

HEADING INCIDENCE AND CHARACTERISTICS IN ELITE WOMEN'S FOOTBALL OVER THE 2020/2021 SEASON

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The purpose of the study was to analyse the magnitude of head impact incidence and heading characteristics in elite women's football across a season. Football players (matches n=25, training n=18) had their headers and head impacts quantified and characterised for the 2020/2021 season. Video recordings from a single elevated camera on the halfway line was used to analyse for 22 matches and 98 training sessions. Overall, 5063 headers and 9 non-ball to head impacts were collected and analysed. This study shows more headers occurred in training than matches for the team of interest across the season (training, 2976; matches, 974). However, the nature of the headers was more submaximal in training than matches, the rate of headers was lower (training, 15.9 headers per hour; matches 29.5 headers per hour), and non-ball to head impacts were much lower (training, 0; matches 9). The longitudinal study presents differences between headers and head impacts in matches and training and provides novel data to further develop our understanding of heading in women's football.

KEYWORDS: football, heading, women.

INTRODUCTION: Football is the most participated sport in the world with approximately 265 million players (FIFA, 2007). Football is unique compared with other contact sports in which players use their unprotected heads to pass, shoot, direct and control the ball (Kontos et al., 2017). Concerns about the potential adverse effects of purposeful heading have been discussed in literature (Spiotta et al., 2011) with some governing bodies, such as the English FA and US Soccer, banning/limiting heading within certain age groups.

It has been hypothesised that heading has an adverse effect on brain structure; with studies reporting current and former football players exhibiting altered brain structures (Koerte et al., 2016) and a higher rate of mortality from neurodegenerative disease to matched controls, as well as more frequently prescribed dementia related medication (Mackay et al., 2019).

Historically, football has been a male orientated sport however the women's side of the game is growing vastly year on year. It is thought that 13.36 million girls and women are playing organised football across the globe with 3.12 million registered female youth players (<18) and 945,068 registered female adult players (18+) (FIFA, 2019).

Further research into women's football and neurodegenerative diseases is important, as previous research has shown women exhibit more widespread evidence of microstructural white matter alteration, when exposed to similar bouts of heading, than men do (Rubin et al., 2018). Females also exhibit higher head accelerations when heading the ball than their male counterparts (Saunders et al., 2020). In addition, it is still unknown if training or match play results in a bigger injury threat regarding peak head accelerations and cumulative head accelerations.

The purpose of the study was to analyse the magnitude of head impact incidence and heading characteristics in elite women's football across a season by use of video recordings. In detail, we examined (i) the match and training quantity of head impacts and (ii) the characteristics of headers in matches and training.

METHODS: Design: For this longitudinal study all matches and practices for a FA Women's Championship side was analysed for the 2020/2021 season.

Participants: The manager of a FA Women's Championship side was approached and consented to participate. All match videos were provided to the research team. The football squad consisted of 25 players for matches and 18 players for training.

Coding: Following 4 pre-season friendly matches to familiarise coder with coding sheet, one coder analysed a total of 22 matches and 98 practices. A total number of purposeful headers and non-ball to head impact was coded for both teams in matches (including opponent) and for the entire squad in training. However, specific heading characteristics was coded for the team of interest only.

Coded heading characteristics included: For training and matches – training and match number, phase of play, header type, opposed or non-opposed, bounce or no bounce. For matches: player number, player position, pitch area. For training – training session type, team size, pitch size, wall players or no wall players.

Table 1: Quantity of Headers in Match Play.

Header Characteristic	Definition
Attacking	Headed shot on goal
Clearance	Defensive action where a player heads the ball away from her own goal with no intended recipient. Maximum effort and distance.
Cushioned	Takes momentum out of the ball to bring it under control.
Flick On	Player heads the ball in the same direction it was received.
Interception	Player is at full stretch with little head movement.
Pass	Submaximal directional header towards an intended recipient.
Unintentional	Ball hits player's head unknowingly.

Data analysis: Data analyses was performed using SPSS version 23 (IBM Statistics). Described data is presented for every header during the season.

RESULTS/DISCUSSION: The purpose of this study was to examine the quantity and characteristics for headers in elite level women's footballers as a precursor for future studies measuring head accelerations in women's football and developing intervention strategies to mitigate injury risk from head impacts. The current data presents the first assessment of heading incidence and characteristics during match play and training for elite women football players across a season. A total of 5063 headers were quantified and analysed over the 2020/2021 season for an elite women's football team, the results for matches and training are shown in Tables 1 – 5 and Figure 1. The main findings were as follows:

Table 2: Quantity of Headers in Match Play.

	Total	Average	Range
Overall	2087	94.9	59-126
Team of Interest	974	44.3	25-64
Opposition	1113	50.6	32-71

During the 20/21 season, there was a total of 22 games with a total match exposure time of 33 hours. The number of headers in matches (94.9) was representative of previous studies analysing elite men's football (Premier League, 111.2; English Championship, 139.0; Bundesliga, 108.4; La Liga, 98.6; Serie A, 92.2)(Tierney & Higgins, 2021).

The total number of headers per players across 22 games ranged from 1 – 92, with an average of 40.

Table 3: Quantity of Headers in Training Sessions.

	Total	Average	Range
Overall	2976	30.4	0-295
Individual Players	2976	1.7	

During the 20/21 season, there was a total of 98 training sessions with a total training exposure time of 186 hours and 48 minutes.

The number of headers performed over the season was higher in training compared to matches (2976 and 974 respectively). However, the rate of headers performed was higher in matches (29.5 headers per hour) compared to training (15.9 headers per hour).

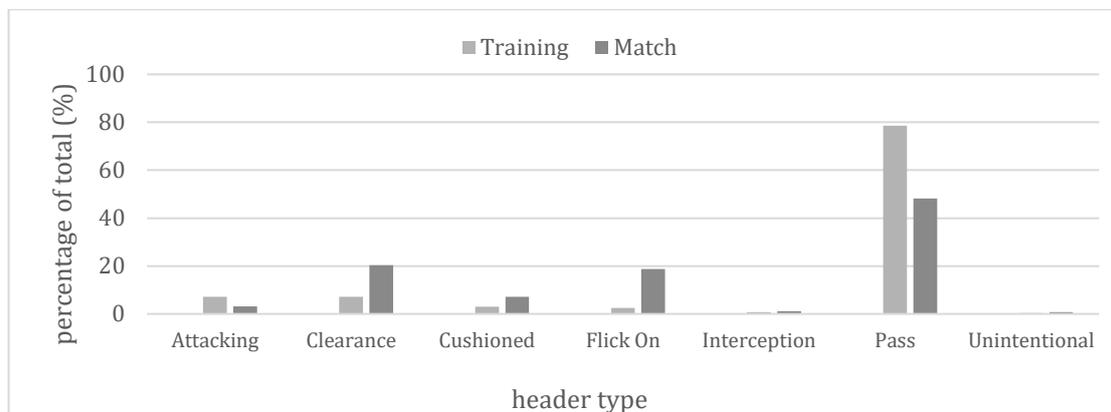


Figure 1: Header Characteristics for Header Type in Matches and Training.

The difference in header type between training and matches shows match play involved a higher rate of maximal clearance headers (match, 20.4%; training, 7.2%) whilst training involved a higher rate of submaximal pass headers (match, 48.2%; training, 78.6%), which may expose players to more frequent higher head accelerations in matches than training. In addition, a higher rate of flick on headers was observed in matches compared to training (match, 18.8%; training 2.5%) which may expose players to an increase in the frequency of higher rotational accelerations in matches.

Matchplay exposed players to a longer ball trajectory rate prior to header (goal kick: match, 6.1%; training, 0.0%). Goalkeeper punt; match, 2.4%; training, 0.0%. Long pass: match, 31.8%; training, 8.0%) and lower exposure rate to smaller ball trajectory prior to heading than training (short pass: match, 61.2%; training 17.6%). These findings suggest players may have increased exposure to higher initial ball velocities in matches than training, which has been associated with higher peak linear and rotational head accelerations (Cecchi et al., 2020).

Table 4: Header Characteristics for Contested Headers in Matches and Training.

	Training (%)	Match (%)
Opposed	4.0	21.5
Non-Opposed	96.0	78.5

A higher rate of contested headers occurred in matches (21.5%) compared to training (4.0%), this may expose players to an increased rate of higher head accelerations in match play as players may be off-balance when heading the ball and have less of a rigid neck-head body. A much higher non-ball to head impact was observed in matches (9: Head to head, 4; Forearm to head, hand to head, knee to head, ball to face, hand to face, 1) compared to training (0). This may be due to the competitive nature of matches compared to training and the higher rate of contested headers in match play.

Table 5: Quantity of Headers in Training Session Type.

Training Session	Total	Percentage (%)
First Touch Training	1540	51.8
Scrimmage	858	28.8
Head Tennis	306	10.3
Set Piece	88	3.0
Keep Ball	66	2.2
Crossing and Finishing	50	1.7
Other (Horse, Rondo, Shape Work, Attack v Defence)	67	2.2

Most headers in training were performed during first touch training where the ball travels at a relatively low velocity, under 5 meters of distance before a cushioned pass back to teammate. Kenny et al., (2022) found similar results in which underhand throw delivery to header was most prevalent phase of play in university women's football training.

CONCLUSION: The present results represent novel data and add valuable information to the general discussion about the number of headers and head impact in women's football. This study shows more headers occurred in training than matches across the season. The nature of the headers was more submaximal in training than matches; training exhibited higher percentages of pass headers and short pass phase of play prior to header compared to matches, whereas matches exhibited higher percentages of clearance headers and long pass, goal kick and goalkeeper punt phases of play prior to header. Training rate of headers were also lower and non-ball to head impacts are much lower. This study did focus on one elite women's football team and does not provide header or head impact data for other teams, who may have a different style of play or training ethos potentially resulting in different header and head impact data.

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