Dietary Intakes, Knowledge and Perceptions of Semi-Professional Rugby Athletes in Scotland.

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Abstract

Background

Adequate nutritional intake plays a pivotal role in optimising performance, recovery and body composition goals. This study aimed to investigate the dietary intakes (DI), nutritional knowledge (NK) and attitudes, perceptions and challenges (APC) of semi-professional rugby players in Scotland.

Methods

Dietary intakes and NK of 24 male semi-professional rugby players of a Super6 club were evaluated using validated questionnaires. Players were categorized as having good or poor NK according to NK scores. Diet-related APCs were assessed online using researcher developed questionnaires and 1–1 semi-structured interviews.

Results

Mean ± SD total NK% was poor, 53.7 ± 11.9%. The 'Good' NK group scored significantly higher in the Weight Management ($p = 0.014$), Macronutrients ($p < 0.001$), Micronutrients ($p = 0.001$) and Sports Nutrition ($p < 0.001$) sections. Mean DI were 26.3 ± 9.2 kcal/kg/day energy, 1.4 ± 0.4 g/kg/day protein, 21.7 ± 10.1 g/day fibre. Median (25th ,75th) carbohydrate intake was 3.0 (2.0,3.0) g/kg/day and 6.3 (2.3,10.6) units/week alcohol. Mean ± SD fat and saturated fat (SFA) % total energy intake (EI) were 36.2 ± 3.7% and 12.8 ± 1.9% respectively, and SFA %EI exceeded recommendations ($p < 0.001$). The 'Good' NK group had a significantly higher intakes of all macronutrients ($p < 0.05$). Total NK% positively correlated with intakes of meat ($r = 0.556$, $p = 0.011$), cereals ($r = 0.458$, $p = 0.042$), dietary fat ($r = 0.477$, $p = 0.034$), vegetables ($r = 0.487$, $p = 0.030$) and alcoholic beverages ($r = 0.541$, $p = 0.014$). Supplement use was 68%. Players felt diet affected performance (94%) but 31% of them were unaware of any specific nutritional strategies. A healthy diet was perceived to be 'balanced' with 'variety from all food groups'. Lack of time for preparation was described as the main barrier to healthy eating.

Conclusions

Overall players had poor NK, their fibre and carbohydrate intake was suboptimal, whereas saturated fat intake exceeded recommendations. Many lacked awareness of current sports nutrition guidelines. Further nutrition education may be needed to improve diet quality and aid performance goals.

Introduction

Nutrition has become increasingly recognized as a key component for optimizing sports performance and adaptations to exercise (Burke et al. 2013; Jeukendrup 2017). Adequate dietary intake (DI) is crucial for athletes for overall health as well as for enhancing performance and recovery after training (Heaney et al. 2011). Despite an increasing number of athletes aiming to fuel performance through optimal nutrition, research shows that many athletes have suboptimal DI and inadequate dietary knowledge which may translate into poorer food choices (Alaunyte et al. 2017; Stokes et al. 2018). Evidence of a relationship between nutrition and sports performance has raised awareness amongst athletes on effective nutritional practices to gain a competitive edge (Devlin et al. 2017; Stokes et al. 2018).

Team sports have unique physiological demands (Jenner et al. 2019), and despite the advances in sports nutrition, there is not an abundance of literature on the determinants of dietary practices in team-sport athletes of amateur or semi-professional leagues. Rugby is characterised by repeated alterations of high intensity exercise placing a heavy demand on the aerobic and anaerobic energy systems (Holway and Spriet 2011; Alaunyte et al. 2017; Trakman et al. 2018). Dietary goals may further differ according to position played, as forwards tend to have higher body mass index (BMI) and strength than backs who are

traditionally leaner and faster (Jenner et al. 2019). Rugby athletes must adapt their DI to match their nutritional requirements to support the physiological demands of the sport and optimise performance (Alaunyte et al. 2015).

Nutritional knowledge (NK) is a significant determinant of food choice (Wardle et al. 2000). Evidence shows that rugby players place lower importance on diet compared to endurance athletes which may lead to poorer food choices when combined with inadequate NK (Alaunyte et al. 2015). However, NK may not necessarily translate into better practice as research suggests that rugby athletes can have suboptimal dietary intakes regardless of NK (Alaunyte et al. 2015). Therefore, rugby players may require assistance with the application of NK to their own diet (Murphy and Jeanes 2006). Previous research has shown that players were not aware of carbohydrate recommendations regardless of NK (Alaunyte et al. 2015). Moreover, men's magazines often cite "protein needs" and lack messages which accurately translate to a healthy balanced diet (Ellison et al. 2011; Stokes et al. 2018). This may reflect players' lack of awareness of the sport nutrition guidelines and/or it could be argued that athletes perceive that the national dietary recommendation for the general population is not applicable to them (Trakman et al. 2018).

It has been long established that there are multiple factors that influence dietary intake such as cost, food preferences, convenience, availability, skills, media, social, cultural and religious beliefs (Nestle et al. 1998). More recent research has suggested that education status may influence food choices and energy intake (Jenner et al. 2018) in addition to physiological, social, psychological and economic factors (Birkenhead and Slater 2015; Stokes et al. 2018). Semi-professional athletes may be presented with additional factors which may influence dietary choices such as access to nutritional advice and time constraints while managing work and family commitments with busy training schedules. Furthermore, it is possible that lifestyle changes associated with the COVID-19 global pandemic could have introduced further challenges that may impact dietary intakes. However, this is yet to be investigated and the determinants of food choices are not well documented in the literature at present, particularly for semi-professional rugby athletes. Considering that some of the semi-professional clubs can potentially feed players into the professional leagues, this is an important issue to address.

There is currently a limited number of studies investigating the relationship between dietary goals and NK of adult rugby athletes. Therefore, it has not yet been corroborated what the actual level of knowledge and understanding of nutritional requirements is among this cohort. Furthermore, no previous studies have assessed the combined effect of NK, attitudes, perceptions and challenges (APC) on the dietary goals of rugby players and analysed the level of NK in comparison to international sports nutrition guidelines (American College of Sports Medicine 2016). Therefore, this study aimed to assess the NK, dietary habits and determinants of food choices of semi-professional rugby athletes in Scotland and explore their interrelationships.

Methods

Study design & Participants

This cross-sectional study was carried out in April 2020 in Scotland using a mixed-methods approach. Both quantitative and qualitative data were collected to explore individual experiences, practices and beliefs (Marcinowicz et al. 2007). Semi-professional male rugby athletes were recruited from one team of the Super6 Scottish Rugby Union League on a voluntary basis. The selected sample size was based on the number of available participants. Data collection took place during the COVID-19 pandemic; therefore, online delivery of the questionnaires and interviews was the only viable option. Research objectives and methods were conducted according to the guidelines laid down by the Declaration of Helsinki (2013) and ethical approval was granted by the Queen Margaret University (QMU) Ethics Committee in April 2020. Written consent was provided by all participants.

Recruitment & Procedures

Participants were provided with an information sheet, a consent form and an introductory video as an invitation to participate in the research study. Participants were free to withdraw from the study at any point without explanation. Subjects who agreed to participate received an email link to the "Online Surveys" on a weekly basis (JISC 2020). Anonymity and confidentiality of participants' responses were ensured through the use of 4-digit username generated by an online tool.

Participants were asked to complete a series of questionnaires of 10–20 minutes each (see *Data Collection*) over a three-week period. All players who completed the questionnaires were included in the data analysis. A sub-group from the team were voluntarily recruited to participate in a semi-structured online interview via Skype of duration 20–30 minutes. Researchers used a standardised proforma to ensure participants were interviewed in a consistent manner.

Data collection *(Questionnaires and interview)*

A questionnaire on demographics and APC was developed in agreement with previously published studies (Alaunyte et al. 2015; Trakman et al. 2017; Stokes et al. 2018). Dietary intakes were assessed using the EPIC-Norfolk Food Frequency Questionnaire (FFQ) that lists UK-specific food items (Bingham et al. 2001). A modified version of the Trakman et al. (2017) Nutrition for Sports Knowledge Questionnaire (NSKQ) was used to assess participants' nutritional knowledge. The interview process was conducted via face-to-face Skype interviews. More information and samples of the questionnaires and discussion proforma used can be found in supplementary material.

Data Management

All data collected using Online Surveys (JISC 2020) was exported to Excel, coded and transferred to Statistical Package for the Social Sciences (SPSS) for analysis. Interviews were recorded, later transcribed and coded. Data was stored in compliance with the general data protection regulation (GDPR) legislation.

Data analysis

The FFQs were analysed using FETA software (Mulligan 2014). Macronutrient intakes relative to body weight were calculated using self-reported body weights. A one-sample T-test was used to compare average macronutrient intakes to ACSM (2016) international sports nutrition guidelines (carbohydrate 5-10g/kg body weight, protein 1.2-2.0g/kg body weight, fibre 30g/day, total fat < 35%, SFA < 11%, alcohol < 14 units/week). Average nutrient intakes were compared to international sports nutrition guidelines (ISSN 2010; ACSM 2016) and UK public health guidelines (SACN 2011; SACN 2015; Department of Health 2016). Dietary intake values were compared to the lower end of the range for carbohydrate and protein. Body mass index (BMI) was calculated based on self-reported weight and height.

Statistical analyses were conducted in IBM SPSS ® version 23 (IBM Corp., Armonk, NY, USA). A preliminary analysis screening for missing values, outliers and univariate normality of the data was conducted using Q-Q plots, skewness and kurtosis statistics (-1,1). Distribution of continuous variables was assessed using formal tests of normality (Shapiro-Wilk). Continuous variables are presented as mean ± standard deviation (SD) and median (25th, 75th) as appropriate. Categorical variables are expressed as *n* (%). The level of significance was set at $\alpha = 0.05$.

Mann-Whitney U and Independent-samples t-tests were used to analyse differences in nutrient and food group intakes based on level of NK (good, poor) using median split. Similarly, differences in NK scores and previous nutrition or health qualification (yes or no, based on self-report of course or degree completed), previous professional dietary input (yes or no) and performance enhancing supplement (PES) use (yes or no) were assessed using an independent-samples t-test/Mann–Whitney U test. Differences in knowledge scores based on highest level of education (GSCE's, A-levels, undergraduate or postgraduate degree) and familiarity with the Eatwell Guide (yes, no or unsure) were assessed using ANOVA/ Kruskal–Wallis. Where ANOVA results were significant, a Tukey post hoc analysis was conducted to determine which groups differed. Relationships between NK scores with dietary intakes and demographic factors were examined using Spearman's Rank-Order correlations.

Triangulation was carried out by collecting data via questionnaires and interviews to increase the robustness of qualitative data. Thematic analysis was used to explore key ideas from the 'APC' questionnaire and Skype interviews. Researchers manually extracted themes by identifying common topics and repeating patterns from the qualitative questionnaire results and interview transcripts. Consensus regarding themes was achieved through discussion. Quotes were extracted to represent the themes identified, with selected verbatim quotes presented in the results. Methods are underpinned by those described in the qualitative research study conducted by Stokes et al. (2018).

Results

Participant Characteristics

Twenty-four male semi-professional rugby players agreed to participate in the study. Response rate was 92% (n = 22) for the 'Demographics & APCs' and 'FFQ', and 83% (n = 20) for the 'NKSQ'. A total of 16 players took part in individual Skype interviews. All participants were white, aged 20–34 with mean ± SD BMI of 27.5 ± 2.4 $kg \cdot m^{-2}$. Median (IQR) years of experience was 14.5 (12.0, 17.5) y. Participants classified their habitual physical activity as active (~ 1–3 hours per day, 77%, n = 17), vigorous (> 4–5 hours per day, 18%, n = 4), or moderate (~ 1 hour per day, 4.5%, n = 1). The median hours of training per week was 7.5 (6.5, 9.0) hr (Table 1).

All players had GSCEs as a baseline education qualification. It was reported that 36% of respondents had previously consulted a registered dietitian (RD)/nutritionist. Of those who never had an RD consultation, five stated that they did not know how to access a consultation with a dietitian/nutritionist, four believed their own knowledge of nutrition was adequate, one did not specify a reason and four responded as "other" as reason for no consultation. Two of the four participants responding "other" as a reason stated: "*I do not really trust nutritionists. It seems to me they often contradict each other, and everyone seems to be claiming they are right*" or "I *never had the opportunity*".

Table 1
Participant Characteristics

N = 21	*Mean ± SD / Median (IQR)*	
Age (years) ^	23 (21.5, 27.5)	
Height (m)	1.87 ± 0.1	
Weight (kg)	96.6 ± 10.8	
BMI ($kg \cdot m^{-2}$)	27.5 ± 2.4	
Training per week ^ (hr)	7.5 (6.5, 9.0)	
Game Experience^* (y)	14.5 (12, 17.5)	
	(n)	*(%)*
Ethnicity		
White/Caucasian	22	100
Position Played		
Back	11	50
Forward	11	50
Level of Education		
GCSE	2	9
A-levels	8	36
Undergraduate Degree	8	46
Postgraduate Degree	2	9
Health/Nutrition related qualifications	3	14
Special dietary needs/conditions	1	5
Previous dietary/nutrition consultation	8	36
Employment Status		
Employed Full-time	12	55
Student	7	32
Unemployed	2	9
Other	1	5
Dependents	2	9

^expressed as median (25th ,75th), *n = 20, BMI = Body Mass Index, IBW = Ideal Body Weight, SD = Standard Deviation

Dietary practices and beliefs

All players perceived healthy eating to be important, when asked about the benefits of healthy eating. When asked specifically about how nutrition is important for athletes, 91% of participants quoted improvements in performance, recovery and training and 96% understood that there are specific dietary recommendations for athletes. Some players believed PES are necessary for athletes (36%) and 68% reported using both PES and nutritional supplements (omega-3 fish oils, vitamins, probiotics). Table 2 summarises athletes' dietary practices and beliefs.

Table 2
Descriptive statistics of Participants' Dietary Practices and Beliefs

Dietary Practices	*N*	*Frequency*
Ability to cook	22	100%
Cooking & Shopping responsibly		
Self	14	67%
Shared	2	9.5%
Partner	3	14%
Parents	2	9.5%
PES Use	15	68%
Nutritional Supplement Use	15	68%
Understanding & Beliefs		
Dietary Recommendations for Athletes	21	96%
Familiar with the Eatwell Guide	5	23%
Importance of Healthy Diet for Athletes	22	100%
Believe they follow a Healthy diet	21	96%
Diet affects performance	20	91%
PES necessary for athletes	8	36%
PES = Performance enhancing supplements		

Nutritional Knowledge

Overall NSKQ scores were low, with an average of 44 items answered correctly out of the 82 questions. The score ranged between 34.2% and 79.3%, with a mean ± SD of 53.7 ± 11.9%. Table 3 shows the mean ± SD NK scores for each category and between group comparisons according to level of NK (good: 63.4 ± 6.5% vs. Poor: 43.2 ± 6.7%). The 'Good' NK group scored significantly higher in the weight management ($p = 0.014$), macronutrients ($p < 0.001$), micronutrients ($p = 0.001$) and sports nutrition sections ($p < 0.001$).

Neither age ($p = 0.420$) or years game experience ($p = 0.386$) were significantly associated with NK scores. Relationships of all other participant characteristics with NK scores are displayed in Table 4. No associations were found between educational level and NK scores. Total NK% was not significantly associated with prior dietetic consultation; however, subjects who had previously had a consultation with a dietitian or nutritionist ($n = 7$) scored significantly higher in the Macronutrients ($p = 0.025$) and Sports Nutrition ($p = 0.026$) subsections. Participants with health or nutrition related qualifications scored higher overall in the NSKQ and ($p = 0.036$) and the sports nutrition sections ($p = 0.030$). Subjects that were familiar with the Eatwell Guide ($n = 4$) scored significantly higher in the NSKQ overall ($p = 0.040$) and the micronutrients section ($p = 0.044$).

Table 3
Mean Nutritional Knowledge results

Category (items)	*All (n = 20)*		*Good NK (n = 10)*		*Poor NK (n = 10)*		*P-value*
	Score	*%*	*Score*	*%*	*Score*	*%*	
Weight Management (9)	6.1 ± 17.4	67.8 ± 16.9	6.9 ± 1.2	76.7 ± 13.3	5.3 ± 1.4	58.9 ± 15.8	**0.014**
Macronutrients (29)	17.4 ± 3.9	59.9 ± 13.7	20.2 ± 2.3	69.8 ± 7.8	14.5 ± 3.2	50.1 ± 10.9	**< 0.001**
Micronutrients (13)	4.2 ± 2.7	32.3 ± 20.5	6.0 ± 2.1	46.2 ± 15.8	2.4 ± 1.9	14.6 ± 15.8	**0.001**
Sports Nutrition (12)	6.7 ± 2.0	55.8 ± 16.4	8.1 ± 1.5	67.5 ± 12.1	5.3 ± 1.3	44.1 ± 11.1	**< 0.001**
Supplements (12)	5.2 ± 2.2	42.9 ± 18.0	6.0 ± 1.6	50.0 ± 13.6	4.3 ± 2.4	35.8 ± 19.7	0.078
Alcohol (7)	4.6 ± 1.3	65.0 ± 18.8	4.9 ± 1.1	70.0 ± 15.7	4.2 ± 1.5	60.0 ± 21.1	0.245
Total (82)	44.1 ± 9.8	53.7 ± 11.9	52.1 ± 5.2	63.5 ± 6.4	36.0 ± 5.5	43.9 ± 6.7	**< 0.001**

P < 0.05, Values are Mean ± standard deviation, NK = nutritional knowledge

Table 4
Mean Nutrition Knowledge Scores as percentages according to participant characteristics

	Subgroup	*Total NK*	*WM*	*Macro*	*Micro*	*Sports*	*Supplements*	*Alcohol*
EDUCATION LEVEL	*GSCE*	48.2 ± 14.6	50.0 ± 23.6	48.3 ± 24.4	34.6 ± 16.3	54.2 ± 29.5	37.5 ± 16.7	78.6 ± 10.1
	A-levels	55.0 ± 10.7	68.1 ± 12.5	60.1 ± 12.5	30.8 ± 18.8	57.3 ± 15.7	51.0 ± 16.3	66.1 ± 18.6
	Undergraduate	56.5 ± 13.6	73.6 ± 19.7	65.2 ± 11.2	37.5 ± 23.8	58.3 ± 16.6	37.5 ± 19.9	64.3 ± 18.7
	Postgraduate	42.7 ± 1.7	61.2 ± 7.0	50.0 ± 17.1	15.4 ± 21.8	41.6 ± 11.8	37.5 ± 17.7	50.0 ± 30.3
DIETARY INPUT	*Yes*	59.7 ± 9.6	71.5 ± 15.5	**70.0 ± 9.7 ***	34.1 ± 15.3	**66.6 ± 15.9 ***	45.2 ± 15.1	67.3 ± 18.0
	No	50.5 ± 12.1	65.8 ± 17.8	55.1 ± 13.2	31.4 ± 23.4	50.0 ± 14.0	41.7 ± 19.8	63.7 ± 20.0
HEALTH QUALIFICATION	*Yes*	**70.1 ± 12.9 ***	88.9 ± 15.7	74.2 ± 17.0	50.0 ± 16.3	**79.2 ± 5.9 ***	54.2 ± 5.9	78.6 ± 10.1
	No	51.9 ± 10.7	65.4 ± 15.7	58.4 ± 12.9	30.4 ± 20.3	53.2 ± 15.2	41.7 ± 18.5	63.5 ± 19.1
FAMILIAR WITH EATWELL GUIDE	*Yes*	**66.8 ± 8.7 ***	83.4 ± 19.2	71.8 ± 11.3	**53.9 ± 18.8 ***	70.8 ± 15.9	52.1 ± 4.2	67.9 ± 27.0
	No	50.3 ± 9.3	63.5 ± 14.7	57.5 ± 12.8	25.8 ± 15.3	52.4 ± 15.5	39.9 ± 17.3	64.3 ± 18.4
PES USE	*Yes*	54.0 ± 13.2	69.2 ± 16.5	61.4 ± 16.5	31.4 ± 16.2	57.0 ± 18.6	39.1 ± 18.7	67.0 ± 18.8
	No	53.1 ± 10.0	65.1 ± 18.6	57.2 ± 5.8	34.1 ± 28.4	53.5 ± 12.6	50.0 ± 15.2	61.2 ± 19.7

* denotes $p < 0.05$, values are Mean ± standard deviation, n = 20, PES = performance enhancing supplement, NK = nutritional knowledge, WM = weight management, Macro = micronutrients, Micro = micronutrients

Dietary Intakes vs. Guidelines

Estimated intakes were significantly lower than the recommended amounts for carbohydrate and fibre (all $p \leq 0.001$) through food sources. Only one player met the lower end of the ACSM (2016) recommended carbohydrate range. The majority (89%) of players were not meeting carbohydrate recommendations and consumed significantly less ($p < 0.001$) than the recommended amounts for their activity level. Mean protein intakes fell within the recommended range for athletes (ACSM 2016). The majority (58%) of participants consumed between 1.2-2.0g/kg/d protein, however 32% did not meet the lower end of the range and 11% exceeded the upper range. Total fat and SFA intakes exceeded the recommended amounts, but differences were only significant for SFA ($p < 0.001$). Table 5. Summarizes the athletes' estimated average intakes for energy, protein, carbohydrate, fibre, fat and alcohol.

Nutritional Knowledge & Dietary Intakes

Those with good NK consumed vegetables, breakfast cereals, wholemeal pasta, sweets and snacks, bacon, chips and pizza more frequently than the poor NK group. Table 6 displays the total estimated average intake for each food group. The 'Good' NK group had significantly higher intakes of all macronutrients, meat and dairy products (all $p < 0.05$). Spearman's correlations showed a significant positive association between NK and CHO intake ($r = 0.652$, $p = 0.015$) and protein intake ($r = 0.649$, $p = 0.015$).

Table 5
Daily Energy and Macronutrient Intakes of Participants (n = 22) from Food Sources versus Sports Nutrition Guidelines

Nutrient	***Absolute Daily Intake***	***Relative Intake (per kg BW)***	***Recommendation***	***Intake vs Guidelines***	***P-value***
Energy (kcal)	2472 (1767, 3374)	26.3 ± 9.2	-	-	**-**
Protein (g)	139.8 ± 51.1	1.4 ± 0.4 *	*1.2-2.0g/kg BW*	Within	0.148
Carbohydrate (g)	266 (199, 341)	3 (2, 3) *	*5-10g/kg BW*	Below	**< 0.001**
Fibre (g)	21.7 ± 10.1	-	*30g/day*	Below	**0.001**
Total Fat (g)	97.0 (68.3, 150.3)	36.2 ± 3.7 ^	*< 35% TEI*	Above	0.149
Saturated Fat (g)	38.7 ± 15.8	12.8 ± 1.9 ^	*< 11% TEI*	Above	**< 0.001**
Alcohol (units/week)	6.3 (2.3, 10.6)	-	*< 14 units/week*	Below	**< 0.001**

* n = 19; values are Mean ± Standard Deviation / Median (25th, 75th); ^ expressed as %TEI; BW = Body Weight; TEI = Total Energy Intake. *Average protein & carbohydrate intakes compared to ACSM (2016) guidelines, Mean fibre intake compared to SACN (2015) guidelines, Mean total fat & saturated fat intakes compared to SACN (2011) guidelines, Average weekly alcohol intake in units compared to the* Department of Health (2016*) guidelines*

Table 6
Athletes average daily food consumption and between group comparisons according to level of nutritional knowledge

Food Group	*All (n = 20)*	*Good NK (n = 10)*	*Poor NK (n = 10)*	*P-value*
Energy (kcal)	2580.9 ± 944.9	3135.2 ± 1005.9	2026.5 ± 436.2	**0.015**
Carbohydrate (g)	295.6 ± 124.7	327.7 ± 106.2	228.7 ± 56.7	**0.019**
Protein (g)	134.5 ± 48.3	160.5 ± 53.0	108.5 ± 24.7	**0.023**
Fat total (g)	106.6 ± 46.7	134.8 ± 49.3	78.4 ± 20.1	**0.007**
SFA total (g)	37.3 ± 14.5	45.8 ± 13.7	28.8 ± 9.9	**0.009**
Iron (mg)	15.1 ± 6.1	18.3 ± 7.0	11.8 ± 2.6	**0.023**
Fibre (g)	21.7 ± 10.1	26.5 ± 12.2	16.8 ± 3.4	0.089
Non-alcoholic beverages (g)	628.6 ± 445.5	713.1 ± 542.0	544.1 ± 330.7	0.450
Cereals & Cereal Products (g)	300 (193, 437)	400.1 ± 235.3	275.7 ± 108.7	0.247
Meat & Meat Products (g)	233.2 ± 104.9	280.3 ± 111.6	186.1 ± 76.3	**0.043**
Dairy & Dairy Products (g)	592.1 ± 282.7	717.5 ± 316.2	466.7 ± 183.8	**0.043**
Fish & Fish Products (g) ^	30 (9, 52)	29.5 (11, 65)	29 (3, 57)	0.796
Eggs & Egg Dishes (g)	40 (11, 50)	40.6 ± 35.8	32.4 ± 17.3	0.631
Fruit (g)^	309 (188, 423)	329 (197, 430)	249 (125, 426)	0.436
Vegetables (g)	338.8 ± 163.4	410.9 ± 195.0	266.7 ± 82.1	0.075
Potatoes (g)	66.9 ± 43.2	79.0 ± 48.3	54.7 ± 35.8	0.280
Fats & Oils (g)^	12 (7, 14)	13 (10, 29)	9.5 (2.5, 13)	0.063
Nuts & Seeds (g)^	17 (5, 36)	22 (11, 53)	8 (2, 25.5)	0.089
Sugars & Snacks (g)	36.2 ± 22.2	35.6 ± 18.7	36.8 ± 26.0	0.971
Soups & Sauces (g)	81.6 ± 65.7	103.7 ± 68.7	59.5 ± 57.4	0.123
Alcoholic Beverages (g)^	111 (30, 149)	138 (82.5, 193.5)	40 (21.5, 129)	0.052

P < 0.05, values are Mean ± standard deviation, ^ expressed as Median (25th, 75th), NK = nutritional knowledge, SFA = saturated fatty acids

Perception of diet and performance identified during interviews

Of the 24 total respondents, 16 (67%) agreed to participate in Skype interviews. Athletes reported healthy eating improved performance and recovery, and positively impacts immune function and health and wellbeing. Free time for planning meals, preparation and bulk cooking was perceived to be the largest contributor to supporting/limiting healthy eating habits when asked about factors that enable or conversely create barriers to healthy eating. Additionally, building healthy habits through discipline and healthy influence of closed ones, and awareness of healthy foods were cited as the most common factors in maintaining a healthy diet. In relation to nutrient goals participants struggled to meet, more than half reported difficulty with achieving recommended protein intake. Food that has been reported healthy were plentiful in fruit, vegetables, wholegrains with a mixture of carbohydrate and protein sources as well as steak, chicken, apples, banana, broccoli, pasta, rice, potatoes, oats, eggs, yoghurt and nuts. Tables 7 and 8 summarize the players' responses to interview questions, themes extracted and supporting quotes.

Table 7
Attitudes, Perceptions & Challenges of Players surrounding diet, performance and PES identified in interviews.

Skype Interview Topics	*Attitudes, Perceptions & Challenges*	*% of population in agreement (n = 16)*
Perceptions of a healthy diet	- a good balance of all food groups, without relying too heavily on one source	94%
	- quality, natural ingredient sources	31%
	- helps improve athletic performance	31%
	- contributes to mood and mental health	63%
	- enhances recovery, sleep, digestion and immune function	25%
	- contributes to feeling 'healthier' and 'looking better"	< 20%*
Perceptions of an unhealthy diet	- high sugar content	50%
	- heavily processed	50%
	- snack foods including; chocolate, crisps & sweets	88%
	- take-away foods including; pizza, fried foods, fish & chips	63%25%
	- sugary drinks	20%
	- ready meals	63%
	- overeating/relying excessively on one food group	31%
	- foods that make you feel "sluggish", "lethargic" or "bloated"	
Impact of diet on performance	- diet significantly impacts performance	100%
	- quality of meals contributes to performance	44%
	- quality and timing of meals influences performance;	56%
	- fuelling several hours before a game and immediately after improves performance	25%
	- not eating enough or too close to a game negatively impacts performance	25%
	- timing of meals does not impact performance	< 20%
	- meeting carbohydrate and protein requirements is important	69%
	- hydration is an important factor to enhance performance	25%
Thoughts on PES	- PES are beneficial, convenient or practical	< 20%
	- PES give you an 'edge' to improve performance or strength	46%
	- PES are non-essential	23%
	- a well-balanced diet should be able to provide all nutritional requirements	< 20%
		50%

If the number of participants was less than 3, figures were reported as < 20%

Skype Interview Topics	*Attitudes, Perceptions & Challenges*	*% of population in agreement (n = 16)*
Specific foods, drinks or products used to aid training and recovery	- whey protein	69%
	- caffeine	44%
	- creatine	38%
	- BCAAs, glucose, energy gels, beetroot shots or isotonic sports drinks	25%
Dietary goals	- weight gain	31%
	- maintain current weight	44%
	- reduce fat mass and increase muscle mass	63%
	- maintaining a well-balanced diet	38%
	- avoid foods high in sugar and processed foods	< 20%
	- increase dietary protein & carbohydrates	25%
	- increase healthy snacks/fruit to achieve a healthy balanced lifestyle	< 20%
	- do no track dietary intake therefore not aware of nutrient intakes versus goals	< 20%
Time of year when nutrition is a priority	- all year-round	44%
	- pre-season	44%
	- less focused during holidays	25%
	- time of year can be a challenge in achieving dietary goals	< 20%
Determinants of dietary choices	- planning and preparation make healthy eating easier	69%
Barriers to meeting dietary goals	- positive habits, influences and good NK	20%
	- enjoyable and easily prepared foods	31%
	- looking and feeling good	25%
	- lack of time for meal planning, preparation and cooking	69%
	- lack of motivation, discipline, tiredness	25%
	- taste preferences, menu fatigue, lack of knowledge	< 20%
	- external influences and dietary requirements of other members of the household	25%
	- training schedule impacting on time for preparation	31%
	- stress, sleep, alcohol, social life	< 20%
	- Cost	25%

If the number of participants was less than 3, figures were reported as < 20%

Skype Interview Topics	*Attitudes, Perceptions & Challenges*	*% of population in agreement (n = 16)*
Impact of coronavirus	- easier to meet dietary goals than before with more time for planning and preparation	< 20%
	- adjusting diet to maintain body composition with restricted access to weights as a significant challenge	50%
	- reduced motivation	
	- changes in appetite	
	- reduced food availability	25%
	- difficulty establishing routine and planning ahead	< 20%
	- reduced disposable income	31%
	- not tracking dietary intake during lockdown	38%
	- struggling to meet protein goals	< 20%
	- struggling to adjust volume of food for new energy requirements	38%
	- reduced muscles mass, fitness and strength likely after the pandemic	31%<20%
	- training at home is adequate to maintain body composition with minimal effects on performance	94%
		< 20%
If the number of participants was less than 3, figures were reported as < 20%		

Table 8
Themes and Quotes Extracted from individual interviews.

	Themes Identified	*Noteworthy Responses*
Perception of a healthy diet	Balance, Variety Enhanced performance, recovery, mental health, well-being & energy levels	*"Making sure you get enough protein, vegetables, fruits, vitamins, not too many processed foods or red meat. It's important for quality of life, I feel more energetic when eat healthily and I can do more."*
		" A balanced diet, hitting all the food groups but not eating one thing in excess. It helps with everyday life for work and sport, mentally and physically you can feel the benefits."
Perception of an unhealthy diet	High sugary content, heavy processing, food groups in excess	*"overindulgent, high sugar processed, too much food, high calorie foods, foods easy to snack on"*
		"Overeating or undereating, both can be unhealthy in different ways, consuming one food group too much like a certain carb, or binge eating on unhealthy foods high in sugar, saturated fat and processed foods."
Influence of diet on performance	Energy to sustain exercise Aids recovery Enhanced athletic performance Improved mental focus	*"The times where I fuel accordingly, I can definitely see the peaks in my performance. If I get my nutrition right prior to training I can last the duration, whereas if I don't, I really struggle."*
		"If I eat the right amount of food I feel like I have more energy, If I don't eat properly, I feel light-headed, low in energy during a game, or it will impact my ability to train."
Aspects of Nutrition influencing performance	Carbohydrate intake Quality of meals Meal timing Volume of food Hydration	*"Release of energy*, you *don't want to go half-way through a game to see that you have no energy left. Goal would be to maintain energy throughout; mainly from carbohydrate."*
		"Carbs as the main source of energy – the right type of carbs too. Hydration so you can function properly. I don't like to eat too much the morning of the game; I eat little before the game and slightly more for dinner the night before."
Nutritional Strategies	Supplements Pre-game/ Post-exercise meal Hydration Carb loading Protein intake	*"I try to come off caffeine a day or two before a game; it works better in terms of being stimulated for the game."*
		"II will take beetroot juice an hour and a half before training for the greatest impact according to the advice"
		"The night before a game, I make sure I have a decent meal with decent amounts of protein and carbs"
		"I try to drink as much water as possible, I am not very good at it, but I try"
Impact of meal timing	Gastrointestinal discomfort Fatigue Prevention Aids Recovery	*"I eat a lot of food after training to refuel, before I try not to eat too much to avoid feeling sick."*
		"I think it's especially important before games and training. If I don't eat enough or eat too much, I will struggle at training. Important to keep yourself fuelled up throughout the day and after games too for recovery "
		"Not too bothered about timing; I eat as I normally would; don't change timing of meals even during a game unless I have to"
Determinants of dietary choices	Time, planning, preparation Work/family/university commitments Convenience, motivation, habits Preferences, cost, availability	*"Biggest thing that affects me is time, I am generally very busy which means I can be lazy with meal prep"*
		"Time management for meal prep, personal motivation, availability of correct foods and money in relation to supplements which can be expensive especially as I am a student"
		"Convenience, if I am short on time due to work or a long week and I want something I can put in the oven"

	Themes Identified	*Noteworthy Responses*
Dietary Goals	Increase muscle mass, strength, weight, protein Reduce fat, processed foods Healthy/balanced diet Not sure/ None	*"Remain the same weight, cut body fat, build muscle, I try to reduce carbs and maintain fat intake"*
		"Making sure I have enough protein, not too many processed foods to keep muscle mass and lose a bit of fat"
		"Maintain a well-balanced diet and stay away from snacking. I try to have three meals and Increase muscle mass"
		"I don't really have specific goals I generally just try and eat quite healthy"
Barriers to Dietary Goals	Meal planning, preparation, cooking, personal discipline, motivation, special dietary requirement, finances	"*Probably time and planning, so planning ahead in terms of when I am going to do a shop, its usually at the weekends so I need to plan ahead what I am going to eat for lunch, snacks and presession so that I can prepare them accordingly throughout the week"*
		"I have been doing alright actually from a nutrition perspective because I have more time to put into it and my evening are freed up to do some more cooking."
		"Having the motivation to cook for 45 minutes when life happens when I could easily just snack on a bowl of cereal"
		"Money. My weight is 108 kg, so I need 2 grams of protein and that costs a lot of money"
Challenges of Coronavirus	Maintaining body composition Training limitations Time/planning, food availability Easier / Not sure / None	*" I have been doing alright from a nutrition perspective because I have more time to put into it and my evenings are freed up to do some more cooking. Training has been more difficult because I don't have the equipment."*
		"I don't really have goals as such around what I am trying to do, I am aware of what I'm eating but I wouldn't say I am eating any better or worse than I was before."
Impact of Coronavirus	Reduced muscle mass, fitness, strength, motivation Minimal / Not sure / None	*"Muscle mass and body weight may drop due to less training; maintaining weight is quite tough. I try to do as much training as I can but as we cannot train with other players, I may not push myself as much and have less motivation."*
		"Corona virus will have a big impact on reconditioning side if it stays any longer. I may lose muscle mass and it may change my body composition."
		"I don't think it will have a huge impact because I am still training at a decent level and we would usually be having a bit of a rest at this time of year anyway."

Discussion

The mean NK score of semi-professional players in this study was 53.4%. The observed score in the present study is significantly lower compared to other studies on elite rugby athletes (73% (Alaunyte et al. 2015) and 61.3% (Spendlove et al. 2012)). However, this study used an adapted NSKQ consisting of 39 questions (Trakman 2017), whereas the other two studies used 90-points and 72-points of the same GNKQ (Alaunyte et al. 2015; Spendlove et al. 2012). Disparity in results may be due to different assessment tools used. Semi-professional players may have limited opportunity to access nutritional resources and advice, therefore lower NK in comparison to elite athletes may be expected (Heaney et al. 2011).

The differences in the scores of the good NK and poor NK groups were significant for all sections excluding supplements and alcohol. Discrepancies between studies make it difficult to compare scores as different tools, nutrition subsections, cut-offs and sample characteristics have been used (Spendlove et al. 2012; Alaunyte et al. 2015; Trakman et al. 2016). However, a common theme between the current findings and other studies has emerged (Torres-Mcgehee et al. 2012; Trakman et al. 2016) and reveals that athletes' knowledge of supplementation is poor. In a study with Australian football players, it was noted that most

players were aware of the alcohol recommendations however only a few were able to identify a unit of alcohol (Devlin and Belski 2015). Given the drinking culture in the sports industry (Barnes 2014) it is surprising to have a gap in knowledge in this area (Martens et al. 2006; O'Brien and Kypri 2008). However, in contrast to previous findings, the average alcohol intake of the rugby players in this study was significantly lower than the maximum allowance of 14 units per week (median 6.3, $p < 0.001$). In addition to general health benefits, this is a noteworthy finding as most players were striving to maximise anabolism, and research has shown that muscle protein synthesis can be suppressed if alcohol is consumed, even in the presence of adequate protein intake (Parr et al. 2014).

Contrary to the hypothesis, neither increased age, years game experience, level of education obtained, nor employment status were associated with improved NK or DI. This study did not find significant differences in NK between all levels of education. This may be due to participants' level of education (100% had GSCEs). Despite NK being shown to be influenced by education (Trakman et al. 2016), similarly to a study on Australian elite athletes (Spronk et al. 2014), this study did not find any significant correlations between NSKQ with either education or age. However, respondents that were familiar with the Eatwell Guide, scored significantly higher in the NSKQ overall and the micronutrients sections. Similarly to the findings of Andrews and Itsiopoulos (2015), participants with health-related qualifications scored higher overall in the NSKQ and the sports nutrition sections. Total NK% was not significantly correlated with dietary input however, subjects who had previously had a consultation with a dietitian or nutritionist scored significantly higher in the Macronutrients and Sports Nutrition subsections which may be related to the information received during the consultation. Participants in this study that have not had a prior consultation with a dietitian reported a range of reasons including problems accessing a sports dietitian (S-RD)/nutritionist, belief around the adequacy of their own NK and lack of trust. It is common for semi-professional athletes to have trouble accessing S-RDs due to limited resources and time (Hull et al. 2016). Athletes' supplements usage is frequently directed by family, friends, teammates, coaches, athletic trainers and the media instead of S-RDs/nutritionists (Braun et al. 2009; ACSM 2016).

Results showed the players' mean energy intakes from food sources were 26.3 ± 9.2kcal/kg body weight which may be insufficient to meet athletic demands. However, fluctuation of dietary intakes throughout seasons according to training demands were not accounted for in the dietary analysis. Average carbohydrate intake (3 g/kg/day) met ACSM sports nutrition guidelines for skill-based activities (3–10 g/kg/day). However, intakes for 89.5% of the group were below the specified recommendation of 5 g/kg BW per day for athletes performing moderate intensity daily exercise. Notably, carbohydrate intakes may have been underreported as supplement use was not accounted for in the calculation of average carbohydrate intakes. These results were consistent with findings from previous studies of rugby athletes where carbohydrate intakes have frequently been shown as inadequate (Potgieter et al. 2014; Alaunyte et al 2015; Mackenzie et al. 2015). Similarly, to the findings of Tooley et al. (2015), mean fibre intake (21.7 ± 10.1 g/d) was less than the recommended amount (30 g/day).

Total fat %TEI did not differ significantly from the guidelines and mean daily protein intake (1.4 ± 0.4 g/kg/day) was in line with ACSM (2016) sports nutrition guidelines, in contrast to past research where protein intakes of rugby players exceeded recommendations (Potegieter et al. 2014; Mackenzie et al. 2015). However, 31.6% of the study population did not meet the lower range of the recommended amounts (< 1.2g/kg/day) from food sources. Interestingly, 68% participants reported taking whey protein supplements, therefore, it is possible that players with intakes below the recommended amount were meeting their protein requirements through a combination of food sources and supplements. Although some results were inconsistent with previous findings (Potgeiter et al. 2014), overall macronutrient and energy intake results corresponded with the findings from a recent systematic review in which dietary intakes of semi-professional team sports athletes were found to meet or exceed sports nutrition recommendations for protein and/or fat and were inadequate for carbohydrate and energy (Jenner et al. 2019).

Overall, the good NK group had higher energy and macronutrient intakes than the poor NK group, suggesting the good NK group would be more likely to reach their energy and protein requirements from food sources. However, the present study reveals that the majority of participants had CHO intake below the lower range of ACSM guidelines, with higher prevalence observed in poor NK group (80% versus 56% for good NK group), this is consistent with other findings (Bradley et al. 2015a ; Bradley et al. 2015b; Devlin et al. 2017). Higher NK has been positively associated with consumption of fruit, vegetables and carbohydrate-rich foods (Alaunyte et al. 2015). However, there are controversial beliefs around CHO in sports nutrition as over the years there has been a downward trend in CHO intakes among athletes including rugby players which may be influenced by motives to reduce body fat

and optimise training adaptations (Bradley et al. 2015a). This may be caused by how the media portrays nutritional information in relation to governmental dietary guidelines (Ellison et al. 2011). Interestingly, a recent study found that adherence to nutritional guidance was seasonal among high performance athletes and similarly to the present study, dietary behaviours were underpinned by emotional barriers/motivation with training schedules limiting opportunities for food planning (Bentley et al. 2021).

Results from a systematic review suggests weak but significant positive correlations between higher NK and DI, and particularly intake of fruits and vegetables (Spronk et al. 2014). Participants in the current study overwhelmingly reported that natural foods or a well-balanced diet should provide all requirements which is in line with the British Dietetic Association (BDA) recommendation for sports (BDA 2020). Stokes et al. (2018) also reported adolescent rugby players to perceive similar foods as healthy. Foods reported as unhealthy by the participants in this study included sugary foods, takeaways, and sugary drinks, which was consistent with other studies (Heaney et al. 2008; Smart and Bisogni 2001; Stokes et al. 2018). Common limitations in studies included varied quality with only a few studies using validated instruments to assess NK and DI (De Vriendt et al. 2009; Spronk et al. 2014; Wardle et al. 2000).

Perception of healthy eating of participants was in line with the messages from the Eatwell Guide in this study (PHE 2018). A study investigating dietary practices of elite athletes in Australia found similar results with participants describing healthy eating with achieving balance and having a variety of foods (Heaney et al. 2008). Players of the current study emphasized the need for moderation which agrees with findings on university students (House et al. 2006). A theme emerged from this study in which players described healthy eating as a perfect balance between reward (e.g. “cake”) and self-control (“unhealthy when in excess”). This cultural norm of associating food high in sugar and fat as a treat was also noted amongst male college hockey athletes who reported the need to balance between self-sacrifice and indulgence (Smart and Bisogni 2001). This is explained by Connors and colleagues (2001) as balancing strategies used by adults to make food choices where there are competing priorities of values such as health and taste.

The current study reported that 68% of players were taking supplements to enhance performance which is line with other studies, with prevalence of supplements use ranging between 37% and 89% (Braun et al. 2009; Maughan 2018). Attitudes towards PES use were variable; 23% of players felt PES gave them a competitive advantage, whereas 46% utilized them for convenience and 50% considered them non-essential. Similarly, to the findings of Potgieter et al. (2014) and Bradley et al. (2015), PES use was high and all players that used supplements took whey protein. Furthermore, 31% used caffeine prior to a game for enhanced-energy purposes and 25% utilised various other PES to aid with training and recovery. It is evident that participants may not be aware of the evidence to support the ergogenic effects of some of these ingredients. Participants used supplements to boost performance, to help achieve nutrient goals, optimize recovery, immune function, improve BC and compensate for a poor nutrition which is in accordance with other studies (Braun et al. 2009; Maughan 2018; Stokes et al. 2018). A systematic review has shown elite athletes are more likely to use PES than semi-professional athletes (Knapik et al. 2016) and a recent study of rugby players found prevalence of ergogenic supplements use was greater among professional rugby athletes than amateur players (Sanchez-Oliver et al. 2021). It could be argued that non-elite athletes are more susceptible to assist their current diet with supplements to gain a competitive edge (Sekulic et al. 2019).

In this study all participants had cooking skills which has been considered an enabler to healthy eating (Smart and Bisogni 2001). The majority of players (67%) reported being primarily responsible for the cooking and shopping in their household however, some players stated that preferences of other members of the household influenced their dietary patterns. Studies have shown that accommodating family or friends food preferences deterred their determination to maintain dietary goals (Stokes et al. 2018; Chang et al. 2008; Thornton et al. 2006). Cost, convenience and availability were also influencing factors however, contrary to previous findings (Heaney et al. 2008; Stokes et al. 2018) cost was not a primary determinant of food choice for most players in the current study. This is most often observed amongst those with limited finances such as low-income groups, students and adolescents (Boek et al. 2012; Glanz et al. 1998).

Players in this study also described decreased personal motivation/discipline as a challenge to maintain dietary goals. This is particularly evident during off-season amongst elite athletes with some drastically changing their eating practices (Smart and

Bisogni 2001; Heaney et al. 2008). Similar to the findings of Heaney et al. (2008), many respondents considered lack of time and preparation to be the primary challenge towards healthy eating healthy and meeting dietary goals. Although the majority reported lack of time to prepare meals as a barrier, a few reported that COVID-19 lockdown has enabled them to have more time to prepare and cook meals. An Italian survey found similar results with participants having more aspiration to cook, which has led to higher consumption of homemade foods (Di Renzo et al. 2020). Moreover, a study of professional/semi-professional rugby union players in New Zealand found the majority of players to have a reduced intake of packaged/convenience foods and greater fruit and vegetable consumption during the COVID-19 pandemic. Findings were similar to the present study, and players reported lack of motivation and limited access to training equipment as challenges during lockdown (Roberts et al. 2020). Concerns over the impact of reduced training and its impact on BC was cited by a few players, which may have detrimental impact on future performance. Elite athletes may be provided with home-based exercise programs and in some cases live video training sessions led by fitness trainers however in this study, none of the participants reported access to such opportunity during skype interviews (Sarto et al. 2020).

Strengths and limitations of the study

To the researcher's knowledge, this is the first study to address NK, APC around dietary goals and dietary practices of semi-professional rugby players in Scotland.

The researchers used both quantitative and qualitative methods, which enabled a more complete picture of the investigated research field (Kelle 2006). The tools used were validated, which enables this paper comparison with other studies in future research. However, the 'Demographics & APC' questionnaires was developed by the researchers therefore not standardised for use in the population and NSKQ was adapted therefore was not validated. The EPIC FFQ is a validated tool but not for athletic populations, and additionally, it may not provide an accurate measurement of fibre and alcohol, whereas FETA software does not account for supplement use in the calculation of macronutrient intakes. Intentional underreporting/overreporting as well as self-reported height and weights may have affected the accuracy of the results. Interviews were carried out individually and therefore the influence of peers, family and coach was significantly reduced. Additionally, all participants were asked the same interview questions ensuring responses were not led by researchers' perspective. However, participants may have answered some of the questions to please the researchers and to meet perceived beliefs. Furthermore, researchers tried to minimise bias in retrieving themes during the analysis by triangulation of data. Additionally, the researcher was able to investigate the dietary impact of COVID-19 on participants, which is a unique time in the history since the second world war that athletes had to interrupt competition (Sarto et al. 2020). The recommendations from this research (supplementary material Table 2) could be potentially used by professionals working with athletes in the UK ensuring optimum nutrition despite limited resource availability (Heaney et al. 2011).

In conclusion, the current group of semi-professional rugby players appeared to have average NK, lacked awareness of current sports nutrition guidelines and subsequently had inadequate carbohydrate and fibre intakes from food sources. Players with good NK had significantly higher total energy, carbohydrate and protein intakes. Despite average dietary intakes of protein meeting the recommended amounts, most players took whey protein due to the perceived benefits for enhancing performance and body composition adaptation. The main challenge identified by players in achieving their dietary goals was lack of time for meal planning, preparation and cooking. Thus, some players found it easier to meet their dietary goals during the COIVD-19 pandemic with more free time however restricted access to equipment was a significant challenge in meeting body composition goals during the same period.

List Of Abbreviations

ACSM	American College of Sports Medicine
APC	Attitude, perception, challenges
ANOVA	Analysis of Variance
BDA	British Dietetic Association
BCAA	Branched Chain Amino Acids
BC	Body composition
BMI	Body Mass Index
BW	Body Weight
CHO	Carbohydrate
COVID-19	Coronavirus
DI	Dietary Intake
EPIC	The European Prospective Investigation into Cancer and Nutrition
FETA	Food Frequency Questionnaire European Prospective Investigation into Cancer and Nutrition Tool for Analysis
FFQ	Food Frequency Questionnaire
GNKQ	General Nutritional Knowledge Questionnaire
GDPR	General Data Protection Regulation
IBW	Ideal Body weight
NK	Nutritional Knowledge
NSKQ	Nutrition for Sports Knowledge Questionnaire
PES	Performance Enhancing Supplements
PHE	Public Health England
RD	Registered Dietitian
SD	Standard Deviation
SFA	Saturated Fatty Acids
SPSS	Statistical Package for the Social Sciences
S-RD	Sport Dietitian
TEI	Total Energy Intake
UK	United Kingdom
WM	Weight Management
kg	Kilogram

Declarations

Ethics approval and consent to participate

All participants consented to this observational study. Participants were asked to disclose personal information such as date of birth, weight, height, dietary intake, education level and occupation however subject identities were concealed and no person

identifiable information was disclosed. All data was anonymised, stored confidentially and will be destroyed within five years. Participants were not offered any payment or incentives for taking part in the research.

Consent for publication

Not Applicable

Availability of data and materials

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

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

SH, RJ, CT and LW designed the study protocol and contributed to the editing of the manuscript. SH and RJ developed the questionnaires and interviewed participants for this purpose of the study. RJ and SH analysed and interpreted the data and literature. Both SH and RJ jointly wrote the manuscript. CT and LW were responsible for the oversight of the project. All authors read and approved the final manuscript.

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