased to 7.2/1000 in 2018-19⁵ which is consistent with 8.67/1000 head hits in 2016 increasing to 11.34 heads hit in 2022
 - Increase in number of back row players being hit compared to front row players could be significant to increasing injury rate
- Limitations
 - Steep angles of some videos
 - Discrepancies in opinion of if an attack was high-velocity or not

FUTURE RESEARCH

- Larger time frame may produce a statistically significant difference
 - Six years could be too short of a time to see an increase in size of players
 - Longer time could mean more prevalent physical differences
- Follow up with players hit in the head to see if they sustained a concussion
 - Could help determine true mechanism of concussion in volleyball
 - Look into where the back row players hands were when they were hit
- Look into differences in teams that have a better record than others
 - Are teams with worse records sustaining more concussions?

REFERENCES

1. Seiger, A., Goldwater, E., & Deibert, E. (2015). Does mechanism of injury play a role in recovery from concussion?. *The Journal of head trauma rehabilitation*, 30(3), E52-E56. <https://doi.org/10.1097/HTR.0000000000000051>
2. Bryan, M. A., Rowhani-Rahbar, A., Comstock, R. D., & Rivara, F. (2016). Sports-and recreation-related concussions in US youth. *Pediatrics*, 138(1).
3. Reeser JC, Gregory A, Berg RL, Comstock RD. A Comparison of Women's Collegiate and Girls' High School Volleyball Injury Data Collected Prospectively Over a 4-Year Period. *Sports Health*. 2015;7(6):504-510. doi:10.1177/1941738115600143
4. Meeuwisse, D. W., MacDonald, K., Meeuwisse, W. H., & Schneider, K. (2017). Concussion incidence and mechanism among youth volleyball players. *British Journal of Sports Medicine*, 51(11), A62-A63.
5. Chandran, A., Morris, S. N., Lempke, L. B., Boltz, A. J., Robison, H. J., & Collins, C. L. (2021). Epidemiology of Injuries in National Collegiate Athletic Association Women's Volleyball: 2014-2015 Through 2018-2019. *Journal of Athletic Training*, 56(7), 666-673.