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ORIGINAL RESEARCH

Comparison of Australian Football League Women's athletes match day energy and nutrient intake to recommendations

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Abstract

Aims: This cross-sectional observational study quantified Australian Football League Women's athletes' match volume, and compared match-day dietary intakes against recommendations.

Methods: Self-report, direct observation, and fluid measurements determined dietary intake ($n = 17$, 25 ± 4.5 years, 22.8 ± 1.8 kg/m^2) on five home match days (early or late starting). Global positioning system software captured match volume. Linear mixed effects models evaluated differences in early versus late match volume and nutrient intakes. Data are presented as mean ± standard deviation.

Results: Athletes covered 6712 ± 622 m during matches, with similar numbers of very high-intensity running efforts over equal distances in early and late matches (early vs. late efforts [no.]: 8.5 ± 4.9 vs. 9.5 ± 5.5; distance [m]: 203 ± 127 vs. 212 ± 113). Across all match days, 71% ($n = 12$) of athletes met their predicted daily energy requirements. However, 82% ($n = 14$) failed to meet minimum daily carbohydrate recommendations; intake was lower on early compared with late match days (4.7 g/day vs. 5.4 g/kg/day, $p = 0.027$). On average, no athletes met carbohydrate recommendations in the 2 h prior to a match and only 24% ($n = 4$) met recommendations during matches. All athletes met post-match carbohydrate and protein requirements.

Conclusion: Athletes cover large distances during games with frequent bursts of high-intensity running. However, they do not adjust their intake to meet the energy demands of competition, with inadequate fuelling prior to and during matches. These findings emphasise the need for greater athlete education and dietary support to maximise strategic fuelling to optimise athletic performance.

KEYWORDS

carbohydrate, energy, global positioning system, match day, team sports

1 | INTRODUCTION

The professional Australian Football League Women's (AFLW) competition commenced in 2017 and the sport has since increased in popularity at all playing levels.[1] Typically, an AFLW match consists of an approximate 30-min warm up, and four 15- to 20-min quarters, with frequent breaks and player rotations. Australian football involves repeated sprints over long distances (up to 200 m) with little rest between efforts and requires whole body strength to mark (catch) the ball and fend off opponents.[2,3] AFLW athletes generally cover 6000 m per match, interspersed with frequent bouts of high-speed running.[4–6] Therefore, these athletes require high aerobic endurance as well as anaerobic strength and power to accommodate for the stop-start nature of the sport.

As for all sports, nutrition plays an important role in health and performance as it helps athletes meet their energy demands, whilst supporting growth and recovery.[7] For example, team sport athletes, such as Australian football athletes, predominantly use carbohydrate as their major fuel source to sustain high-intensity efforts over long durations.[8,9] Prior studies have shown improvements in athletic performance with increased carbohydrate intakes in cyclists,[10,11] endurance runners,[12] and other intermittent/team sport athletes, such as soccer, rugby, and field-hockey players.[8,13,14] Given the importance of energy and carbohydrate for athletic performance, it is crucial to establish whether AFLW athletes meet nutrient requirements on match days.

The American College of Sports Medicine[7] has established nutrient recommendations to promote optimal health and performance of athletes, which have been used to evaluate the dietary intakes in previous studies involving Australian football athletes.[15–17] The relevant daily carbohydrate recommendations applicable to AFLW athletes ranges from 6 to 10 g/kg/day, with the variation due to different training volumes/performance demands. An AFLW match day attracts the lower end of this range (~6 g/kg/day) as it best matches the intensity and duration of competition.[15,18] Emerging evidence suggests that hormonal fluctuations within the menstrual cycle may also influence energy and carbohydrate requirements in female athletes,[19] but no adjustment for potential impact of menstruation has been made within current recommendations.

In addition to meeting daily requirements, it is important to periodise carbohydrate intake to fuel for the work required. Furthermore, meeting training and match carbohydrate requirements (pre-, during, and post-) promotes energy balance in athletes which may help to avoid low energy availability, a common disorder amongst female athletes which has negative physiological and psychological implications.[20] For Australian football athletes, carbohydrate intake prior to and during matches helps maintain blood glucose and muscle glycogen to sustain performance. Whereas, post-match carbohydrate and protein intakes aid in replenishing fuel stores and support muscle recovery and growth.[7] Recommendations are dependent on body weight (expressed in g/kg of body mass/day), except for carbohydrate intake during a match (expressed in g/h).[7]

Overall, there is limited research into the nutritional intake of Australian football athletes[15–18,21–25]; only three studies have been conducted in females.[15,18,25] Condo et al.[15] and Jenner et al.[18] evaluated the dietary intake of elite AFLW athletes during a single preseason period in 2017, whilst Otte et al.[25] more recently evaluated intake across the pre- and competition seasons. All studies concluded that AFLW athletes did not meet their energy and carbohydrate requirements. However, it is currently unknown whether AFLW athletes meet sports nutrition recommendations on match days. Therefore, the aim of this study was to assess daily and periodised dietary intake of AFLW athletes on match days and compare energy and nutrient (specifically carbohydrate and protein) intake to the American College of Sports Medicine sports nutrition recommendations.[7] To better understand the impact of match timing on energy intake, a secondary aim was to compare dietary intake on early compared late games.

2 | METHODS

A squad of 30 AFLW athletes contracted to one club for the 2021 competition season were invited to participate in this cross-sectional observational study. Athletes who had a chronic injury and were unable to play during the competition were excluded. Ethics approval for the study was provided by the University of South Australia Human Research Ethics Committee (no. 203272), with further approval obtained from the club's General Manager of Football Operations, Reporting followed the STROBE-nut guidelines.[26] Athletes provided both verbal and written informed consent to participate.

Match volume and dietary intake data were collected at all five home matches (out of a total of eight matches for the season, excluding finals); early matches ($n = 3$) were played at either 12 PM or 12:40 PM, late matches ($n = 2$) were played at 3:40 PM or 4:40 PM. All matches were played on weekend days within the Australian summer season between the end of January to mid-March 2021, where daily maximum temperatures on match days ranged from 32.0 to 37.9°C.

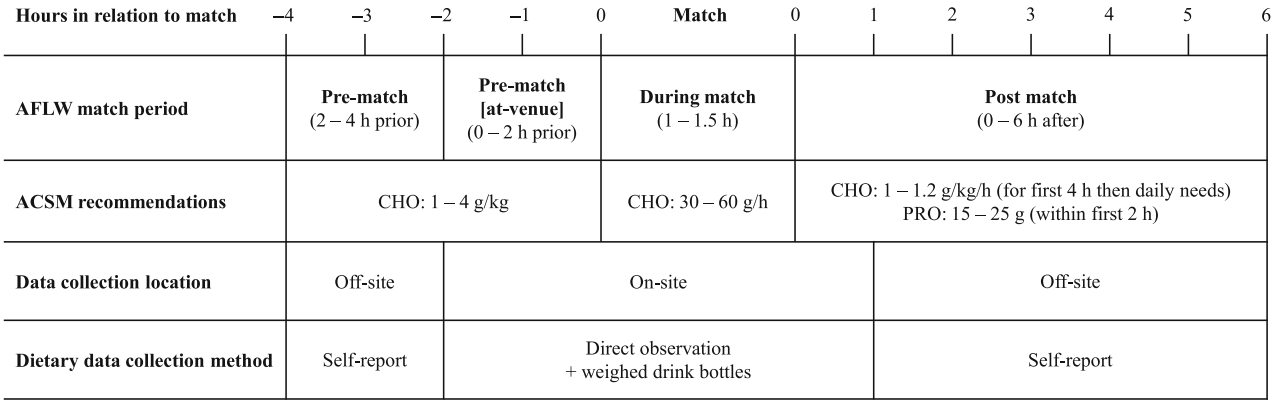

FIGURE 1 American College of Sports Medicine (ACSM)[7] acute fuelling strategies for optimal performance in competition aligned with the timing of an Australian Football League Women's match day. Note that on-site data collection began 2 h prior to the match and continued for 1 h post-match. AFLW, Australian Football League Women's; CHO, Carbohydrate; g, grams; kg, kilogram of body weight; hrs, hours; PRO, Protein.

Height (cm) and weight (kg) were measured in duplicate using a Mobile Stadiometer (SECA-217, Hamburg, Germany) according to the International Society for the Advancement of Kinanthropometry protocol for stretch stature[27] and portable Bioelectrical Impedance Analysis scale post-void (Tanita Ultimate Scale 2000, Tokyo, Japan), respectively at the start of the competition season. A third measure was taken if values differed by more than 0.5 U, and all measures were averaged.

Match volume was captured using Global Positioning System monitors, worn in a small pocket inside athletes' playing guernseys, positioned on the upper back between the shoulder blades. Data were analysed using Catapult Sports software (version 3.3); total distance covered (m), distance covered during very high-intensity running (>21 km/h), and number of very high-intensity running efforts were selected to reflect athlete's match volume.

Dietary intake was collected on each match day (24 h) using a combination of self-reported weighed food records and direct observation. Dietary assessment methodologies differed depending on athlete location throughout the day (i.e., at the venue [on-site]; or away from the venue [off-site], Figure 1). Instructions for recording were given to athletes at training the night before each match. Following the match, a single reminder to continue recording dietary intake for the remainder of the day was sent via athlete's preferred communication method of email or text message. Study personnel reviewed completed diaries with athletes the following day to cross-check entries and identify missing foods and drinks.

Off-site data collection involved athletes weighing and self-reporting dietary intake using a printed template or via the Easy Diet Diary (Xyris Software, Brisbane, Australia) phone application. This method was used to record intake on the morning of the match prior to arrival, and after leaving the venue. On-site dietary intake was collected from the time athletes arrived at the venue (~2 h prior to warm up), until their departure (~1-h post-match), using direct observation (via manually recording on pen and paper and video recording). While on site, athletes had access to a food station inside the change rooms (muesli bars, lollies, carbohydrate sports gels, bananas, popcorn, pretzels, crackers, beetroot juice, pickle juice). Foods (lollies, gels, and pickle juice) were distributed to athletes on-field during match breaks. Flavoured milks (300 mL bottles) and pre-prepared meals (including burgers or pastas) were provided after the match for athletes to either take home or eat on-site. All foods consumed on-site were recorded using a video camera which was directed at the athlete when they were eating. Athletes were also provided with four individual pre-prepared drink bottles with their choice of water (Powerade® or Hydralyte™): one bottle pre-match (2–0 h before the match), two bottles during the match (one bottle on the substitution bench, one bottle with a trainer on the field), and one bottle at half-time. Fluid in the bottles were weighed at the end of the pre-match period, end of the match, and end of the half-time break, respectively. Athletes were asked to avoid rinsing and spitting beverages. All bottles were refilled once empty, and study personnel notified if a bottle was refilled. All dietary data (i.e., from self-reports or videos) were transcribed for each athlete into FoodWorks nutritional software (Xyris Software, version 10, Highgate Hill, Australia). Food/fluid items not found in the FoodWorks database were substituted for products with similar nutritional composition. Post- match pre-prepared meals were entered as a recipe to provide an ingredients list and nutritional information. FoodWorks provided an estimate of total daily energy, macronutrient, and micronutrient intakes.

TABLE 1 Comparison of Australian Football League Women's athletes dietary intake against daily and periodised nutrient recommendations ($n = 17$).

Nutrient	Recommendation Min–max	Match time	Intake Mean ± SD	Intake vs. *minimum* recommendation *p*-value[1]	Early vs. late match intake *p*-value[2]	Proportion meeting *minimum* recommendation (%)	Early vs. late match proportion meeting *minimum* recommendation *p*-value[3]
Daily nutrient intake							
Total energy	9704–12 103 kJ[a]	All	11 086 ± 2977	0.232	0.015	71	0.229
	9711–12 103 kJ[a]	Early	10 521 ± 2917	0.047		59	
	9577–11 945 kJ[a]	Late	12 968 ± 3144	0.458		85	
Carbohydrate	6–10 g/kg[b]	All	4.1 ± 1.1	<0.001	0.027	18	1.000
		Early	4.7 ± 1.0	<0.001		18	
		Late	5.4 ± 1.4	0.148		23	
Protein	1.4–2.0 g/kg[b]	All	1.6 ± 0.6	0.148	0.142	59	0.051
		Early	1.5 ± 0.5	0.527		47	
		Late	1.9 ± 0.7	0.017		78	
Periodised nutrient intake							
Pre: CHO	1–4 g/kg[b]	All	1.0 ± 0.5	0.470	0.157	59	0.106
		Early	1.1 ± 0.4	0.198		71	
		Late	0.7 ± 1.0	0.166		31	
Pre [at-venue]: CHO	1–4 g/kg[b]	All	0.4 ± 0.2	<0.001	0.145	0	0.179
		Early	0.4 ± 0.2	<0.001		0	
		Late	0.6 ± 0.5	0.005		16	
During: CHO	30–60 g/h[b]	All	23 ± 13	0.029	0.138	24	0.441
		Early	21 ± 17	0.033		24	
		Late	27 ± 11	0.430		43	
Post: CHO	1–1.2 g/kg[b] (within first 6 h)	All	2.8 ± 0.7	<0.001	0.101	100	1.000
		Early	2.9 ± 0.9	<0.001		100	
		Late	2.6 ± 0.7	<0.001		100	

TABLE 1 (Continued)

Nutrient	Recommendation Min–max	Match time	Intake Mean ± SD	Intake vs. *minimum* recommendation *p*-value[1]	Early vs. late match intake *p*-value[2]	Proportion meeting *minimum* recommendation (%)	Early vs. late match proportion meeting *minimum* recommendation *p*-value[3]
Post: PRO	15–25 g[b] (within first 2 h)	All	74 ± 26	<0.001	0.772	100	1.000
		Early	75 ± 30	<0.001		100	
		Late	74 ± 28	<0.001		100	

Note: Total energy recommendations determined by athlete participation which varied depending on team selection: match 1 ($n = 13$, early), match 2 ($n = 14$, early), match 3 ($n = 11$, late), match 4 ($n = 11$, late), and match 5 ($n = 12$, early). *p*-value refers to [1]comparison of intake against minimum recommendations based on a 1-sample *t*-test; [2]comparison of early versus late game intake based on a linear mixed effects model; [3]comparison of the proportion meeting minimum recommendations on early versus late game days based on Pearson's Chi-Square and Fisher's exact tests. Recommendations based on: [a] Schofield equation[28] multiplied by physical activity levels of 1.6–2.0, [b]American College of Sports Medicine.[7]

Abbreviations: AFLW, Australian Football League Women's; CHO, Carbohydrate; Max, maximum; Min, minimum; PRO, Protein.

Statistical analyses were conducted using Stata version 15.0 (StataCorp, 2017) with significance set at $p < 0.05$. The normality of data was visually inspected and assessed using the Shapiro–Wilk and Kolmogorov–Smirnov tests. All data are presented descriptively as means and standard deviations. For each athlete, data from matches played (up to five matches) were averaged. Averages were also determined for early and late games. Thus, the average values for each athlete were used in all analyses and determined whether an athlete met or did not meet a specific recommendation. A linear mixed effects model was used to determine whether match volume, energy, and carbohydrate intake differed between early and late matches. A Pearson's correlation determined the relationship between total distance covered and energy intake on match days. One sample *t*-tests were used to compare athlete energy and nutrient intakes against their respective recommendations. Individual estimated energy requirement ranges were determined using the Schofield equation[28] (which provides an estimate of basal metabolic rate), multiplied by a physical activity level of 1.6 and 2.0, values which have previously been used for female team sport athletes,[18,29] to establish a minimum and maximum cut-off range for comparison. Daily carbohydrate intakes were compared against the American College of Sports Medicine guidelines specific for high physical activity (endurance based 1–3 h/day of mod–high-intensity exercise), while periodised carbohydrate intakes were compared against the American College of Sports Medicine acute fuelling strategies for optimal performance in competition.[7] To align with the American College of Sports Medicine acute fuelling strategies, daily carbohydrate intake was divided into periods based on the athletes' proximity to the match (presented in Figure 1). Post-match guidelines (1–1.2 g/kg in 4–6 h post-event) are issued for 'speedy' recovery, where athletes typically have <8 h between two energy demanding sessions.[7] Athletes completed a recovery session the morning after a match. While this was not energy demanding or within the 8-h period following a match, these guidelines were selected as rapid glycogen restoration is important to ensure athletes return to optimal physiological function and performance quickly during the competition season.[30] Figure 1 also summarises the location where dietary data collection occurred (i.e., on/off-site) and the method of data collection (i.e., self-report or direct observation). Daily protein and post-match protein intakes were also compared against American College of Sports Medicine recommendations.[7] Pearson's Chi-Square and Fisher's exact tests were used to determine the proportion of athletes who met specific recommendations for energy and carbohydrate, and differences in proportions according to match time (early vs. late).

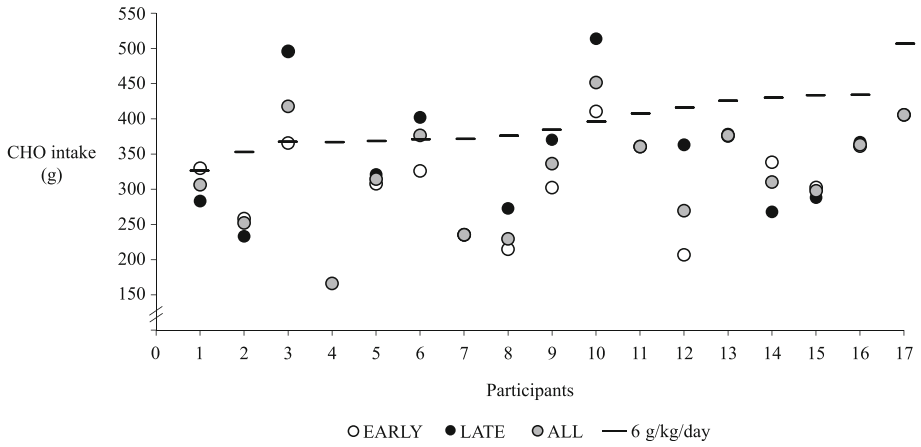

FIGURE 2 Individual variability in daily carbohydrate intake according to match time. American College of Sports Medicine[7] daily carbohydrate (CHO) needs for high physical activity (endurance based 1–3 h/d of mod-high intensity exercise) are 6 g/kg/day. Note that athletes with only one dot visible demonstrated consistent carbohydrate intakes across both early and late games and thus are stacked behind one another, that is, participants 4, 7, 11, 13, and 17.

3 | RESULTS

Twenty of the thirty contracted athletes enrolled to participate. Three athletes withdrew; two prior to the start of the study due to concerns of interference with match day preparation and performance, and one during the study due to injury. Seventeen athletes (25 ± 4.5 years, 66 ± 7 kg, 171 ± 7 cm, 22.8 ± 1.8 kg/m^2) completed the study, however match participation varied depending on team selection; match 1 ($n = 13$, early), match 2 ($n = 14$, early), match 3 ($n = 11$, late), match 4 ($n = 11$, late), and match 5 ($n = 12$, early).

Across the five matches, athletes covered an average of 6712 ± 622 m; total distance covered was significantly greater in late compared with early matches (7230 ± 707 vs. 6463 ± 616 m, $p < 0.01$). During early and late matches, athletes performed a similar number of very high intensity running efforts over equal distances (early vs. late efforts [n]: 8.5 ± 4.9 vs. 9.5 ± 5.5, $p = 0.874$; distance [m]: 203 ± 127 vs. 212 ± 113, $p = 0.698$).

Across all matches, 29% ($n = 5$) of athletes did not meet their minimum predicted daily energy requirement (Table 1). Energy intake was 2447 kJ lower in early compared with late match days ($z = 2.43$, $p = 0.015$). Although fewer athletes met minimum energy recommendations on early compared with late match days, this difference was not significant ($p = 0.229$). There was a weak positive relationship between total distance (m) and daily energy intake (kJ) on match days ($r = 0.264$, $p = 0.04$).

Athletes' average daily diet comprised 50% carbohydrate, 16% protein, and 32% fat. The proportion of energy from macronutrients (protein, carbohydrate, fat) did not differ significantly ($p \geq 0.05$ for all) between early and late matches (data not shown). Although athletes' mean protein intake was within the recommended range across all matches, only 59% of athletes met the requirements. Daily carbohydrate intakes were significantly less than minimum recommendations on early ($p = 0.001$) but not late match days ($p = 0.148$, Table 1). Individual variability in daily carbohydrate consumption on early, late, and all (average of all matches) match days is shown in Figure 2. The proportion of athletes meeting daily carbohydrate recommendations was low for both early ($n = 3$, 18%) and late ($n = 3$, 23%) match days (Table 1). Athletes consumed significantly less carbohydrate on early compared with late match days ($p = 0.027$). Consequently, carbohydrate intake was significantly lower than minimum recommendations on early ($p < 0.001$), but not late match days ($p = 0.148$).

On average, for all matches, 59% ($n = 10$) of athletes met carbohydrate recommendations pre-match (2–4 h prior to match venue arrival; however, no athletes met pre-match [at-venue]) recommendations. Average carbohydrate intake during the pre-match [at-venue] period was significantly lower than recommended ($p < 0.01$), with no differences between early and late matches (Table 1). Less than 25% ($n = 4$) consumed sufficient carbohydrate during all matches (Table 1). Comparatively, all athletes met post-match carbohydrate and protein recommendations on all match days (Table 1). On average, athletes consumed significantly less carbohydrate than required during early matches ($p = 0.033$), but not late matches ($p = 0.430$). Carbohydrate intake was greatest in the post-match period; all athletes exceeded recommendations irrespective of match time ($p < 0.001$ for all, Table 1).

4 | DISCUSSION

This is the first study to capture and compare AFLW athletes' match day dietary intakes to recognised sports nutrition recommendations. While most athletes in this study met their estimated daily energy and protein requirements, they did not meet minimum daily carbohydrate recommendations. Furthermore, athletes did not consume adequate carbohydrate in the lead up to and

during matches. Of interest, match time influenced energy and carbohydrate intake, with significantly more athletes meeting recommendations on late compared with early match days.

Energy expenditure is the sum of resting metabolic rate, the thermic effect of food, and the energy expended during physical activity.[7] Exercise makes up only a small proportion of overall energy expended during a day; however, it has the potential to contribute the greatest variability, particularly in athletes. As there is no perfect method to capture energy expenditure in competitive athletes, match volume, specifically total distance, and average speed, has been used as a proxy in studies involving team sport athletes.[31] Athletes in this study covered ~6700 m per match which is consistent with total distances reported in other recent studies involving AFLW athletes (~6500 to ~7000 m per match[2,4,6]). There was a weak positive relationship between total distance covered during a match and daily energy intake ($r = 0.264$, $p = 0.04$), suggesting that athletes did not appropriately fuel to match their energy expenditure. Since the AFLW competition is still in its infancy, it is likely that increases in match volume will be evident as the physical capabilities of players improve over future seasons,[2,5] emphasising the need to continue monitoring athletes training and match volumes and respective dietary intakes. Only a handful of studies have assessed distance covered, or other forms of training or match volume, alongside dietary intake of Australian football athletes.[9,17,21] One study reported that athletes adjusted their carbohydrate intake in accordance with physical load (total distance, average speed, and distance covered within four specific velocity bands) on match days,[17] whereas the others showed inability to match intake with training demands,[9,21] consistent with studies conducted in other team sports.[23,32]

In the current study, the majority of athletes met their individual energy requirements, yet carbohydrate intake was inadequate. The low carbohydrate intakes seen in this study (4.1 ± 1.1 g/kg/day) are consistent with two previous studies involving AFLW athletes within the preseason period, with mean carbohydrate intakes ranging from 2.7 ± 0.7[18] to 3.0 ± 0.8 g/kg/day.[15] Athletes in the present study made up for this deficit by consuming greater amounts of fat (including saturated fat) and protein. This finding is similar to Condo et al.[15] and Jenner et al.[18] who reported total fat intake met National dietary recommendations,[33] while protein intake was higher than American College of Sports Medicine recommendations (1.2–2.0 g/kg/day)[7] in their sample of AFLW athletes. Although fat and protein support a healthy and balanced diet,[7] a diet with inadequate carbohydrate becomes impractical for an Australian football athlete given its role in fuelling high intensity exercise and recovery. An under-fuelled athlete is at greater risk of performance detriments, such as decreased jumping and tackling (taking a player to the ground) capabilities and slower reaction times.[7] In terms of strategic carbohydrate consumption, athletes were poor at distributing their carbohydrate intakes across the day. The largest proportion of energy from carbohydrate was during the post-match period which contributed to meeting daily energy needs and is beneficial for recovery (as adequate carbohydrate is required in conjunction with protein to maximise net protein balance[7]). The contribution of post-match carbohydrate to daily intake may also have important immunity implications. While regular moderate physical activity may enhance immune function,[34,35] some studies suggest that immunity may be compromised in the hours after strenuous exercise.[36,37] Furthermore, infection risk in athletes is co-dependent on other factors such as inadequate nutrition, psychological stress, poor sleep quality or quantity, and environmental conditions.[38] Therefore, it is acceptable to suggest that athletes are at increased risk of illness if nutrition is inadequate. This is an important consideration given the risk for low energy availability in AFLW athletes.[25] Consequently, it is essential that coaches and staff working with these athletes provide targeted nutrition plans to meet, not just the daily carbohydrate recommendations, but the strategic pre-match and during-match fuelling recommendations for optimal performance.

There are many potential reasons why athletes may fail to meet nutrient, specifically carbohydrate, requirements on match days. Factors such as time commitment for food preparation and consumption, and access to professional nutrition support have been reported to influence the dietary intakes of male Australian football athletes.[39] Social interactions with family and peers also contribute.[35] Athletes have reported that time of day (early vs. late matches) and gastrointestinal discomfort are important determinants in food selection around competition.[40–43] This may explain why the largest consumption of food (and all nutrients) occurred post-match; increased fat and protein intake during this period is of less concern as associated lower blood glucose and possible gastrointestinal disturbances will not impact on performance. Compared with early match days, higher carbohydrate intakes would be expected on late match days given the increased time available to prepare and consume larger, more carbohydrate-rich meals prior to a match. Finally, several studies have suggested that greater nutritional knowledge positively influences athlete's food choices and improves their ability to meet nutritional requirements.[44,45] However, recent studies have reported 'poor' nutritional knowledge in both male[16] and female Australian football athletes.[15,18,25] Unfortunately, other than anecdotal

reports, it is currently unknown whether these are considerations for AFLW athletes on match days. Further investigation into the factors influencing food choice and timing of dietary intake surrounding a match is needed.

This study was the first to assess the match day dietary intakes of AFLW athletes. Unfortunately, dietary intake in the 24-h period prior to matches and 24- to 48-h period following matches was not assessed, which limits ability to evaluate overall daily carbohydrate needs leading up to and following matches. Future studies should expand the dietary intake collection period. A combination of direct observation and self-reports provided an advantageous method to accurately evaluate dietary intake at home matches in real-time when on-site. However, this study relied on athletes to complete weighed food diaries when off-site (e.g., before a match) which may have influenced the accuracy of captured data and saw some athletes withdraw from the study due to perceived burden and potential interference with match preparation. Athletes are a unique population who may require different assessment methods to reduce these limitations. As part of this study, we evaluated match volume using the Global Positioning System as a proxy for energy expenditure, however, the use of Global Positioning System data in AFLW athletes requires further investigation to establish its use in determining energy expenditure, and thus energy requirements.[46] In addition, we applied a standard physical activity level to all players, irrespective of position played, thus future studies could account for this variation when estimating energy requirements.

Our findings indicate that athletes are not meeting daily carbohydrate recommendations, or the acute fuelling strategies for competition, which may impact performance. This study highlights the need for more targeted nutrition education to reinforce the importance of fuelling for the work required, and thus optimising performance and recovery following competition.

AUTHOR CONTRIBUTIONS

The study was designed by all authors. CJO collected the data. AMH and CJO analysed the data. AMH, EM and BSS assisted with data interpretation. CJO drafted the article. EM, BSS and AMH provided critical review of the article. All authors were in agreement with the article and declare that the content has not been published elsewhere. The authors thank the AFLW athletes for their participation in the study.

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CONFLICT OF INTEREST STATEMENT

CJO, BSS and AMH declare no conflicts of interest. EM is an Associate Editor of *Nutrition & Dietetics*. She was excluded from the peer review process and all decision-making regarding this article. This article has been managed throughout the review process by the Journal's Editor-in-Chief. The Journal operates a blinded peer review process and the peer reviewers for this article were unaware of the authors of the article. This process prevents authors who also hold an editorial role to inflence the editorial decisions made. All other authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The participants of this study did not give written consent for their data to be shared publicly, so due to the sensitive nature of the research supporting data are not available. The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

Ethics approval for this study was granted by the University of South Australia Human Research Ethics Committee (no. 203272), with further approvals obtained from the club's General Manager of Football Operations.

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