Performance Nutrition

BRIEF REPORT

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The effect of a short recipe book intervention on nutrition confidence and sports nutrition knowledge of women football players

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Abstract

Background Nutrition knowledge and confidence can be key facilitators to good nutrition behaviours. This study aimed to evaluate the impact of a structured and personalisable recipe-based nutrition education resource, on sports nutrition knowledge and confidence among women football players. Fifty-two women football players across different competitive levels (tiers two and four of the English league and academy players) completed a survey assessing training and nutrition habits, nutrition confidence, and sports nutrition knowledge. A sample of participants were randomized into an intervention group ($n=10$), receiving a resource with practical applications and personalisable meal adaptations, or a control group ($n=8$) receiving theoretical guidance without recipes (both two weeks). Both groups then repeated the same survey at the end of the two-week period.

Results In the initial survey fewer than half of the players (40%) regularly planned their meals ahead of time, but the majority planned what (71%) and when (73%) they ate in relation to training and competition most of the time. More than half had at least some responsibility for doing the grocery shopping (67%) and preparing and cooking meals (90%), highlighting an opportunity to intervene. Results demonstrated that while the intervention significantly improved nutrition knowledge compared to control ($p=0.004$), the overall score was still low (< 50% for both groups), and the change was within the typical error for the measure. Nutrition confidence was also low, with no significant differences between groups.

Conclusions This short home-based intervention had a statistical but unlikely meaningful impact on nutrition knowledge, but not confidence. These findings are considered alongside the participants' nutrition habits, and discussed in the context of self-determination theory to highlight the potential role of relatedness to improve competence and autonomy, and subsequently knowledge and confidence.

Keywords Female athlete, Cooking skills, Food skills, Sport

Background

While visibility and professionalism of women's football has been increasing, there remains a significant gap in sport and exercise science research of women [1]. Such under-representation is also evident in sports nutrition research [2], which is concerning as adequate nutrition is an essential component for optimising sport performance and recovery, and overall health. Previous studies have identified that although women footballers identify

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nutrition as a critical factor for both sport performance and health [3], there is a lack of base knowledge [4, 5] and frequent misconceptions about the correct recommendations [3]. Across football the exponential rise in sports nutrition research has advanced knowledge and expertise but has also been identified as 'creating confusion' on what is sound advice [6]. The greater awareness and media coverage of the differences in advice between men and women athletes [7] may further exacerbate the uncertainty on whether the promoted advice applies to women players [2]. A recent systematic review from Martinho et al. [8] outlines relevant research on nutrition for women footballers, but the authors note that much work has been descriptive, and more intervention studies are needed to facilitate the translation of knowledge into applied practice.

Not every athlete or/and team has professional sport and exercise nutrition support, which may leave athletes reliant on informal sources with no factual backing. Indeed, previous research has indicated that athletes engage with a variety of both formal and informal approaches to gaining nutritional advice, including using peers, family, social media and independent research [9]. This may highlight that athletes are unaware of where and how to access accurate, evidence-based information. Furthermore, data demonstrates that even in circumstances whereby athletes are aware of the published nutritional recommendations, confusion and misconceptions are still prevalent regarding the theoretical underpinning and practical application of meeting such energy requirements [3, 10]. Therefore, athletes can be at risk of receiving and acting upon less well-informed information. That might be particularly concerning for women athletes as it was reported that they might experience higher sociocultural pressures, such as body image concerns [11]. Collectively, this reinforces the importance of nutrition education and the potential role of nutrition support in this population.

Structured nutrition education is often designed to enhance an athletes' knowledge of nutrition with the view to improving dietary choices. Examples of such formal nutrition education with women footballers are limited. Petri et al. [12] implemented a sport nutritionist led nutrition programme throughout a season but there is only a limited description of what and how education topics were covered. Two studies implemented an intervention to support making positive food choices and personalising guidelines [4, 13], and Robinson et al. [14] describe a case study in one international level player. Broader previous research has shown that nutrition education is typically delivered as face-to-face or online sessions [15], although some modes of delivery include resources such as information leaflets [16]. A systematic review by Tam et al. [17] identified 32 studies evaluating the effectiveness of nutrition education interventions in athletes. Of the 36 experimental conditions assessed, 77.8% (28/36) used face-to-face delivery methods, while only a minority explored alternative approaches such as online modules or written resources, for example, handouts and leaflets. The total contact time for most interventions was < 5 h, and 85.7% (30/35) of the interventions reported significant improvements in nutrition knowledge, with a mean increase of 16.1% [14]. Despite these promising results, the review highlighted a notable gap in experiential education strategies, such as supermarket tours and cooking classes. These applied practical methods were used in very few studies, suggesting an over-reliance on traditional, classroom-style instruction. Expanding the use of applied learning formats may enhance the real-world impact of nutrition education by translating knowledge into actionable skills.

Whilst classroom-based interventions have shown promise for increasing nutritional knowledge, there can be barriers to translating this knowledge to practice. Typical barriers include athlete confidence in selecting and preparing appropriate meals, and the time commitment required [3, 18]. Certainly, Heaney and co-authors [19] have identified such barriers when exploring dietary practices of elite athletes. Inadequate cooking skills were among the common barriers identified, which can subsequently impact on the ability to translate knowledge to practice. Indeed, authors have observed that cooking workshops can improve cooking knowledge, skills and confidence in athletes [20].

Since education sessions to improve practical skills can often be burdensome on both time and facilities, home-based resources might be an alternative and efficient strategy to deliver information, and such strategies may allow individuals to retain information whilst working at an individual pace [4]. Moreover, women's football is typically under resourced compared to men's football, meaning this population may have less access to such hands-on nutrition support [21, 22], making interventions like those described by Abood et al. [4] and San Antosio et al. [13] not feasible for all. However, when combined with observations by Renard et al. [23] that women athletes on average have greater confidence related to cooking and food skills than men, cooking may be less of a barrier to the translation of nutrition advice, and the provision of recipes contextualised to timing relative to training and match timing may be advantageous. When considered alongside self-determination theory [24], the potentially higher food and cooking skills in women athletes may facilitate autonomy, meaning interventions can focus on developing application (competence) and being personalisable (relatedness).

The aim of this study was to design a nutrition education resource that used recipes and advice on how to personalise those recipes to translate current sport nutrition guidelines and examine the subsequent effect on nutrition knowledge and confidence. This was evaluated by comparing the resource to information only with no recipes.

Methods

Participants

Fifty-two women footballer players volunteered to take part in the study, all of whom were currently competing for one of; Team A, a senior team in the second tier of the English football league ($n=23$), Team B, under 21 academy players from the same club ($n=11$), Team C, a senior team in the fourth tier of the English football league ($n=15$), Team D, a University academy team ($n=3$). All players were actively participating in training or competitive fixtures at least three times per week, for at least five hours per week. All participants provided informed consent, and the study received institutional ethical approval (54,329).

Design

All 52 players completed the survey once to assess the survey reliability and validity, and eight (Teams B and D) completed the survey a second time after 2-weeks following no intervention to assess test–retest reproducibility.

Ten players from Team A and eight players from Team C then participated in the main part of the study, completing the survey a second time 2-weeks after either an experimental or control intervention (64% of players invited to take part). Teams A and C were randomised into the two groups via cluster randomisation, with team A becoming the intervention group, and team C the control group. Individual players were not randomised into the two groups to ensure players from the same team were in the same condition to reduce the risk of them sharing the resource with a teammate allocated to a different group.

Procedure

The survey consisted of two sections: (i) descriptives of current training (how many times and hours per week they trained/competed in season) and nutrition habits (see questions in Fig. 1), (ii) nutrition confidence, and (iii) sports nutrition knowledge. Nutrition

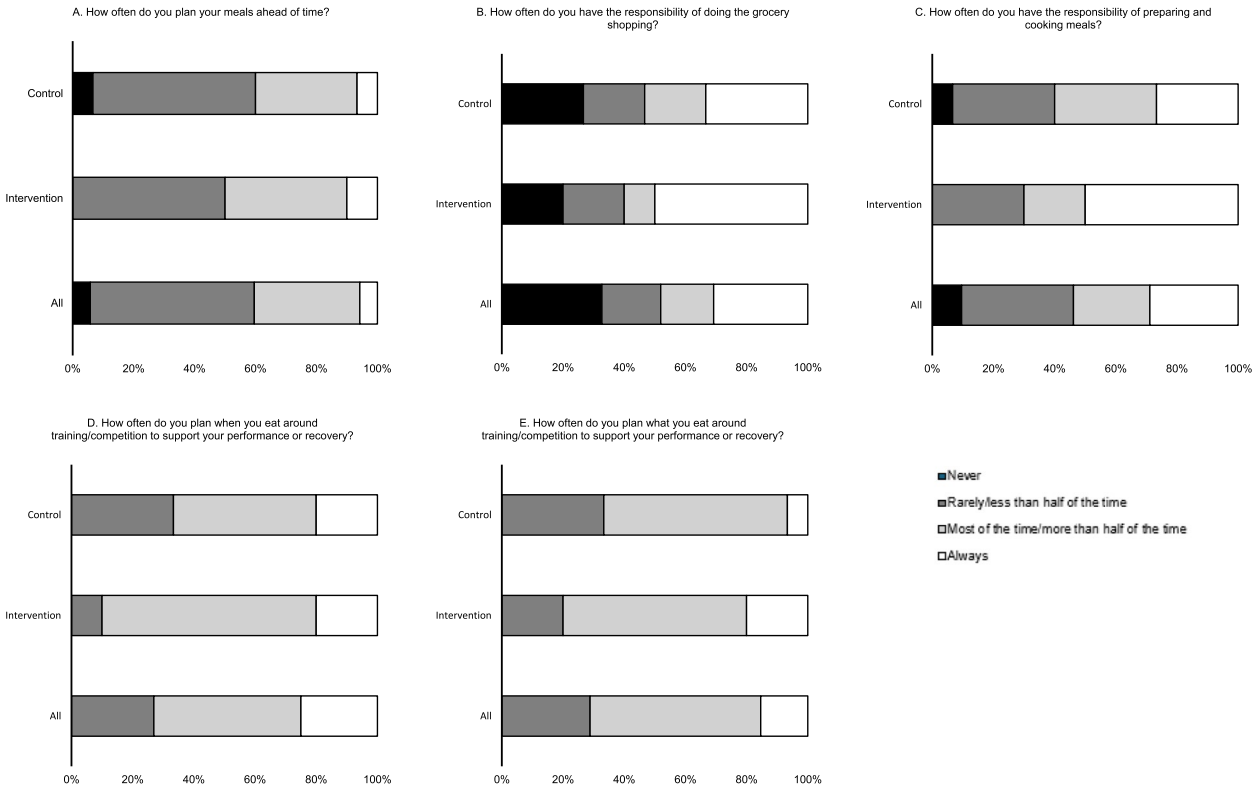

Fig. 1 Nutrition habits of players in the control group (top bar, $n=8$), players in the experimental group (middle bar, $n=10$), and all players who took part in the survey validation ($n=52$). Data is shown as 'never' (black bar), rarely/less than half of the time (dark grey bar), most of the time/more than half of the time (light grey bar), and all of the time (white bar)

confidence questions were prefixed with *"Say how good you are at each task on a scale of 1–7, where 1 is very poor/never do it, and 7 is very good"*, and then listed 13 tasks selected from the tool developed and validated by Lavalle et al. [25] (see Table 1). Nutrition knowledge was assessed using the abridged nutrition for sport knowledge questionnaire (A-NSKQ) developed and validated by Trakman et al. [26, 27]. The questionnaire contained thirty-five multiple choice questions, and has been shown to have acceptable internal reliability (PerSepIndex = 0.7) and the ability to discriminate between those who have and have not studied human nutrition, indicating suitable construct validity. Test re-test reliability was reported to be high ($r = 0.9$, $p < 0.001$), but typical error was not indicated so this was calculated for our population. See 'data analysis' and the first section of the results for more details.

Players in the experimental intervention received an information resource consisting of guidance for (i) daily intake of macronutrients, (ii) pre training/competition nutrition, (iii) during training/competition nutrition including hydration, (iv) post training/competition nutrition, (v) a template to help them personalise the sports nutrition guidelines for their own needs (e.g. body mass, training frequency and intensity), (vi) food hygiene, handling and storage, and (vii) twenty recipes (five breakfast, five small meals, five large meals and five snack ideas). Each recipe contained additional information on how to change the relative carbohydrate and protein content to match their personal template, make it plant based, and adapt to their own taste. All general advice was based mainly on the recommendations from Thomas et al. [28].

Players in the control group received an adapted version of the nutrition education resource. Information in sections i-iv was the same, with any links to example meal contexts removed, and they did not receive sections v-vii. The purpose of this was to isolate the effects of the practical guidance from the theoretical guidance. Both groups of players received their respective resource as a printed hand-out.

Data analysis

The reliability of the confidence part of the survey was assessed by calculating the Chronbach's alpha value using a threshold of 0.8 for acceptable reliability. A factor analysis was conducted to reduce the questions into valid groupings, employing a varimax rotation and coefficient threshold of 0.5. Test–retest reproducibility was assessed for this measure and nutrition knowledge by calculating the typical error between the two attempts by those in teams B and D who completed the follow-up, with no intervention in between ($n = 8$).

A sample size estimation was conducted to identify a difference between the experimental and control intervention groups. Assuming a difference of two points on the seven-point likert scale for the self-efficacy questions, and a standard deviation of 1.242 [25], eight in each group would provide a power of 80% (Minitab version 21.4).

The non-parametric Mann–Whitney U test was used assess the difference between groups as the data was not normally distributed, as checked by visual inspection of box plots. Therefore, the data is presented as median ± interquartile range. Comparisons were made between the pre-post change scores for each group, with significance where $p < 0.05$. All analyses were conducted using IBM SPSS (Statistical Package for the Social Sciences) Statistics version 28.0.0.

Table 1 Component Coefficients For The Confidence Items

	Factor 1: Meal planning and timing	Factor 2: Meal content and execution
Choose a meal to assist your preparation for or recovery from training/competition	0.916	
Plan the time of your meals ahead? (e.g. to fit around training/competition)	0.876	
Prepare and cook a meal to assist your preparation for or recovery from training/competition	0.802	
Plan meals ahead (e.g. for the day/week ahead)	0.698	
Drink the correct amount of fluid pre and post training/competition	0.681	
Identify an appropriate portion size for your own training needs	0.678	
Prepare or cook a meal with limited time		0.805
Follow recipes when cooking		0.702
Prepare or cook a meal with limited ingredients		0.638
Adapt a recipe for your own needs		0.630
Choose an ingredient high in protein		0.611
Choose an ingredient high in carbohydrate		0.573

Results

Survey reliability and validity

The Chronbach's alpha statistic was 0.905, above the threshold of 0.8. An initial factor analysis using all thirteen items resulted in several instances of cross-loading, but the removal of *"make a plant-based meal"* created two distinct factors (Table 1). Therefore, this item was excluded from the composite scores but still reported as an individual question. The test–retest reproducibility was 5.2, 3.5 and 4.4 points for the overall, factor 1 and factor 2 composite scores respectively. Average completion time was 15 ± 6 min.

Nutrition Habits

Fewer than half of the players (40%) regularly planned their meals ahead of time (Fig. 1A) but the majority planned what (71%) and when (73%) they ate in relation to training and competition most of the time (Fig. 1D&E). More than half had at least some responsibility for doing the grocery shopping (67%) and preparing and cooking meals (90%) (Fig. 1B&C).

Nutrition confidence and knowledge

The perceived confidence for each question, each factor, and overall is presented in Table 2, with no significant differences between groups evident. Sports nutrition knowledge increased from 12.00 ± 6.75 (21%) to 16.00 ± 5.50 (39%) for the intervention group, with no change for the control group (16.00 ± 2.25 and 16.00 ± 6.25), indicating a statistically significant improvement in the intervention group ($P=0.004$). Test re-test reproducibility for the A-NSKQ was four points. Players in each group selected 'not sure' on average eight times on both attempts.

Discussion

The results of the current study demonstrate that a nutrition intervention giving a personalisable information recipe-based resource for two weeks had a statistically significant but unlikely meaningful impact on sports nutrition knowledge and had no impact on nutrition confidence in women football players.

The findings of the present study showed that women players were conscious that they needed to adapt their eating behaviour around training and competition (Fig. 1), but sports nutrition knowledge (average score 13/35, 38%) and confidence were low. These results align with previous research reporting that women athletes are aware that nutrition is a key aspect of sport performance and health [3], but they often lack in fundamental knowledge [4, 5], which may be a contributory factor to misconceptions about appropriate nutrition recommendations observed by others [3]. Whilst the exponential growth in sports nutrition research in football has expanded knowledge and expertise, this could have caused confusion about what constitutes sound advice [6]. Considering the awareness of sex-specific nutritional differences has increased [7], this ambiguity might be more pronounced in women athletes regarding if the generalised recommendations are applicable for them [2]. Athletes or/and teams who are with limited resources, often rely on other support staff (i.e., coaches) or online sources for nutritional advice [29], but previous studies have found coach nutrition knowledge is often poor [10, 30, 31] and the quality of dietary information on the internet inconsistent [32]. The low confidence exhibited by players in the current study when planning or adapting meals for their performance would back these findings (Table 2). McHaffie et al. [3] found that 'confusion' was particularly acute around carbohydrate advice, particularly relating to body shape, and that there is evidence of 'carbohydrate fear' in women footballers. Previous studies in women team sport athletes have shown lower than recommended carbohydrate intakes [3, 33] and a narrative review by Birkenhead and Slater [34] concluded that athlete food selection was influenced by concerns about body composition. Players in the current study may have been aware of the advice given for performance on both diet and body composition but also of media coverage on low carbohydrate diets, explaining this finding.

Face-to-face or online education is typically used to increase nutrition knowledge in athletes [15]. Over 80% of education interventions are shown to improve nutrition knowledge in athletes [17, 35] but they do not always ensure a change in dietary practice [36] and delivering education resources alone is often insufficient to create behaviour change as greater self-efficacy is required [4]. This is especially the case in skill-based sports like football where nutrition does not dictate performance, and the motivation to change may be low [37]. Developing programmes of support that target knowledge, attention and decision processes, behavioural regulation, and skill are shown to be more effective in athletes [38]. However, this can be difficult to achieve in the small amount of time some athletes have access to a nutritionist for. Therefore, the current study added a personalisable template and adaptable recipe advice to aid translation from the information sheet to practice. The addition of this material resulted in a significant improvement in nutrition knowledge compared to the control group who only received advice without the recipes ($p=0.004$), but the knowledge was still low (Table 2). Furthermore, there was no clear pattern in which questions the players improved on, and 'not sure' was selected a similar number of times at each point by both groups, indicating that the difference may be type one error as opposed to improved

Table 2 Nutrition Self-Efficacy For Each Question, Each Factor And The Total Score For All Participants ($N=52$), Control Group ($N=8$), And The Experimental Group ($N=10$)

Item (out of possible 7)	Group	Pre	Post	*P*
Plan meals ahead (e.g. for the day/week ahead)	Control	3 ± 4.25	3.5 ± 3.25	0.07
	Intervention	3 ± 1.5	4 ± 1.75	
	All	3 ± 2	-	
Plan the time of your meals ahead? (e.g. to fit around training/ competition)	Control	3 ± 2	4 ± 1.25	0.97
	Intervention	3 ± 2	4.5 ± 2.25	
	All	4 ± 2	-	
Choose a meal to assist your preparation for or recovery from training/ competition	Control	3 ± 1.5	3.5 ± 2.25	0.20
	Intervention	4 ± 2.5	4.5 ± 2.25	
	All	4 ± 3.25	-	
Prepare and cook a meal to assist your preparation for or recovery from training/competition	Control	3 ± 2.25	2.5 ± 2.25	0.20
	Intervention	3.5 ± 2.75	4.5 ± 2.25	
	All	4 ± 3	-	
Identify an appropriate portion size for your own training needs	Control	3 ± 3	2.5 ± 3	0.08
	Intervention	2.5 ± 2	3 ± 2.5	
	All	3 ± 3	-	
Drink the correct amount of fluid pre and post training/competition	Control	4.5 ± 3.25	3.5 ± 3	0.52
	Intervention	3.5 ± 2.75	4.5 ± 2.75	
	All	4 ± 2.25	-	
Factor 1 total: Meal planning and timing (out of possible 42)	Control	18 ± 12.5	17.5 ± 10.25	0.08
	Intervention	18.5 ± 13.25	27.5 ± 12.5	
	All	22.5 ± 14.25	-	
Follow recipes when cooking	Control	5 ± 2.25	4.5 ± 1	0.32
	Intervention	2 ± 1.5	3 ± 3	
	All	2.5 ± 3.25	-	
Prepare or cook a meal with limited time	Control	3.5 ± 2	4.5 ± 2	0.83
	Intervention	3 ± 1.5	3 ± 2.25	
	All	3.5 ± 3	-	
Prepare or cook a meal with limited ingredients	Control	2.5 ± 1.25	2.5 ± 4	0.10
	Intervention	2 ± 1.5	3.5 ± 2.5	
	All	3.5 ± 3	-	
Adapt a recipe for your own needs	Control	4 ± 2.25	3.5 ± 2	0.90
	Intervention	3.5 ± 3.25	3 ± 2	
	All	3 ± 3	-	
Choose an ingredient high in carbohydrate	Control	4.5 ± 1	5 ± 2.25	0.76
	Intervention	4.5 ± 2.5	5 ± 2	
	All	4 ± 3	-	
Choose an ingredient high in protein	Control	4 ± 2.25	4 ± 2	0.70
	Intervention	4 ± 2.75	5 ± 2	
	All	5 ± 3	-	
Factor 2 total: Meal content and execution (out of possible 42)	Control	20.5 ± 9	23.5 ± 10	0.70
	Intervention	18.5 ± 9.5	22 ± 8.75	
	All	21.5 ± 14	-	
Total score (out of possible 84)	Control	40 ± 19.5	40 ± 20.25	0.52
	Intervention	41.5 ± 19.75	51 ± 21.75	
	All	46 ± 22.25	-	
Make a plant-based meal*(excluded from the composite scores)	Control	3.25 ± 4	3.5 ± 4	0.90
	Intervention	1 ± 0.2	1 ± 1	
	All	1 ± 1	-	

knowledge. Topics that were consistently answered incorrectly by more than half of players related to protein intake, micronutrients, carbohydrate feeding during exercise, and hydration; information which can be used to inform future education content for this population.

Nutrition confidence was low at the start of the study (Table 2), potentially having a negative impact on perceived competence, and therefore autonomy. The experimental resource was designed to be relatable, allowing players to adapt guidelines for their own needs, with practical advice such as recipes and information for the handling and storage of food to help players develop their perceived competence, and become more confident in their own performance nutrition. Most players in this study had a responsibility for grocery shopping and cooking in their households (Fig. 1B&C), which highlights opportunity for autonomy, the final element of self-determination theory. Within self-determination theory, autonomy develops with familiarity with information [39], and competence develops when individuals developing a sense of mastery and self-efficacy [24]. Despite this, the intervention did not result in any statistically significant improvements in either of the two factors emerging from the survey, or the overall composite score (Table 2). It is possible that the two-weeks given between surveys in the current study might have not been enough time to influence autonomy and competence. This is perhaps due to relatedness not being as high as intended, as engagement with the study was poor (of the 52 who started the study, only 26 finished and only 7/10 made one of the recipes). That some of the areas consistently answered incorrectly in the knowledge questionnaire were explicitly covered in the resource further indicates that engagement was low. The intervention was designed to stand alone and be available to clubs and teams with low nutritionist contact time. Incorporating other factors with the written resource that influence the behaviour of athletes, and being aware of key barriers and enablers [37] would help to create lasting behaviour change. For example Solly et al. [40] found the most effective teaching techniques chosen by National and International athletes in a self report survey of best practice were giving real life examples (47.6% of athletes), including hands-on activities (30.6%), and adding discussion (30.6%). Therefore, our results reinforce the importance of ongoing visibility of nutrition support for athletes as opposed to take home guidance that may not be engaged with. Future research could incorporate regular in person support to build relatedness, to allow investigation into whether a supplementary resource such as the one used in this study can develop competence and autonomy to improve motivation to engage with nutrition and develop confidence. It is also important to acknowledge that the guidelines were general as opposed to female specific, which may have impacted upon engagement.

The experimental resource did not include information on supplementation or safe supplement use, rather a link to relevant guidelines and the Informed Sport testing database. This was done so as not to risk any supplementation advice being misinterpreted or initiating a misunderstanding that they should be taking supplements. Answers to questions on supplement knowledge in the initial survey with 52 players was weak, with fewer than 50% of correct answers on supplement label accuracy, possible contamination, evidence of benefit and WADA guidance. Supplement use by athletes has been shown to increase with the level of sport performance [41]. Recent studies have observed high prevalence of supplement use in female athletes [42, 43], and with the increasing professionalism within the women game, greater education on safe supplement use should also be included as part of any future education resource and greater research is needed to investigate the efficacy of supplements, and supplement dosing strategies that have previously only been investigated in male athletes [6, 44].

Conclusions

In conclusion, the present study showed that a short-term structured and personalisable recipe-based nutrition resource resulted in negligible improvements in sports nutrition knowledge but not confidence in women football players.

We highlight the importance of ongoing nutrition support for players where feasible as opposed to a take-home 'do-it-yourself' resource. When paired with the low engagement from players in this study, we recommend that researchers design interventions in partnership with the players to increase motivation through relatedness and seek to evaluate the integration of these resources within other regular support.

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Authors' contributions
DP, IW, MB, VM, PR, conceptualisation; DP, IW, MB, VM, PR, OE, TS methodology; DP, IW, MB, VM, PR, OE, TS investigation and data collection; DP formal analysis; all authors; writing, review and editing. All authors approved the final version of the manuscript.

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Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This study was performed in accordance with the Declaration of Helsinki and was approved by the Northumbria University Ethics Committee (54329). All participants provided informed consent.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. Cowley ES, Olenick AA, McNulty KL, Ross EZ. "Invisible sportswomen": the sex data gap in sport and exercise science research. Women Sport Phys Act J. 2021;29(2):146–51.
2. Holtzman B, Ackerman KE. Recommendations and nutritional considerations for female athletes: health and performance. Sports Med. 2021;51(Suppl 1):43–57.
3. McHaffie SJ, Langan-Evans C, Morehen JC, Strauss JA, Areta JL, Rosimus C, et al. Carbohydrate fear, skinfold targets and body image issues: a qualitative analysis of player and stakeholder perceptions of the nutrition culture within elite female soccer. Science and Medicine in Football. 2022;6(5):675–85.
4. Abood DA, Black DR, Birnbaum RD. Nutrition education intervention for college female athletes. J Nutr Educ Behav. 2004;36(3):135–9.
5. Manore MM, Patton-Lopez MM, Meng Y, Wong SS. Sport nutrition knowledge, behaviors and beliefs of high school soccer players. Nutrients. 2017;9(4):350.
6. Collins J, Maughan RJ, Gleeson M, Bilsborough J, Jeukendrup A, Morton JP, et al. UEFA expert group statement on nutrition in elite football. Current evidence to inform practical recommendations and guide future research. Br J Sports Med. 2021;55(8):416.
7. Okholm Kryger K, Wang A, Mehta R, Impellizzeri FM, Massey A, McCall A. Research on women's football: a scoping review. Science and Medicine in Football. 2022;6(5):549–58.
8. Martinho DV, Field A, Naughton R, Ribeiro AS, Rebelo A, Gouveia ÉR, Sarmento H. Nutritional perspectives in female soccer: a scoping review. J Int Soc Sports Nutr. 2024;21(1):2366427.
9. Hornstrom GR, Friesen CA, Ellery JE, Pike K. Nutrition knowledge, practices, attitudes, and information sources of mid-american conference college softball players. Food Nutr Sci. 2011;2(2):109–17.
10. Cockburn E, Fortune A, Briggs M, Rumbold P. Nutritional knowledge of UK coaches. Nutrients. 2014;6(4):1442–53.
11. Langan-Evans C, Cronin C, Hearris MA, Elliott-Sale KJ, Morton JP. Perceptions of current issues in female sport nutrition from elite athletes, practitioners, and researchers. Women Sport Phys Act J. 2022;30(2):133–43.
12. Petri C, Pengue L, Bartolini A, Pistolesi D, Arrones LS. Body Composition Changes in Male and Female Elite Soccer Players: Effects of a Nutritional Program Led by a Sport Nutritionist. Nutrients. 2024;16(3).
13. San Atanasio SA, Maroto-Izquierdo S, Sedano S. Effects of exchange vs. controlled diet on biochemical, body composition and functional parameters in elite female soccer players. PLoS One. 2023;18(11):e0289114.
14. Robinson SL, Morton JP, Close GL, Flower D, Bannock L. Nutrition intervention for an international-standard female football player. JACSSES. 2014;1:17–28.
15. Cholewa JM, Landreth A, Beam S, Jones T, MacDonald CJ. The effects of a sports nutrition education intervention on nutritional status, sport nutrition knowledge, body composition, and performance in NCAA Division I baseball players. J Int Soc Sports Nutr. 2015;12:1–2.
16. Dewi M, Hanifah G, Purnawan AI, Putri WP, Mulyo GPE. The effect of nutrition education on nutrition knowledge and Macronutrition Intake in Muay Thai Athletes. Open Access Maced J Med Sci. 2021;9(E):1544–8.
17. Tam R, Beck KL, Manore MM, Gifford J, Flood VM, O'Connor H. Effectiveness of education interventions designed to improve nutrition knowledge in athletes: a systematic review. Sports Med. 2019;49:1769–86.
18. Jenner SL, Devlin BL, Forsyth AK, Belski R. Assessing the nutrition knowledge of professional female Australian football (AFLW) athletes. Science and Medicine in Football. 2020;4(3):240–5.
19. Heaney S, O'Connor H, Naughton G, Gifford J. Towards an understanding of the barriers to good nutrition for elite athletes. Int J Sports Sci Coach. 2008;3(3):391–401.
20. Lydon R, McCloat A, Mooney E, Kelly-Blakeney E. Recipes for Success: Lessons learned from the implementation of a food skills and nutrition education workshop with Gaelic athletic players on the Island of Ireland (IOI). Health Educ J. 2023;82(1):41–53.
21. Clarkson BG, Plumley D, Philippou C, Wilson R, Webb T. Money troubles and problems ahead? The financial health of professional women's football clubs in England. Sport, Business and Management: An International Journal. 2023;13(5):563–81.
22. Krech M. Towards equal rights in the global game? FIFA's strategy for women's football as a tightly bounded institutional innovation. Tilburg Law Review. 2020;25(1):12–26.
23. Renard M, Kelly DT, Ní Chéilleachair N, Lavelle F, Ó Catháin C. Cooking and food skills confidence of team sport athletes in Ireland. Nutr Bull. 2023;48(3):329–42.
24. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. Am Psychol. 2000;55(1):68.
25. Lavelle F, McGowan L, Hollywood L, Surgenor D, McCloat A, Mooney E, et al. The development and validation of measures to assess cooking skills and food skills. Int J Behav Nutr Phys Act. 2017;14:1–13.
26. Trakman GL, Brown F, Forsyth A, Belski R. Modifications to the nutrition for sport knowledge questionnaire (NSQK) and abridged nutrition for sport knowledge questionnaire (ANSKQ). J Int Soc Sports Nutr. 2019;16(1):26.
27. Trakman GL, Forsyth A, Hoye R, Belski R. Development and validation of a brief general and sports nutrition knowledge questionnaire and assessment of athletes' nutrition knowledge. J Int Soc Sports Nutr. 2018;15:1–8.
28. Thomas DT, Erdman KA, Burke LM. Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: nutrition and athletic performance. J Acad Nutr Diet. 2016;116(3):501–28.
29. Abbey EL, Wright CJ, Kirkpatrick CM. Nutrition practices and knowledge among NCAA Division III football players. J Int Soc Sports Nutr. 2017;14(1):13.
30. Couture S, Lamarche B, Morissette E, Provencher V, Valois P, Goulet C, Drapeau V. Evaluation of sports nutrition knowledge and recommendations among high school coaches. Int J Sport Nutr Exerc Metab. 2015;25(4):326–34.
31. Trakman GL, Forsyth A, Hoye R, Belski R. Australian team sports athletes prefer dietitians, the internet and nutritionists for sports nutrition information. Nutr Diet. 2019;76(4):428–37.
32. Hirasawa R, Yachi Y, Yoshizawa S, Horikawa C, Heianza Y, Sugawara A, et al. Quality and accuracy of Internet information concerning a healthy diet. Int J Food Sci Nutr. 2013;64(8):1007–13.
33. Tarnowski CA, Rollo I, Carter JM, Lizarraga-Dallo MA, Oliva MP, Clifford T, et al. Fluid balance and carbohydrate intake of elite female soccer players during training and competition. Nutrients. 2022;14(15):3188.
34. Birkenhead KL, Slater G. A review of factors influencing athletes' food choices. Sports Med. 2015;45:1511–22.
35. Sánchez-Díaz S, Yanci J, Castillo D, Scanlan AT, Raya-González J. Effects of nutrition education interventions in team sport players. A systematic review Nutrients. 2020;12(12):3664.
36. Boidin A, Tam R, Mitchell L, Cox GR, O'Connor H. The effectiveness of nutrition education programmes on improving dietary intake in athletes: a systematic review. Br J Nutr. 2021;125(12):1359–73.
37. Bentley MR, Mitchell N, Sutton L, Backhouse SH. Sports nutritionists' perspectives on enablers and barriers to nutritional adherence in high performance sport: A qualitative analysis informed by the COM-B model and theoretical domains framework. J Sports Sci. 2019;37(18):2075–85.
38. Cane J, Richardson M, Johnston M, Ladha R, Michie S. From lists of behaviour change techniques (BCT s) to structured hierarchies: comparison of two methods of developing a hierarchy of BCT s. Br J Health Psychol. 2015;20(1):130–50.

39. Deci EL, Ryan RM. The support of autonomy and the control of behavior. J Pers Soc Psychol. 1987;53(6):1024.
40. Solly H, Badenhorst CE, McCauley M, Slater GJ, Gifford JA, Erueti B, Beck KL. Athlete Preferences for Nutrition Education: Development of and Findings from a Quantitative Survey. Nutrients. 2023;15(11):2519.
41. Garthe I, Maughan RJ. Athletes and supplements: prevalence and perspectives. Int J Sport Nutr Exerc Metab. 2018;28(2):126–38.
42. Molina-López J, Pérez AB, Gamarra-Morales Y, Vázquez-Lorente H, Herrera-Quintana L, Sánchez-Oliver AJ, Planells E. Prevalence of sports supplements consumption and its association with food choices among female elite football players. Nutrition. 2024;118:112239.
43. Sebastiá-Rico J, Martínez-Sanz JM, Sanchis-Chordà J, Alonso-Calvar M, López-Mateu P, Romero-García D, Soriano JM. Supplement Consumption by Elite Soccer Players: Differences by Competitive Level, Playing Position, and Sex. Healthcare. 2024;12(4):496.
44. Moss SL, Randell RK. Sports nutrition recommendations for elite female soccer players. Sports Science Exchange. 2022;227.

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