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ORIGINAL INVESTIGATION

Carbohydrate fear, skinfold targets and body image issues: a qualitative analysis of player and stakeholder perceptions of the nutrition culture within elite female soccer

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ABSTRACT

Purpose: This qualitative study explores player and stakeholder perceptions of the role of nutrition in supporting player development and performance in elite female soccer.

Methods: Semi-structured interviews (36 ± 18 mins in length) were conducted with 47 participants, including players (n = 12), parents (n = 9), coaches (n = 9), sport scientists (n = 7), nutritionists (n = 5) and medical staff (n = 5). Via thematic analysis, data provided an insight into the nutrition culture within elite women's soccer.

Results and conclusions: Data demonstrate that considerable confusion and misconceptions exist amongst players and stakeholders regarding the theoretical underpinning and practical application of meeting energy requirements. As such, it is perceived that players 'under-fuel', which is likely caused by misunderstandings about the impact of carbohydrate intake on body composition, a fear of weight gain and the associated impacts upon body image. The 'carbohydrate fear' that is experienced by players is exacerbated by external pressures arising from social media, key stakeholders (e.g., coaches) and the skinfold culture surrounding measurement of body composition. Such cultural issues are amplified by the lack of full-time professionally accredited nutritionists overseeing the provision of nutrition support. Indeed, the infrastructure supporting the women's game (e.g. staffing resource, on-site food provision, player education programmes, etc.) was considered incomparable to the men's game.

When taken together, our data provide a platform for which to develop organisational, stakeholder and player centred education and behaviour change interventions that strive to promote a positive performance nutrition culture within the women's game.

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KEYWORDS
Body composition; body image; weight gain; carbohydrate

Introduction

In recognition of the increasing growth and professionalism of the women's game (Fédération Internationale de Football Association 2017, 2019; Petty and Pope 2019), there have been multiple calls for a strategic and multidisciplinary research agenda that seeks to improve the health and performance of the female soccer player (Datson et al. 2017; Nassis et al. 2021). Indeed, in a recent audit of research conducted to date, it was demonstrated that the existing research base is not comparable to the men's game (Okholm Kryger et al. 2021). In terms of potential research priorities, this audit identified that nutrition-related research is less studied when compared with other sub-disciplines of sport and exercise science (Okholm Kryger et al. 2021). Furthermore, the nutritional guidelines that are currently directed to female athletes are based on research primarily conducted on males (Moore et al. 2021). This lack of female specific research is of particular concern given that female athletes are susceptible to chronic low energy availability (LEA) (Heikura et al. 2021), the result of which can manifest as symptoms associated with the female athlete triad or relative energy deficiency in sport (RED-S) models (Nattiv and Lynch 1994; Mountjoy et al. 2018). In this way, female players may also be susceptible to negative health outcomes such as disordered eating, extreme weight loss, amenorrhea and low bone mineral density (Brown and Knight 2021; Langbein et al. 2021).

In a step towards female-specific guidelines, we recently provided the first report to assess total daily energy expenditure (using the doubly labelled water technique) of international standard female soccer players (Morehen et al. 2021). Although we observed a relative daily energy expenditure (i.e., 50 kcal.kg^{-1} fat-free mass, FFM) comparable to their male counterparts (Anderson et al. 2017), it is noteworthy that 88% of the players presented with LEA when energy intake was assessed during a 4-day training period, as defined as an energy availability <30 kcal.kg^{-1} FFM. Furthermore, only one of the 24 players consumed the recommended amount of carbohydrate (CHO) intake (e.g. 6–8 g.kg^{-1} body mass) on the day prior to the game, thus it is likely that players commenced match play with sub-optimal muscle glycogen stores (Krustrup et al. 2021). Additionally, mean daily CHO intake during the assessment period was 3.3 g.kg^{-1} body mass, and players did not adjust daily CHO intake in line with the daily physical training load and demands, as is suggested based on CHO guidelines for soccer (Collins et al. 2021). Our data were comparable to previous observations of female professional players from the English

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Women's Super League (WSL) (Moss et al. 2021), thereby suggesting that female players 'under-fuel' in relation to the energetic requirements of daily training and match play.

The precise reasons underpinning the prevalence of 'underfuelling' are not yet understood. On the one hand, it could simply be that female players (and associated stakeholders, e.g., coaches, sport science staff, parents, etc.) are not yet aware of the recommended nutritional guidelines and hence, the requirement to fuel is not actively encouraged. Alternatively, there may be various organisational and financial (e.g., lack of qualified staff and practical on-site food provision) factors that present as a reduced opportunity to engage with sound nutritional practices. Moreover, there may be underlying belief systems and misconceptions amongst players and stakeholders that manifest as a reluctance to actually consume a sufficient energy (and CHO) intake, potentially occurring where players are exposed to an environment where 'body composition' is emphasised as a performance priority and high CHO diets are thought though to promote body fatness (Kerr et al. 2006; Jankauskiene and Pajaujiene 2012; Beckner and Record 2016; Hyatt and Kavazis 2019). In consideration of all the above, the first step in changing future behaviour is to therefore understand the reasons behind current activities that are limiting the desired approaches (Michie et al. 2011). Considering such factors through the lens of theoretical models such as the 'capability, opportunity and motivation behaviour (COM-B) framework and behaviour change wheel (Michie et al. 2011, 2014) may help to provide a basis to formulate improved behaviour change interventions.

With the above in mind, the aim of the present study was to explore player and stakeholder perceptions of nutrition practices in support of female soccer players' development and performance. Using a qualitative analysis, we interviewed a cohort of players (n = 12), parents (n = 9), coaches (n = 9), sport scientists (n = 7), nutritionists (n = 5) and medical staff (n = 5) from elite women's soccer at both club and international level. Our data provides a starting point to formulate organisational and individual educational and behaviour change strategies that aim to create a positive culture surrounding nutrition for the female soccer player.

Methods

To explore players' and key stakeholders' perceptions on the role of nutrition in influencing player development and performance, we took a qualitative approach. Qualitative research provides a route to understand the experiences and perceptions of individuals within complex social environments (Sparkes and Smith 2014). As such, it was deemed an appropriate methodology for the present study. This manifests in the methods described below that were employed to provide a credible and transparent account of nutritional practices in elite women's soccer.

Sample

To gain detailed and multiple insights into the perceptions of nutrition in elite female soccer, players, parents and staff in varying roles (all currently working in and residing in England) were purposefully invited to take part in the study. This approach is comparable to previous qualitative explorations of nutrition practices in professional sport (Martin et al. 2017; Logue et al. 2021), which values the perceptions of those who experience a phenomenon, and enables the development of a broad understanding of the soccer context in question. The inclusion criteria for the purposeful sample included those above 16 years old, who had experiences of elite female football in England, within one of the roles (e.g., player, parent, coach etc.). To recruit this sample, some participants were contacted through gatekeepers of their respective governing bodies via an email including details of the study and participant information details. Convenience sampling was also used to contact other participants who met the inclusion criteria. This convenience sample was appropriate to reflect a range of experiences. All players (n = 12) recruited were aged above 16 years old and competed in elite women's soccer, representing teams in the WSL (n = 9) or The FA Women's Championship (n = 3) in England. Some players also competed at senior (n = 4) and youth (n = 7) international level at the time of the study. Parents or guardians (n = 9) also took part, all of whom currently live with an elite female soccer player, aged 16–18 years. Staff members invited to the study all currently work full-time in elite women's soccer, at club level or international level, in varying roles. These roles included technical coaches (n = 9), sport scientists (n = 7), nutritionists (n = 5), and medical staff (n = 5). Together, this sample enabled the generation of an in depth understanding of nutrition in elite women's soccer. Institutional ethical approval was granted by the ethics committee and, as condition of this, further details of the participants are not provided to avoid direct identification. All participants provided verbal and written informed consent before completing the interview, including child assent and carer consent forms for those under the age of 18 years. Consistent with qualitative research (Sparkes & Smith, 2014), the sample size was not decided a priori, but determined by the analysis, with recruitment stopping for each participant group once saturation was experienced. This involved the lead researcher ceasing to recruit participants when no new insights were derived from further interviews.

Data collection

Semi-structured interviews (36 ± 18 mins) with cameras on were conducted with all participants using online software (Zoom Video Communications, California, USA) and were audio-recorded. A parent was present in the room for all interviews with players under the age of 18 years (n = 5). These interviews provided accessible and safe spaces for participants to share their experiences and perceptions. An 'open ended' (Gall et al. 2003) format was adopted, presenting all questions in a conversational and informal manner, to allow maximum voluntary contribution and detail. For example, questions began with phrases such as, 'What are your thoughts on … ?' and 'In your opinion … ?'. Following this, naturally occurring probing questions (Gratton and Jones 2004) were asked to gain more detail. This format of enquiry allowed participants the liberty to express their experiences and opinions with minimal constraints and to self-navigate

towards areas they felt significant (Braun and Clarke 2013). The interview was centred on determining the participants' perceptions of the nutritional priorities and challenges of elite female soccer players. The questions were created with the study aims in mind; however, it was difficult to base the questions on previous research due to a lack of qualitative studies conducted in elite female soccer players (Okholm Kryger et al. 2021). The interview was split into three domains: (1) 'Participant background and demographic', (2) 'Perceived impact of nutrition on performance with an emphasis on priorities and challenges', and (3) 'Female specific performance nutrition priorities and challenges, detailed in Table 1 (note, the full data set derived from domain 3 is not presented in the present paper due to scope). In order to determine the viability of the interview questions for use with athletes and stakeholders, pilot interviews were conducted with two female players and three staff members, which were not included as part of the final analysis. The wording of some questions was adjusted following these trial interviews based on feedback, to make the questions more accessible to all.

Analysis

All interviews were transcribed verbatim and Nvivo10 software (QSR International, London, England) was used as a data management tool to store data. Primarily an inductive approach was taken, in order to prioritise the voices of those with experience in elite female soccer. The lead author identified meaningful segments of text based on the question domains. As part of the analysis process, these meaningful segments were subject to initial (open) coding (Saldaña 2021). Once this initial coding was complete, codes were revisited as part of a focused process to identify potential themes across the data, and to consider the research aim. Themes were subsequently developed over several iterations by the lead researcher. Through discussion with the research team, these themes were refined in order to provide a credible and trustworthy 'common thread' (Sparkes and Smith 2014), which is presented in the findings to come.

Rigour

In order to ensure credible and transparent perceptions of nutritional practices in elite women's soccer, several procedures were undertaken. These procedures aspired to add rigor whilst maintaining a coherent qualitative focus on understanding the subjective and multiple perspectives of the participants (Sparkes and Smith 2009; Smith and McGannon 2017). For example, interviews were conducted by a researcher trained in qualitative methods and experienced as a nutritionist in women's soccer. Mindful of their own subjectivities, interview questions were examined by a critical friend to ensure they were not leading. Pilot interviews were conducted to ensure questioning and probing were accessible to participants. A range of views from players, parents and staff were gathered. A critical friend (Smith 2018) who is detached from nutrition practices in elite sport was also used to check and challenge data analysis, theme generation and the presentation of selected quotes that come. The role of the critical friends is 'not to "agree" or achieve consensus, rather to encourage reflexivity by challenging each other's' construction of knowledge (Cowan and Taylor 2016).

Table 1. Player interview guide and aims – Wording adjusted for stakeholders (note, the full data set derived from domain 3 is not presented in the present paper).

Questions	Prompts	Aim
Domain 1: Participant background and demographic		
Can you tell me about your journey as a footballer so far?	Clubs, age started, setbacks, injuries.	Understand their background and experience.
How are training and matches going at the moment?	Club schedule, international schedule, any challenges.	Understand their history in terms of standard and training schedule.
Can you tell me about what kind of support you currently get from staff?	Size of staff team, sport science, nutrition, part/full time, internal/external.	Understand the level of support they have had and responsibility for nutrition.
Domain 2: Perceived impact of nutrition on performance – priorities and challenges		
Have you received much nutrition advice throughout your career so far?	Who from? Was it useful? Method of support.	Understand their experience of nutrition support.
Has your attitude towards nutrition or nutrition knowledge changed over time?	What has impacted this?	Understand their perceptions of the importance of nutrition.
What are your thoughts on nutrition and whether it impacts performance?	What areas? To what extent? Matches, training?	Understand what areas they perceive nutrition to impact and why.
Can you tell me about you approach to these areas of performance?	Strategy in place? Optimal? Barriers?	Understand their level of knowledge and practice.
Have you experienced any nutrition challenges?	When? Why? Areas of performance?	Understand what nutritional challenges they face and why.
Is there any support you have received to overcome these challenges that has been helpful?	Why? What else would be helpful?	Understand what they perceive to be helpful.
Domain 3: Female specific performance nutrition priorities and challenges		
Do you think any of the priorities previously mentioned are more of a challenge because you are female?	If so, why? Physiological or cultural?	Understand if their previous perceptions are female specific.
Do you think contraceptive status or the menstrual cycle impacts performance?	Their status? Why? Tracking, area of performance.	Understand if they perceive/experience a performance impact of the menstrual cycle.
Do you think this impacts your nutrition at all?	Positively or negatively? Appetite? Intentional?	Understand if and how nutrition habits/needs are impacted.
In your opinion, is support in this area is necessary?	Any experience? What is helpful? Who should be responsible?	Understand what they think support should look like in reality.

Consistent with this, the critical friend challenged the coding process and themes were refined over time to provide a credible account of participants' experiences.

Results and findings

Following data synthesis and analysis, four themes were established that present a narrative of the nutrition culture within elite women's soccer. These themes are presented below, with player and stakeholder quotes presented verbatim to support the narrative.

Theme one – fuelling is important but under-fuelling is common

When initially asked to identify performance nutrition priorities for elite female soccer players, participants across all groups identified a range of components such as fuelling, body composition, hydration, supplementation and recovery. Fuelling (the act of consuming enough energy to meet energy demands) emerged as the most consistent theme, where a specific focus was placed on adequate CHO intake for match day performance. Indeed, most players (n = 9/12) identified the importance of fuelling for match day performance. One player specifically discussed the positive impact she has felt on her performance since being made aware of the importance of CHO intake. This awareness came as a result of receiving more nutrition support at both club and international level.

Player 1: One of the best examples from last season I can give is the FA Cup Final when we went to extra time. I think a lot of things were quite fresh, ideas and strategies, so I think that we did really well in that game. We covered a lot of ground and I don't think you can do that unless you are doing things correctly prior to the game and then during the game.

Whilst 'fuelling well' was identified as facilitative to performance, 'under-fuelling' (i.e., the act of consuming insufficient energy and CHO to meet energy demands) was also identified by some players as having a negative impact on match day performance, as well as the long-term development and performance of team mates. This view was shared by an experienced international player, who has grown to understand the importance of fuelling, particularly in the context of a tournament with congested fixtures, since working with a full-time nutritionist.

Player 2: An endurance runner, they probably know that they have to eat a sh*t load of carbs but I do believe in football we're still not quite switched on with it. We play for 90 minutes, it's a long time. It's not a 100m sprint, you know, it's 90 minutes and I think it's making females understand that, you can still play at a top level of course, 100%, but you can't maintain it for game 1, game 2, game 3, game 4, you know. There's a reason why we get to semi-finals and we can't quite get over the line, you know, it's not a coincidence. People will bring up the 'they're not fit enough', no, that's not the case, we are fit enough, we play in the top league in the world, you know. WSL is one of the most competitive leagues in the world, like, there are other things that we need to be focussing on apart from that. Is it the fact that you're eating salad the day before a game? You know, you've been eating salad for two weeks now on camp, you know, so I think it's just normalising the conversation, making people aware you have to eat, you can't not eat.

Fuelling was also identified as a nutrition priority by the majority of (but not all) coaches (n = 5/9), parents (n = 6/9), sport scientists (n = 5/7) and medical staff (n = 4/5). As expected, all nutritionists (n = 5/5) identified fuelling as their 'number one' performance priority. However, despite such recognition from both players and stakeholders, there were contrasting views and an apparent lack of understanding of what fuelling should look like in practice i.e., what to eat and when, thereby highlighting a gap between knowledge and practice. For example, most players and stakeholders (except for nutritionists) did not understand the importance of consuming higher levels of CHO the day before a game, a day of the week that is often referred to as match day minus one (MD-1). Rather, there seemed to be a misconception amongst participants that the 'pre-match meal' (i.e., the last meal consumed by players before kick-off) was of greater importance than the CHO intake consumed on MD-1. One player astutely recognised the prevalence of misconceptions about match day nutrition amongst her teammates.

Player 5: Some of my team-mates, they read this theory, but I have no idea where, where they said eating salad is the new having carbs before a game.

Nutritionists were the only participant group who consistently recognised the importance of CHO intake on MD-1, and they were readily aware that this is an area where player knowledge and implementation is lacking.

Nutritionist 1: I haven't been part of a squad where every single player could genuinely tell you what their consistent MD-1 fuelling plan is.

From their experience, players do not get close to achieving the recommended CHO intake on MD-1, typically cited as ranging between 6–8 $g.kg^{-1}$ body mass (Collins et al. 2021).

Nutritionist 2: We started to do some lower-level analysis of the players, picked a couple of players out initially, did some analysis and it became quite clear that the carbohydrate intake of the team was likely to be certainly less than 10 g per kilo. In fact, none of them were anywhere near 6 g per kilo.

This confusion surrounding the practices inherent to match day fuelling was particularly apparent in coach interviews. For instance, two coaches appeared to be incorrectly concerned that consumption of high CHO foods on MD-1 may have an adverse impact on performance.

Coach 1: They obviously like their toast the night before a game and I'm no expert but I'm sure that's not the greatest preparation.

In addition to concerns regarding the impact of under-fuelling on performance, several stakeholder groups also extended this discussion to health and wellbeing outcomes. One club doctor (*Medical Staff 5*) provided an example of a player who suffered with secondary amenorrhea, who 'used to have, like, a banana in the morning and the first meal that she had was at about 4 o'clock in the afternoon.' *Player 11* also shared her personal experience of secondary amenorrhea. When she subsequently received nutrition and medical support, she later associated under-fuelling as the cause.

Player 11: I was increasing my training load and then I lost my period. I was then like, why have I? And then that made me realise 'oh, I need to focus on nutrition as well as football because it is just as important.

Impaired menstrual health was also reported by *Sport Scientist 7*, stating that 'There's also players who have never actually had a cycle while I've been at the Club'. Furthermore, some medical staff and nutritionists were particularly concerned about the potential impact that under-fuelling for performance could have on chronic low energy intake and therefore, injury prevalence.

Medical 5: They could become lethargic on the pitch, they may not be able to meet the demands of training, the demands of the matches. It could also put them at an injury risk, you know, if they're fatiguing quickly because they're not having enough food, they're not having enough nutritional intake and then the muscles become tired quicker, they start to become tighter and they then run the risk of injury.

Theme two – carbohydrate confusion, do carbs make me fat?

As an extension of the discussion regarding the impact of under-fuelling, some participants perceived that players may under-fuel daily due to an intentional reluctancy to consume CHO. Some staff members even referred to this as a 'fear of carbohydrates' and also identified players as being 'carb-phobic'.

Coach 3: When players are going through natural growth changes, you see them from a developmental point of view, changing body shape. Sometimes they feel that 'oh well I can't be eating extra carbs because carbs mean fat.'

Three players addressed this directly, all of whom believed that consuming 'too much' CHO makes you gain fat mass.

Player 4: It was quite difficult for me to actually transition into eating, like, more carbs and more calories because I was scared of putting weight back on. Sometimes I just don't want to eat carbs because I know they will make me fat.

This sentiment was also reported by nutritionists, with two participants giving examples of players not wanting to consume a 'protein shake' with added CHO after matches or strength and conditioning sessions. Such practices conflict with the well documented role of post-exercise CHO intake in facilitating muscle glycogen re-synthesis (Burke et al. 2017).

Nutritionist 4: The players don't want a mixed protein shake, they just want a protein shake because the mixed protein shake has got too much carbs in and it's, like, 'wow, they're not willing to have carbs after a game, that's pretty scary' I guess … The fact that they're worried about some carbohydrate powder in a protein shake because they think it will make them fat is quite a scary thing. And so they might not be recovering quickly or as efficiently because of that.

Despite the importance of CHO intake on MD-1, there was also a perceived reluctance from players to adhere to this strategy.

Sport Scientist 1: I've had conversations with players where I'm like 'you need to have carbs at least on match day minus one, making sure you're fuelling for the game ahead' and they're a bit reluctant to want to take on that amount of carbs. Like 'I don't like eating that many carbs, that's not something I do.'

The fact that it is 'not something they do' is also of interest here, as the language suggests a reluctancy to change. As well as being CHO specific, a fear of gaining weight also manifests itself as a general fear of consuming too much food.

Sport Scientist 7: This is basically a quote from a player she's 'afraid to eat more', you know, she was shown how much she needed to eat on a training day and she was, like, 'no I don't want to eat that much'. She had concerns.

Staff stakeholders also believe that players are often confused when told to consume more food or CHO, with some staff members believing that players are receiving 'mixed messages around body composition and fuelling' (*Sport Scientist 2*). This confusion was identified further by a goalkeeper coach working with an international senior team. *Coach 9* experienced this following the first appearance of a nutritionist on an international training camp.

Coach 9: Working with *National Team*, bringing in the nutritionist and saying, 'well we need to eat more' and, you know, they used to stand on the scales and say 'well I weigh this and that's my ideal body weight and I've always been that since I as 16 or 17' and then all of a sudden you're asking them to eat more food.

These misunderstandings are also present in parents, with *Sport Scientist 7* being 'asked by a parent if her daughter, aged 18, should go on a low carbohydrate diet.' Such mixed messages, misconceptions, and the 'intentional' reluctance to consume sufficient CHO are all indicative of a culture of CHO

confusion, the result of this lack of education has been documented as leading to both negative health and performance outcomes, due to the complex interplay between physiological and psychological components of RED-S and the female athlete triad (Langbein et al. 2021).

Theme three – Skinfold culture, body image issues and social media pressure

Themes one and two present a narrative surrounding the role of fuelling as a performance nutrition priority. However, the challenge to fuel whilst also promoting a desirable body composition (and body image) also emerged as a cause for concern amongst participants. Interestingly, over half of the coaches (n = 6/9) interviewed specifically mentioned 'body composition' as an example of how nutrition can affect performance, whereas this thought was not as prevalent amongst other groups e.g. players (n = 3/12), parents (n = 2/9), medical staff (n = 1/5), nutritionists (n = 2/5) and sport scientists (n = 2/7). Coaches appeared to value players presenting with low levels of body fat, in order to optimise their physical performance.

Coach 5: I think generally you'd want players to be bit leaner, so have more muscle mass and not as much, erm, body fat percentage just in terms of the physical objectives that it allows them to then accomplish.

In contrast, all other staff members were more concerned with the challenge of players losing too much body fat or not gaining enough body mass, with nutritionists identifying the need for players to 'find their sweet spot' (*Nutritionist 4)* when it comes to levels of body fat. Although only three players specifically mentioned 'body composition' as a performance priority, it was 'body image' that presented as a more consistent challenge experienced by players. The consequences of players being consciously aware of how they look (and associated feelings of body dissatisfaction) may potentially present as mental health problems.

Player 4: I just feel like with women, weight is a touchy subject . . . .That's just how it's always been and I feel like it will always be this way, just because of the society we live in and especially with, like, all social media and stuff, the last thing you want is to feel is fat.

The assessment of players' body composition is frequently evaluated using a combination of weighing scales (to measure body mass) and skinfold callipers (to estimate body fat), often with a frequency of every 4–8 weeks. The perceived pressure to meet body composition targets was an important feature of the discussions surrounding body image. *Player 3* was one of many players (n = 7/12) who reported struggling with the 'skinfold culture'.

Player 3: I think for me, personally, it was skinfolds. So, knowing that you're getting your weight checked every 8 weeks, knowing that you were in the red zone, amber, green, it was almost, like, 'well if I'm in red now, how am I going to get into green? The only way to get into green is not eating, eating minimal', like, I think that is the main thing why women players struggle is because we constantly get weight checked and skinfolds.

The challenge to simultaneously fuel whilst also meeting body composition targets was reported as a contributing factor to the transient episodes of under-fuelling that were evident in Themes 1 and 2.

Player 2: I feel, as women, we're so conscious about our weight, how we look, how our body comps are, like, it's incredible actually, like when you actually think about it, the stress that people go through when they know that someone's coming in to take their body mass. You can just see it on people, like, some people don't eat the day before because they're so worked up about it and I think then you see what effect it has.

In addition to external pressure to meet objective targets, participants reported that comments from stakeholder groups (e.g. coaches, parents etc.) can also negatively impact a player's perception of their body image.

Coach 4: Her mum had made a throwaway comment 'oh you look like one of those East European shot putters' and I think she took this quite bad and worked so hard but ate so little during the break and came back something like 10 kilos underweight.

Participants also discussed the role that social media can play in influencing players' perceptions of body image. Indeed, in accordance with the increasing profile of the women's game, players' personal online following are also increasing, the result of which may manifest as further negative comments akin to 'trolling'.

Sport Scientist 7: Pressures on social media, being perceived to have to be a certain way, that comes with it's own remit of pressures. We had a player in the Academy quite recently and she was quite open about some of the negative comments that have been put her way on social media.

The 'desired ideal' women's body that is often portrayed on social media platforms may also not align to the body composition that is considered conducive to athletic performance. In this regard, medical and sport science staff identified that players may be concerned about putting on *too* much muscle. This was also identified by parents who are aware that their daughters are increasingly conscious of 'looking different' to their friends.

Sport Scientist 5: I've also noticed players don't want to look athletic in the gym as well so then you're trying to get them to increase protein and increase muscle mass obviously for performance and injury prevention that you struggle to get them to do, erm, a lot of gym

work and/or physical work 'cause' they're worried what they might look like in a dress for example.

In extreme circumstances, the collective pressure that can arise from objective body composition targets, stakeholder comments and social media presence may lead to a significant psychological impact. Indeed, many participants also provided examples of players who have apparently suffered with eating disorders that subsequently led to drop-out at both academy and senior level.

Player 1: I've seen it (under-fuelling) first-hand affect people to a point where it's actually ruined their careers because they've been more obsessed with what they look like than their football.

Theme four – Nutrition support – the current challenge and future solution

In relation to the current level of sport science service provision in the women's game, it became apparent that considerable discrepancies exist between teams from domestic-level competitions (i.e. the WSL and Championship) versus international teams. This was especially the case for performance nutrition services, where the lack of professionally accredited nutrition staff (i.e. sports nutritionists and/or dieticians) was highlighted. Such differences in the level of service provision can present as players with varying levels of nutritional knowledge.

Medical Staff 4: You'll have some clubs who have all singing and dancing and they do appear to have some education around this and then in the international set up you'll have people picked from the top clubs but you'll also have people from, you know, tier 3 or 4 clubs coming in and they have nothing.

The apparent lack of knowledge and dedicated (specialist) service provision can often result in players seeking knowledge elsewhere. For example, nutrition support was frequently reported as the responsibility of someone else at the club. This is typically a sport scientist, which may take time away from their own specialism or result in nutrition support not meeting the often-complex needs of individual players.

Coach 5: It ends up being almost more of a burden on the sports scientist who's got other concerns as well.

The lack of presence of an 'on-site' nutritionist may also increase the likelihood of unhelpful comments from other staff members. This can be damaging, and one example was provided by a senior player where the first team manager was making decisions on when players needed to lose weight.

Player 2: You had a manager, for example, who was telling people they needed to lose weight and, you know, that's not a good conversation to have, not just with anyone but with a female athlete 'cause, you know, that can have really, really bad effects on someone's mental state.

Additionally, players may seek nutrition support online, which is often not specific to the needs of an elite soccer player and can result in misconceptions. This may manifest itself as a player attempting to tailor their nutritional intake to their menstrual cycle status, which at present is not underpinned by a robust set of scientific data (Desbrow et al. 2019; McNulty et al. 2020; Moore et al. 2021).

Nutritionist 5: Sometimes I'll get players coming to me with 'I've heard this … ' or 'I've read this … ' and you're like 'where have you heard or read that?' [laugh] I think that's a challenge of itself.

The perceived lack of nutritional knowledge also extends to other key stakeholder groups. Indeed, parents also recognised that although they consider themselves critical to the education of their daughters, the lack of support provided by the clubs prevents them from imparting constructive messages.

Parent 1: I can tell you lots about how fast she should be able to do her 'MAS' test, you know, it's gotta be less than 4 minutes if you wanna play for *International Team*. I know all that but what I don't know is how many calories a day should she eat, nobody's told me this.

MAS, maximal aerobic speed test

Notwithstanding the conscious reluctance to fuel (i.e. the CHO fear) described in Themes 2 and 3), it could also be suggested that the lack of nutrition resource is also a contributing factor.

Player 5: When I first started going from such a low training load to a high training load I never really seemed to notice, like, I never understood that I needed to be fuelled more because I never had that support around me. It didn't really occur to me, like, it was that important because I just didn't have any support in it.

Due to a lack of finances, resources are not just lacking when it comes to personnel but also food provision. This was perceived as a 'major challenge' at some clubs, with many not providing any pre-training or post-training on-site food provision, even when the players have a full-time schedule. In instances where meals are provided, the quality can be poor, or it may not be what is required to meet specific player demands.

Player 3: I know obviously some clubs they might not get fed so they have to provide their own lunch, like, I remember at *WSL Club* we would get given whatever was left over from the men … So the men will have everything set out based on what they need for that week whereas, if we've got a game on a Wednesday night they might be having a low carb day so they've got less in the kitchen but you need obviously something different because our timetable's obviously different.

Due to this lack of provision, educating whoever is responsible for food provision when the players are away from the club was also identified as a key priority. This is particularly challenging when players move away from home, often when they get their first professional contract (commonly at aged 18–20). Players, parents or host families may struggle due to a lack of finances or cooking skills.

Player 3: I can't cook so if, yeah, if I didn't have someone around me now that could actually cook then what would I be eating? And then I think it's also, like, it's your family and for example I remember at, *Previous Club* there was one girl that wasn't from the wealthiest family, lived at home, we weren't on very good contracts at the time and she would have to eat what her family was cooking that night. So, if her family was having, I don't know, fish and chips from the chippy she was eating that every day because where else was she getting her food from?

Despite the recent and increasing professionalism of the women's game, it is therefore apparent that the level of performance nutrition service provision is not near comparable to that of the men's game. Indeed, in the latter environment, it is now commonplace for professional teams to employ full-time specialist staff to deliver a nutrition programme that is aligned from senior to academy level (Carney et al. 2022). Although it is not yet clear whether this lack of service provision is due to a lack of awareness of the role of nutrition and/or limited finances, our findings collectively demonstrate that a more strategic and aligned approach (amongst all stakeholders) is required to promote long-term player health and performance.

Discussion

Using a qualitative approach, the aim of the present study was to explore player and stakeholder perceptions on the role of nutrition in supporting player development and performance. Although 'fuelling' was identified as a critical nutritional priority, our data demonstrate that considerable confusion and misconceptions exists amongst players and stakeholders regarding the theoretical underpinning and practical application of current nutritional guidelines for soccer. Importantly, the application of such guidelines is also hindered by prior beliefs on the perceived impact of CHO on body composition. Furthermore, a 'fear of getting fat' also arose as a result of external pressures from key stakeholders (e.g., coaches, support staff and parents), social media and the culture surrounding measurements of body composition, all of which are likely exacerbated by the lack of professionally accredited nutrition staff overseeing the provision of nutrition support. When taken together, our data provide a platform for which to develop organisational, stakeholder and player-centred educational and behaviour change interventions that strive to promote a positive performance nutrition culture.

To address our aim, we interviewed a cohort of 47 participants comprising individuals actively involved at the highest level of club and international soccer in England. Although we acknowledge that our present sample are limited to those presently working in England, our data provide a novel insight into the current nutritional challenges within the women's game. Many participants, especially players, sports scientists, and nutritionist, identified fuelling as a critical factor for both performance and health. Amongst these participants, discrepancies in theoretical knowledge and practical awareness of strategies manifested in contrasting views on the timing (i.e., MD-1 versus the pre-match meal), quantity of foods required to prepare for match day, particularly regarding the role CHO. The apparent lack of knowledge and common misconceptions (especially in relation to CHO guidelines) also extended to fuelling for training days, where the concerns associated with under-fuelling also manifest as health outcomes associated with the female athlete triad and RED-S models e.g. impaired menstrual health, disordered eating, injury risk, underperformance etc. As such, our data support the need for player, parent, and staff education (e.g. coaches) on the importance of fuelling adequately for both physical and mental health as well as performance outcomes (Mountjoy et al. 2018).

With this in mind, the COM-B framework and behaviour change wheel (Michie et al. 2011; Atkins and Michie 2015) provides one such model for which to begin to formulate behaviour change interventions. For example, in those cases where under-fuelling is *unintentional* (Kerr et al. 2006), there were a variety of sources of behaviour that can be made as part of a behavioural diagnosis. In this regard, our data allude to a lack of psychological capability i.e., players and stakeholders are initially unaware of the current nutrition guidelines for soccer (Collins et al. 2021) and/or physical capability (e.g. players lack the basic cooking skills required to prepare the desired food) that may prevent the desired behaviour that is required to consume sufficient daily CHO intake. However, numerous behaviours were reported that relate to a lack of a physical opportunity to engage in optimal nutrition practices, as evident by the lack of on-site food provision described by some players. Such lack of physical opportunity is also likely underpinned by the lack of social opportunity (i.e., cultural norms) associated with the specific environment, as evidenced by language such as '*we would get whatever was left over from the men*' when eating at the training ground, as well as the apparent lack of specialist nutrition provision in terms of professionally accredited staff. These findings appear to agree with sentiments within the professional women's game that there is an *acceptance* of unsatisfactory working conditions (Culvin 2019), with players expecting to be grateful for the opportunity despite this inadequacy (Culvin 2021). When taken together, it is apparent that there are numerous intervention functions (e.g. environmental restructuring, education, modelling, training etc) that could underpin a cultural change in the nutrition provision currently provided to women players, all of which would seek to improve the unintentional under-fuelling that has previously been reported by us (Morehen et al. 2021) and others (Moss et al. 2021). At the very least, an initial starting point could be the mandatory regulation that all professional clubs should employ a full-time professionally accredited sports nutritionist or dietician in order to enhance the overall quality of service provision currently delivered to female players. Furthermore, due to physiological differences between men

and women and particularly the importance of normal menstrual function (McNulty et al. 2020), a staff member who has female-specific knowledge would also be beneficial to support and educate all players and staff members. Indeed, the lack of dedicated support staff may result in players seeking education elsewhere (e.g. social media), the result of which likely exacerbates misconceptions surrounding the role of CHO intake on performance and body composition (i.e. 'eating salad is the new having carbs before a game'). The lack of expertise on female specific health amongst staff members may be especially problematic in those instances where players present with symptoms related to the female athlete triad and RED-S. Despite the recent increase in professionalism of the women's game in England with the introduction of the WSL in 2018, it is apparent that the provision of specific sport science support services (i.e. nutrition) has not developed in accordance with the progression of players and staff to full-time employment.

In contrast to unintentional under-fuelling, we also report evidence of *intentional* under-fuelling where sentiments surrounding the practice of eating CHO were communicated as 'that's not something I do'. Upon further probing, it became evident that 'carbohydrate fear' exists where players apparently associate CHO intake with 'getting fat'. Such intentional episodes of under-fuelling and fear of getting fat seems to be exacerbated by the frequent assessment of body composition where players are banded in skinfold targets that are classified as red, amber or green. The concern with 'how am I going to get into green' is thus representative of reflective motivation (according to the COM-B model) where the player modifies their behaviour on the belief of what is good or bad. The practice of avoiding CHO intake has also been previously reported in female soccer players in the belief that it may promote a favourable body composition (Culvin 2019, 2021). Although players reported that they understood the benefit of measuring body composition, they did comment on the 'unhelpful' nature of frequency of measurement, setting targets and the lack of application to performance (i.e. how does it affect my performance on the pitch). In consideration of key stakeholders, it is interesting that coaches initially identified body composition as the priority area of where nutrition can affect performance. In this regard, it is noteworthy that players also report incidences where managers/coaches had been issuing body weight targets, the result of which is likely to directly impact player's behaviour based on the perceived outcomes surrounding team selection. From a behaviour change perspective, the apparent 'skinfold culture' is therefore representative of an environment where the social opportunity (i.e. cultural norms) to engage in optimal fuelling practices is not aligned to the desired behaviour.

The external pressures associated with social media and both online and stakeholder incidences of body disparagement (e.g. from parents or coaches etc) may also contribute to intentional episodes of under-fuelling. Such issues have been previously reported in weight-sensitive sports (Mosley 2009; Hockin-Boyers et al. 2020). For example, gymnasts who received disparaging comments about their bodies or instructions to lose weight had significantly more disordered eating patterns than those who had not received such comments (Kerr et al. 2006). The rise of social media also results in external pressures 'to look a certain way' and players reported incidences of peers who were 'more obsessed with how they look than their football'. The issue of body image in sport has, of course, been researched extensively and the solutions are likely complex at both an organisational and individual level (Berry and Howe 2000; Ackerman et al. 2020). Nonetheless, it is suggested that player focussed educational strategies should begin during adolescence to promote healthy eating behaviours at a young age (Lieberman et al. 2001; Tiggemann 2001). Additionally, the education of coaches should also be prioritised given the role of the coach in influencing player development (Sabiston et al. 2020; Carson et al. 2021). Such education interventions should also address the heighted pressure arising from social media given that new media formats can result in greater critique of athletic bodies (Kohe and Purdy 2016). Collectively, our data suggest that targeted interventions addressing player's reflective and automatic motivation associated with specific nutritional behaviours may help to reduce feelings of body dissatisfaction and the potential to develop eating disorders. Stakeholder education addressing that 'women's bodies are different to men's' (Clarkson et al. 2020) may also help to improve the cultural norms and practices associated with skinfold assessment and 'generalised' target setting. Indeed, carefully monitored assessment of body composition may actually function to *improve* overall player health, owing to the fact that making decisions about weight-loss based on appearance alone can also lead to body dissatisfaction, disordered eating and eating disorders (Griffin and Harris 1996; Rhea 1998).

Despite the novelty of the present data, the present paper is not without limitations. Indeed, we readily acknowledge 'generalisability' as a limitation of the study, given that our sample does not represent *all* elite female soccer players. The use of purposeful sampling requires that the reader does not generalise from the sample, rather they should critically reflect on the relevance of the findings within their context (Smith and McGannon 2017). Furthermore, as all interviews with players aged 16–17 were conducted with a parent present (in order to meet safe guarding guidelines), this may have had an impact on the willingness of these players to share their perceptions and experiences. Lastly, a further limitation was the broad nature of the questioning within study. Although this allowed the interviews to be participant lead, further research should be conducted to explore each of the presented themes in greater depth.

Conclusion

In summary, our data provide a novel insight into the culture surrounding nutrition and body composition within elite women's soccer. Importantly, we observed confusion and contrasting views on the theoretical and practical awareness of nutritional guidelines for soccer. Although unintentional episodes of under-fuelling are likely related to a lack of theoretical knowledge or ability to translate this into practice, intentional incidences of under-fuelling are more complex and appear related to cultural norms and external pressures associated with body composition and body image. When taken together, our data provide a platform for which to develop

organisational, stakeholder and player-centred educational and behaviour change interventions that strive to promote a positive performance nutrition culture.

Disclosure statement

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