Elite Squash Players Nutrition Knowledge and Influencing Factors

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Abstract

Background: There is a reported mismatch between macronutrient consumption and contemporary macronutrient guidelines in elite standard squash players. Suboptimal dietary practices could be due to a lack of nutrition knowledge among players. Subsequently, the purpose of this study was to assess the sports nutrition knowledge of elite squash players through the RNSKQ and provide an indication of whether players require nutrition support to increase their nutrition knowledge.

Methods: This cross-sectional study assessed the nutrition knowledge of 77 elite squash players via the RNSKQ over the period of June 2020 to August 2020.

Results: Players conveyed average nutrition knowledge with a mean RNSKQ score of 48.78 ± 10.06 (56.07 % ± 11.56 %). There were no significant differences in RNSKQ score between male and female players (p = .532). There was found to be a weak positive correlation between world ranking and RNSKQ score (r = .208) and age and RNSKQ score (r = .281). Players who had a relevant undergraduate degree (e.g. BSc Sport & Exercise Science) had significantly greater RNSKQ score than players with no qualifications (p = .022). Players who consulted a sports nutritionist to obtain their main source of nutrition information were shown to have significantly greater knowledge than those who acquired knowledge from a sports scientist (p = .01) or the internet / social media (p = .007).

Conclusions: Players should consult with a sports nutritionist to increase their sport nutrition knowledge. Future research should quantify the effectiveness of a nutritional education intervention at increasing nutrition knowledge in players.

Background

Squash is a high intensity intermittent sport [1] which is classified as one of the four major racket sports [2]. Elite male squash players are reported to exhibit a mean energy expenditure of 4933 ± 620 $kJ.h^{-1}$, mean heart rate of 92 ± 3% heart rate maximum and mean respiratory exchange ratio of 0.94 ± 0.06 throughout simulated match play [3], conveying the glycolytic nature of the sport [1]. At elite standard, players are reported to train for more than 12 hours per week, with many squash-specific sessions such as pressure sessions and continuous rallies eliciting heart rates above 90% heart rate maximum [4]. Due to the high energetic demands of elite squash, adequate energy intake is required to optimise health and physical performance [5]. Subsequently, sports nutritionists have become an integral part of high-performance teams to help promote optimal nutrition practices using evidence-based approaches [6]. Despite this, there is a paucity of information regarding specific nutritional recommendations for squash, unlike in other racket [7] and high intensity intermittent sports [8]. This makes it difficult for practitioners working with elite squash players to make evidence-based recommendations.

Ventura-Comes et al., (2019) [9] analysed the food habits of elite Spanish squash players using a food consumption frequency questionnaire and found that players under consumed carbohydrate-rich foods

such as bread, potatoes, pasta and rice when compared to contemporary guidelines [10]. Low carbohydrate intakes in relation to training loads can reduce high intensity intermittent performance [10].

Mismatches between contemporary recommendations and players habitual nutritional practices suggest that elite squash players might lack the nutrition knowledge to have optimal dietary practices. An athlete's dietary practices are influenced by many individual and environmental factors such as hunger and appetite, taste and food preferences, beliefs, culture, experiences, self-efficacy, financial status, peers, sporting culture, access to food, cooking skills and nutrition knowledge [11]. There is a weak positive correlation between athlete's nutrition knowledge and the quality of their diet (r = .261) [12]. Subsequently, increasing an athlete's nutrition knowledge is of interest to sport nutrition practitioners as it might enhance athlete's dietary practices [13].

To date, no study has quantified the nutritional knowledge of elite squash players. Assessing the nutrition knowledge of elite squash players would help provide an indication of whether players require nutrition support and education to increase their nutrition knowledge and therefore improve food choices to support high training and match demands, as well as a general healthy lifestyle. Subsequently, the main aim of the study was to assess the nutrition knowledge of elite squash players using the validated RNSKQ [14, 15]. Secondary aims of the study were to investigate the association between age and world ranking on nutrition knowledge to provide an indication of whether these influence a squash player's nutrition knowledge. A third aim was to quantify whether players had any previous relevant education and the effects on players nutrition knowledge as this might influence nutrition knowledge [16]. A fourth aim was to establish where players obtained their main source of nutrition information from and whether this has an effect on players nutrition knowledge.

The final aim of the study was to survey what contemporary sports nutrition research elite squash players would like to see being conducted in the future. There are currently no specific nutritional guidelines for elite squash players. By surveying players, the aim was to ensure that all relevant nutrition research in elite squash is undertaken, specific to player's needs.

Methods

Participants

The research was approved by an institutional ethics committee (ER23597808). All participants who volunteered provided informed consent with the study being conducted according to the principles of the 7th revision of the Declaration of Helsinki [17].

A convenience sample of prospective participants were contacted through the PSA on two separate occasions (June 2020 and August 2020) and were provided with information about the study. 77 elite squash players took part in the study, 37 were male, and 40 were female. Responses were received from a global sample of the population (North America = 5; South America = 2; Europe = 55; Africa = 5; Asia = 6; and Oceania = 4). The mean average (± standard deviation) age and world ranking of the participants

was 24 ± 5 and 190 ± 167 respectively. World rankings were taken from the PSA September rankings upon termination of the data collection period. Figure 1 details the distribution of the players world ranking.

Nutrition Knowledge

Players nutrition knowledge was measured via the validated RNSKQ [14, 15]. The questionnaire includes 87 questions with six subsections; weight management (*n* = 12), macronutrients (*n* = 30), micronutrients (*n* = 13), sports nutrition (*n* = 12), supplements (*n* = 12) and alcohol (*n* = 8). Nutrition knowledge was quantified using a scoring system set by Trakman et al. (2017) [14] of: poor (0–49%), average (50–65%), good (66–75%) and excellent (76–100%). Players were asked to complete the questionnaire without the use of resources (peers, books, internet etc.).

Players were also asked to detail any relevant qualifications which are specific to nutrition (e.g. A-Level biology, BSc sport and exercise science etc.), as level of education has been shown to positively influence nutrition knowledge [16]. These were subsequently ordered into four groups upon analysis taking the participants highest standard of relevant education (no qualification, A-Level [physical education / sport, biology, chemistry etc.] undergraduate degree [sport and exercise science, nutrition or equivalent] and postgraduate degree [sport and exercise science, nutrition or equivalent]). Players were also asked where they obtained their main source of nutritional information from to gain an understanding of how many players currently consult with a sport nutritionist. Nutrition knowledge has been shown to positively or negatively influence nutrition knowledge depending on the source [16]. Players were provided six options, with them selecting the most relevant (sports nutritionist; conditioning coach or sport scientist; squash coach; peer review journal articles; internet or social media; and other). Finally, players were asked to share what squash nutrition research they would like to see in the near future. This was split into six options with players able to select their top three (quantification of energy expenditure throughout training periods in elite squash players to create specific nutritional training guidelines; quantification of energy expenditure throughout competition periods in elite squash players to create specific nutritional competition guidelines; quantification of sweat sodium losses in elite squash players to create specific hydration guidelines; nutrition to support immune function in elite squash players; efficacy of ergogenic aids in elite squash; other). These options were devised as they underpin the relevant knowledge to create specific nutritional recommendations for elite squash players (e.g. how much energy do elite squash players expend during training and competition, what are players sweat sodium losses etc.).

Statistical Analysis

SPSS V 24.0 software (SPSS Inc., Chicago, IL) was used to perform the data analysis. All data was displayed as mean ± standard deviation for all participants. The Kolmogrov-Smirnov test was used to check for normality. Levene's Test for Equality of Variances was used to assess homogeneity of variance. Independent Samples T-Test or Mann-Whitney *U* Test (for non-parametric analysis) was used to analyse the differences in overall RNSKQ scores and sections between male and female players. Pearson's Correlation Coefficient or Spearman's Rank-Order Correlation was used to quantify the relationship between RNSKQ score or section scores against age and world ranking. Pearson's Correlation Coefficient

and Spearman's Rank-Order Correlation were interpreted according to accepted thresholds (small: r = 0.10–0.29, moderate: r = 0.30–0.49, large: r = 0.50-1.0) [18].

A One-Way Analysis of Variance (One-Way ANOVA) or Kruskal-Wallis K Test (for non-parametric analysis) was performed to calculate any significant differences between RNSKQ score or section scores against standard of relevant education and main source of nutrition information. Where a significant main effect was observed, the Hochberg Post-Hoc pairwise comparison was used to determine which groups were statistically significant.

Results

RNSKQ Score, Subsection Scores and Individual Question Responses

Figure 2 details players grand mean subsection scores. The mean RNSKQ score was 48.78 ± 10.06 (56.07% ± 11.56%), defined as "average" nutrition knowledge. The highest scoring section was alcohol, with players demonstrating "good "knowledge. Players had "average" macronutrient, weight management and sports nutrition knowledge. Supplements was the lowest scoring section with players exhibiting "poor" nutrition knowledge. Players also had "poor" knowledge of micronutrients. An additional file details individual question scores [see Individual Question Scores for Supplementary Tables 1–87].

Differences Between Male and Female Players in RNSKQ Score and Subsection Scores

Figure 3 details differences between male and female players RNSKQ score and subsection scores. There were no statistically significant differences between male and female players in RNSKQ score or subsection scores ($P > 0.05$).

Association Between World Ranking and RNSKQ Score and Subsection Score

World ranking had a small positive association with RNSKQ score (r = .208), weight management (r = .211), macronutrient (r = .135), sports nutrition (r = .137), supplements (r = .154) and alcohol subsections (r = .170). World ranking had practically no association with micronutrient subsection score (r = .059).

Association Between Age and RNSKQ Score and Subsection Score

Age had a small positive association with RNSKQ score (r = .281), weight management (r = .288), macronutrient (r = .189), micronutrient (r = .189), supplements (r = .255) and alcohol subsections (r = .215). Age had practically no association with sports nutrition subsection score (r = .027).

Effects of Standard of Relevant Education on RNSKQ Score

Figure 4 details the effects of standard of relevant education on RNSKQ score. Standard of education had a statistically significant effect on RNSKQ score (p = .024). Hochberg Post-Hoc pairwise comparison revealed that players with a relevant undergraduate degree scored significantly better than players with no relevant qualification (p = .022). No other statistically significant differences were observed across any of the groups.

Effects of Main Source of Nutrition Information on RNSKQ Score

Figure 5 details the effects of main source of nutrition information on RNSKQ and subsection scores. Players main source of nutrition information had a significant positive effect on RNSKQ score ($p = .000$). Hochberg Post-Hoc pairwise comparison showed that players who received their main source of nutrition information from a sport nutritionist, nutritionist, registered dietitian or equivalent scored significantly higher than players who received their main source of nutrition information from a sport scientist ($p = .010$) or the internet / social media ($p = .007$). No other significant differences were observed across any of the groups.

Future Sports Nutrition Research in Elite Squash

Figure 6 details players votes for future sports nutrition research in elite squash. The quantification of energy expenditure throughout training periods to create specific nutritional guidelines ($n = 55$; 71.43%) was the most popular area for future sports nutrition research in elite squash. The quantification of energy expenditure throughout competition periods to create specific nutritional competition guidelines was the second most popular ($n = 34$; 44.16%). 17 players stated they would like to see research regarding nutrition to support immune function (22.08%), with 16 players specifying they would like to see a quantification of ergogenic aids in squash (20.78%). The lowest scoring area of interest was the quantification of sweat sodium losses in squash to create specific nutritional guidelines ($n = 10$; 12.99%). Two players selected the 'other' suggesting "how to get everything into your diet while choosing plant based" and "the sustainability of a ketogenic diet for high performance in squash".

Discussion

The main aim of this study was to assess the nutrition knowledge of elite squash players. This study also aimed to quantify the association between age and world ranking on players nutrition knowledge. Thirdly, the study aimed to quantify the effects of standard of relevant education and where players obtained their main source of nutrition information from on players nutrition knowledge. The final aim of the study was to survey what contemporary sports nutrition research elite squash players would like to see being conducted in the future.

The main findings of this study were (1) elite squash players have average nutrition knowledge, (2) there were no differences in nutrition knowledge between male and female players, (3) age and world ranking had a small positive association with nutrition knowledge, (4) players who had a relevant undergraduate degree were found to have better nutrition knowledge than those who had not relevant qualification, (5) players who obtained their main source of nutrition knowledge from a sports nutritionist were shown to have better nutrition knowledge than players who obtained from a sports scientist or the internet, (6) players valued quantifying the energetic demands throughout a training period as the research they would like to see undertaken in the future.

Sports Nutrition Knowledge and Influencing Factors

Overall, players sport nutrition knowledge was average (56%). Evaluations of players nutrition knowledge in comparison to other athletes is difficult due to the heterogeneity of tools and standard of athlete used

to assess sports nutrition knowledge [16]. The RNSKQ was devised as a universal tool to quantify athlete's nutrition knowledge and make comparisons among different sports [14]. To date, three previous studies [19, 20, 21] have used the NSKQ to assess sports nutrition knowledge with no previous study using the RNSKQ. All three studies found athletes sports nutrition knowledge to be poor (Jenner et al., 2018 = 46% [19]; Trakman et al., 2018 = 46% [20]; McCrink et al., 2020 = 40% [21]) in contrast to the present findings. Elite squash players should aim to increase their nutrition knowledge as this may optimise their dietary practices [12] which have been reported to be sub-optimal [9, 22]. Nutritional education interventions have been effective at increasing nutrition knowledge in athletes [13]. Future research should aim to quantify the effectiveness of a nutritional educational intervention at increasing nutrition knowledge in elite squash players.

Sex was shown to have no significant differences on overall nutrition knowledge or any subsections (Fig. 3). Assuming appropriate energy availability [23], aside from iron intake in regularly menstruating females [24], the main determinants of a player's nutritional requirements are based on their training load, regardless of sex [25]. Therefore, sex shouldn't influence nutrition knowledge and is consistent with findings from Trakman et al. (2016) [16]. Future research should aim to quantify the training loads and energy expenditures of male and female elite squash players to determine whether there are any differences in relative energetic demands between sexes. This would convey whether any differences in nutrition education are required between sexes among elite squash players. It would also provide specific nutritional recommendations for elite squash players to follow as reported in other racket [7] and high intensity intermittent sports [8]. 55 players (71%) surveyed in the present study conveyed that they would like to see this research undertaken. Players dietary intakes should also be quantified alongside training loads, as reported in other high intensity intermittent sports (26, 27). This would give an insight into whether players dietary intake is optimal in relation to their training load [28]. Players in the present study had poor knowledge of the contemporary carbohydrate and protein guidelines (see supplementary tables 13 and 33 [10, 29]). This is consistent with findings from Ventura-Comes et al., (2019) [9] that elite Spanish squash players under consume carbohydrate in comparison to contemporary guidelines [10], with players rarely consuming foods which have a high carbohydrate content such as bread, potatoes, pasta and rice. Despite having poor knowledge of contemporary guidelines, players in the present study were able to identify the carbohydrate (see supplementary tables 14–18) and protein (see supplementary tables 32 and 42) content of foods, as well as appropriate protein sources to promote muscle growth post resistance training (see supplementary tables 34–37). Players were also aware of what macronutrients to consume pre (see supplementary table 59), during (see supplementary table 64) and post exercise (see supplementary table 66), as well as a suitable fuelling strategy (see supplementary table 61) and snack during a 60-90-minute session (see supplementary table 65). This suggests that although players are unaware of contemporary guidelines, they may still follow optimal fuelling and recovery strategies. Many of the carbohydrate sources Ventura-Comes et al., (2019) [9] were reporting players to under consume were low glycemic index carbohydrates. It could be possible that squash players have a higher intake of high glycemic index carbohydrates. These are recommended around training sessions [10]. Food consumption frequency questionnaires have been shown to display poor

validity and reliability [30] in comparison to other methods such as weighed food diaries, snap 'N' send and 24-hour dietary recall [31, 32]. Subsequently, more valid and reliable methods need to be employed to assess the energy intake and nutritional habits of elite squash players to obtain a better understanding of their dietary practices.

Players were shown to have poor supplementation knowledge in the present study (45%). This is consistent with findings from Venutra-Comes et al., (2018) [22] who reported that elite Spanish squash players consumed ergogenic aids which had a lower efficacy such as glutamine, branch chain amino acids and flaxseed oil, rather than ones which had higher efficacy such as beta-alanine, creatine and sodium bicarbonate [33]. Players in the present study were unable to identify the rationale for use of beta-alanine (see supplementary table 77) supplementation. Beta-Alanine could enhance squash performance by increasing muscle carnosine stores and the subsequent buffering capacity of the muscle [34]. Tam et al., (2019) [13] reported that supplementation was the least frequent topic of nutrition education interventions (34%). This may explain why supplementation knowledge is poor in players. Players should aim to increase their supplementation knowledge to optimise their supplementation strategy. Future research should quantify the effectiveness of a nutritional education programme in elite squash players which includes supplementation information. Future research should also aim to quantify the efficacy of ergogenic aids (e.g. beta-alanine, sodium bicarbonate, creatine, caffeine and nitrates) in elite squash to establish a supplementation strategy specific to the sport.

Age was shown to have a small positive effect on nutrition knowledge (r = .281), which is in contrast to previous findings [16]. Players may not have support to a nutritionist in their early years, as national governing bodies prioritise senior players who have a greater likelihood of achieving success. Nutritional education interventions have been shown to increase nutrition knowledge in adolescent athletes [13]. Future research should aim to quantify the effectiveness of a nutritional education intervention to increase nutrition knowledge in adolescent athletes and determine whether this translates into practice.

World ranking was also shown to have a small positive effect on nutrition knowledge (r = .208). Players with better nutrition knowledge have been shown to have more optimal dietary practices [12]. This may increase athletic performance and consequently increase a player's world ranking.

A relevant undergraduate degree was shown to significantly increase nutrition knowledge in players in comparison to players with no relevant qualification (Fig. 4). This is to be expected given that undergraduate degrees (e.g. BSc Sport & Exercise Science) are designed to increase knowledge in a subject specific area, and many players cited that they had completed a nutrition module as part of their course.

Players who received their main source of nutrition information from a sport nutritionist were shown to score significantly higher than players who received their main source of nutrition information from a sport scientist, or the internet / social media (Fig. 5). Consequently, players should look to consult with a sports nutritionist to obtain nutrition information and be discouraged from using the internet / social media to increase their nutrition knowledge. Surprisingly, players who obtained their main source of

nutrition information were shown to have poor nutrition knowledge (44%). Sport scientists might be able to understand and communicate mechanistic underpinning. However, they may lack the ability to translate this into practical nutrition recommendations and coherent strategies for athletes.

Limitations

A limitation of the study is that it is impossible to know whether players cheated throughout completion of the RNSKQ. Players were asked to complete the RNSKQ without the use of resources (peers, books, internet etc.). However, no member of the research team was supervising players when they completed the questionnaire due to the universal nature of the study. Therefore, it is impossible to know whether players completed RNSKQ with or without the use of resources. If players were to complete the RNSKQ with resources this could influence their score and provide a false result. Another limitation of the study is that the RNSKQ is not specific to an individual or sport. Therefore, while players may have poor nutrition knowledge, they may have a good understanding of nutrition in relation to their sport and this is not reflected in their score.

Conclusions and Future Directions

This was the first study to quantify the nutrition knowledge of elite squash players. Players were found to have average nutrition knowledge (56%). Sex was shown to have no effect on players nutrition knowledge. Age and world ranking were shown to have a small positive effect on nutrition knowledge. Players who had a relevant undergraduate degree had better nutrition knowledge than those who had no relevant education. Players who consulted with a sports nutritionist were shown to have better nutrition knowledge than those who obtained nutrition information from the internet or a sport scientist. Consequently, based on data from this study, elite squash players should aim to increase their nutrition knowledge by consulting with a sports nutritionist. Future research should aim to quantify the effectiveness of a nutrition education intervention at increasing the nutrition knowledge of elite squash players.

Players had poor knowledge of contemporary carbohydrate and protein guidelines with previous research reporting mismatches between guidelines and dietary intakes [9]. However, it is possible that these guidelines and not specific to elite squash players and does not translate into poor dietary practices. Future research should quantify the training load and dietary practices of elite squash players to create specific nutritional recommendations for the sport. This will provide information on whether players dietary practices are optimal and will create specific nutrition recommendations for elite squash players as exhibited in other racket [7] and high intensity intermittent sports [8].

List Of Abbreviations

RNSKQ = Revised Nutrition for Sport Knowledge Questionnaire

PSA = Professional Squash Association

NSKQ = Nutrition for Sport Knowledge Questionnaire

Declarations

Ethical Approval and Consent to Participate

The research was approved by Sheffield Hallam University's ethics committee (ER23597808). All players provided informed consent prior to participating in the research.

Consent for Publication

All participants gave consent for publication.

Availability of Supporting Data

Most of the data generated or analysed during this study are included in this published article [and its supplementary information files] such as overall RNSKQ scores and subsection scores as well as individual RNSKQ question scores (ST1-ST87). Individual players scores cannot be request due to identification of players.

Competing interests

The authors declare that they have no competing interests.

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Authors Contributions

O. Turner, M. Ranchordas N. Mitchell, A. Ruddock, A. Purvis and designed the study. O. Turner recruited players, undertook data analysis, drafted the manuscript and oversaw manuscript preparation. M. Ranchordas, N. Mitchell, A. Ruddock and A. Purvis assisted with revising the manuscript. All authors read and approved the final manuscript.

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Figures

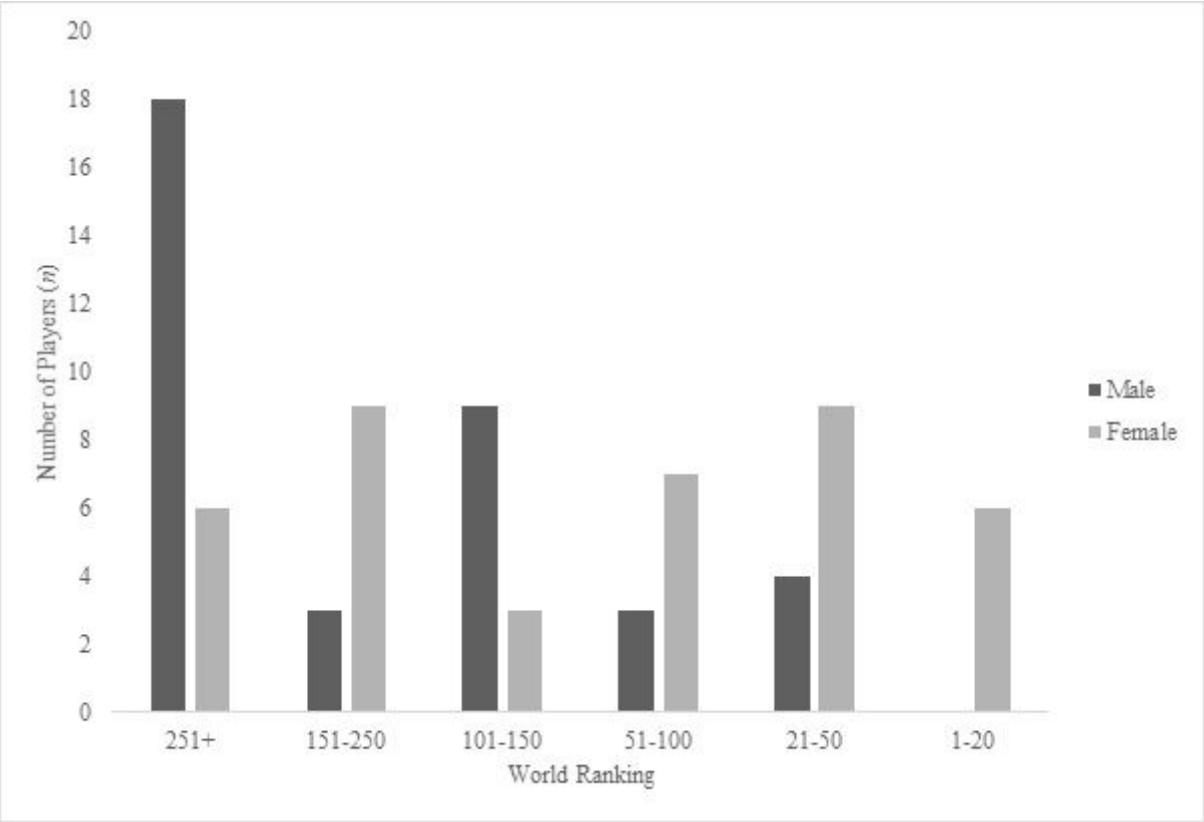


Figure 1

Distribution of player world ranking

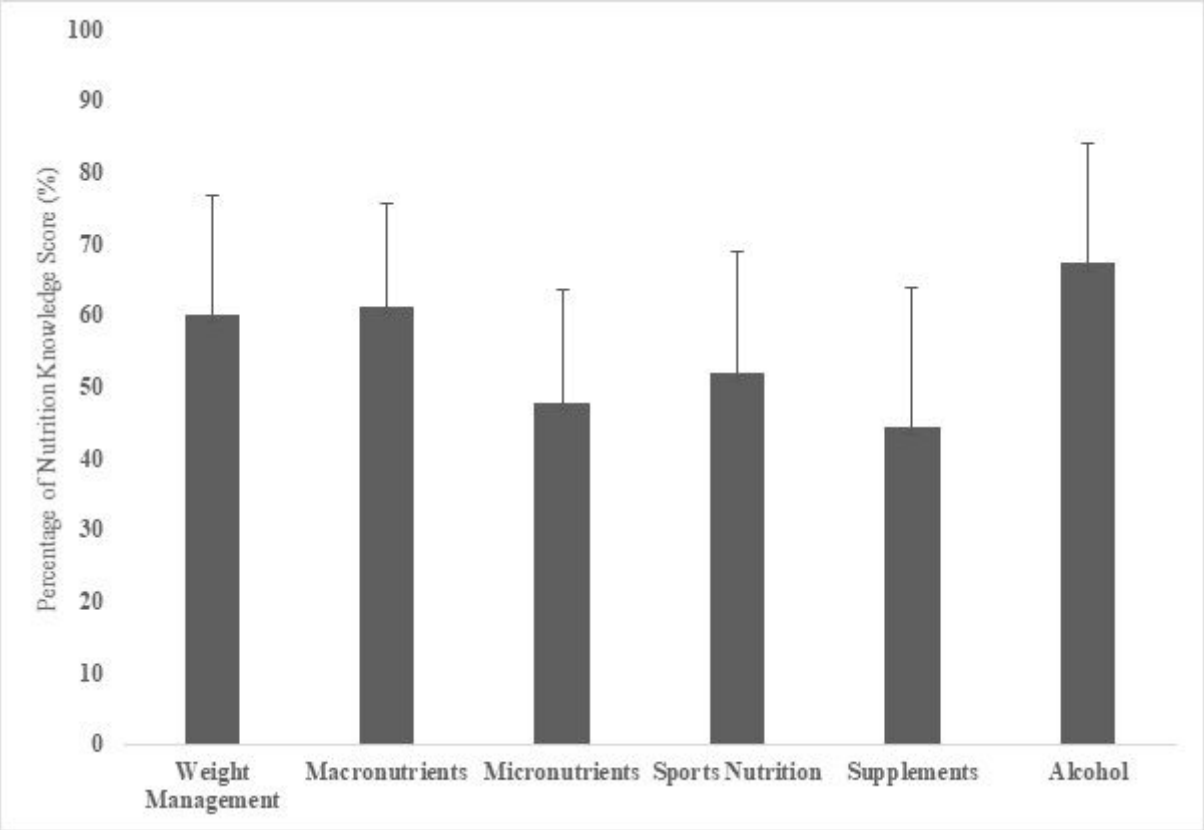


Figure 2

Players mean subsection scores

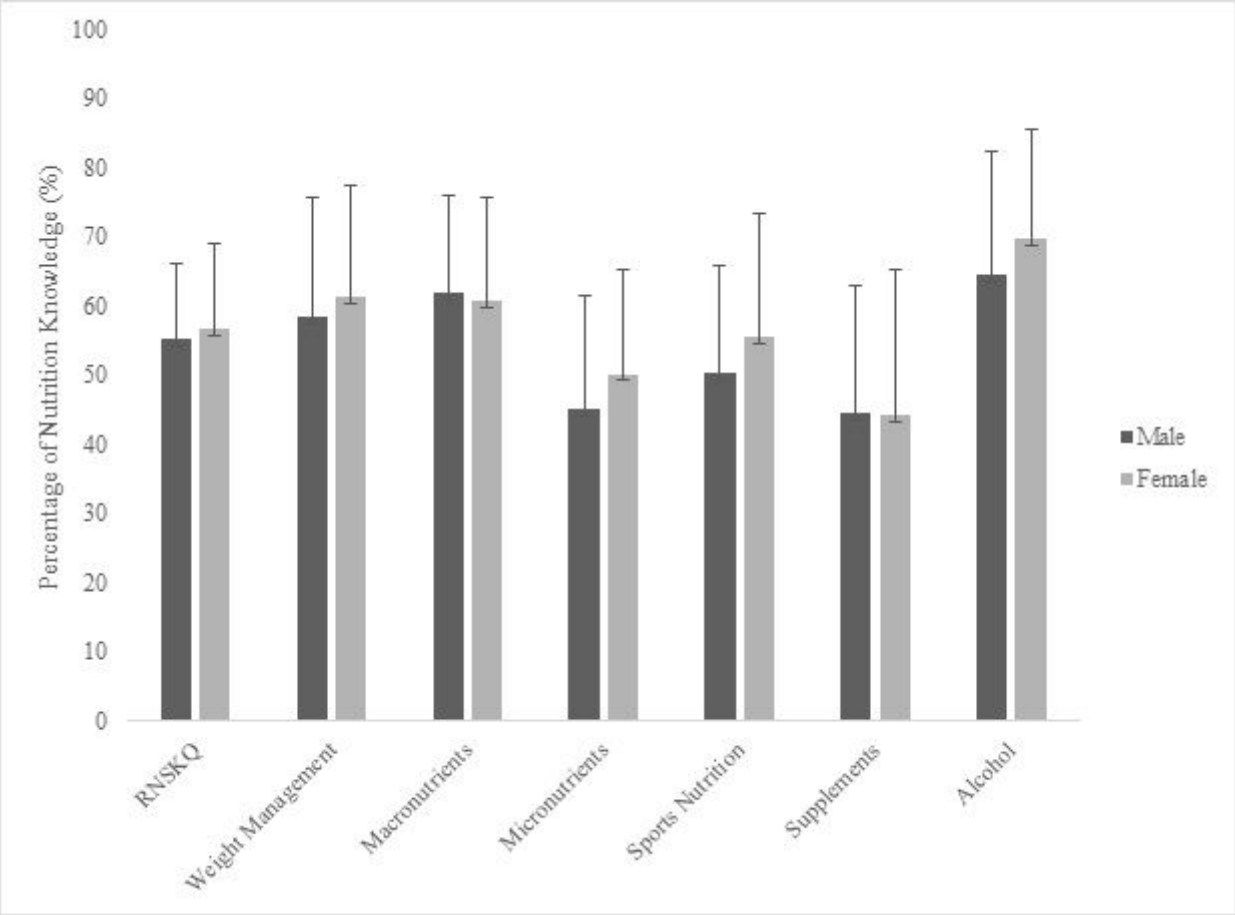
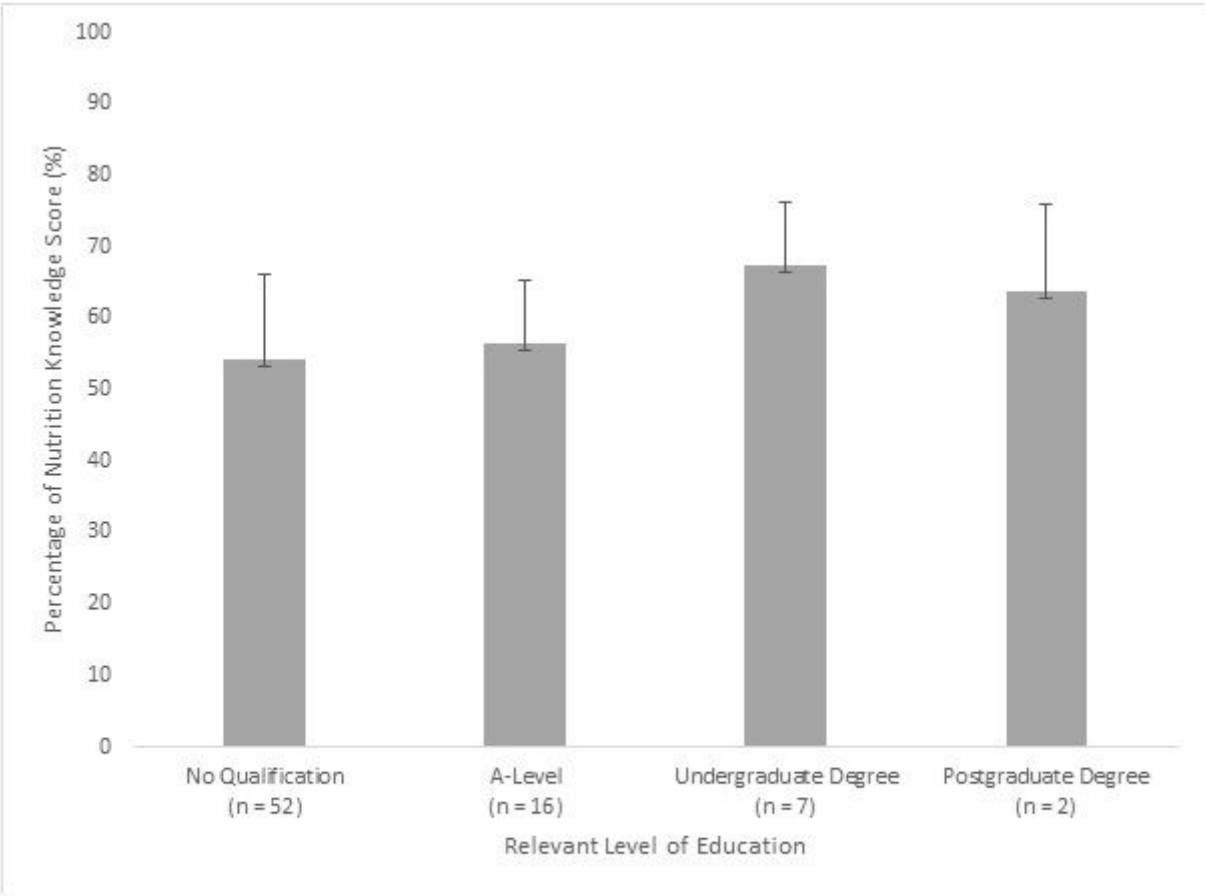


Figure 3

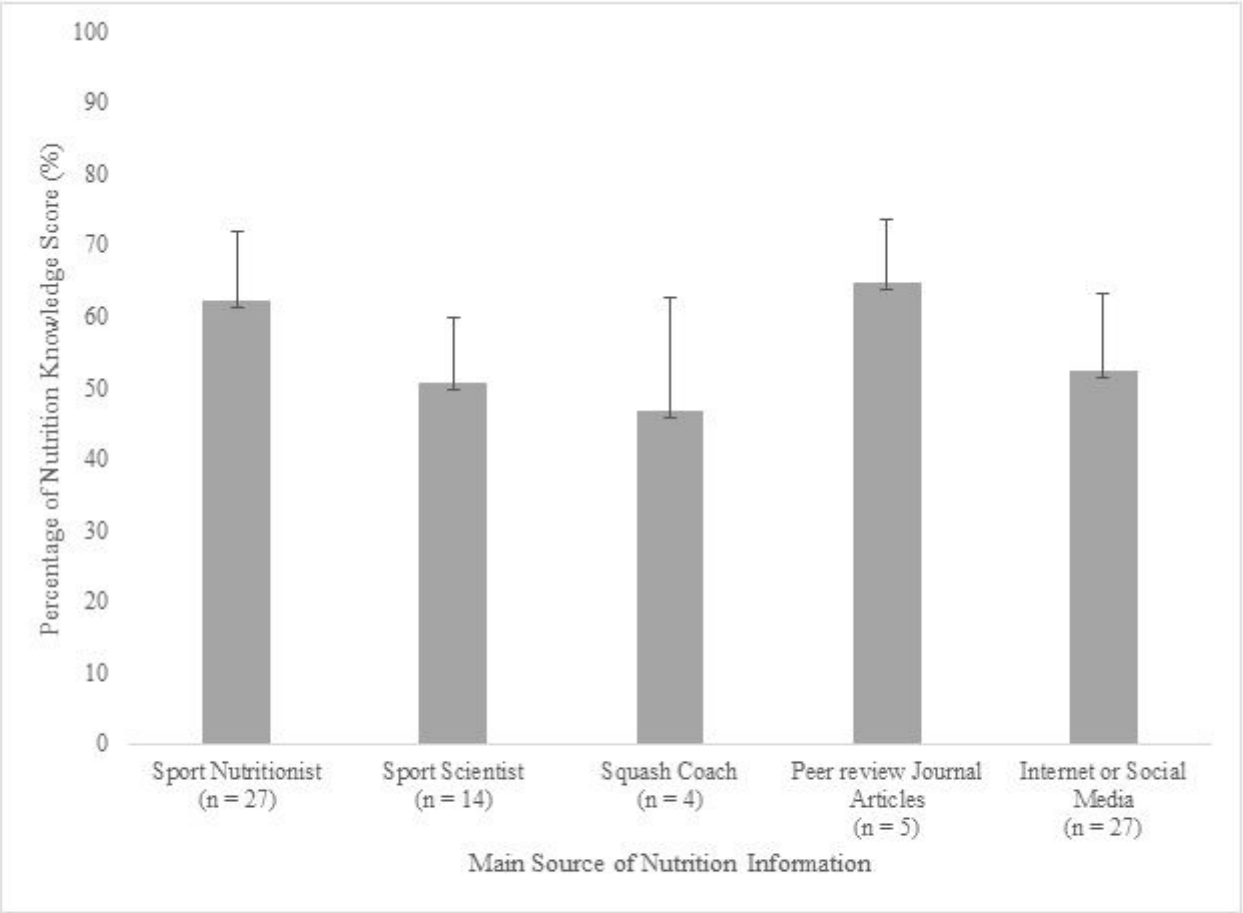
Differences between male and female players mean RNSKQ score and subsection scores



*Statistical significance between the two groups ($p < .05$)

Figure 4

Effects of level of relevant education on RNSKQ score



*Statistical significance between the two groups ($p < .05$)

+ Statistical significance between the two groups ($p < .05$)

Figure 5

Effects of main source of nutrition information on RNSKQ score

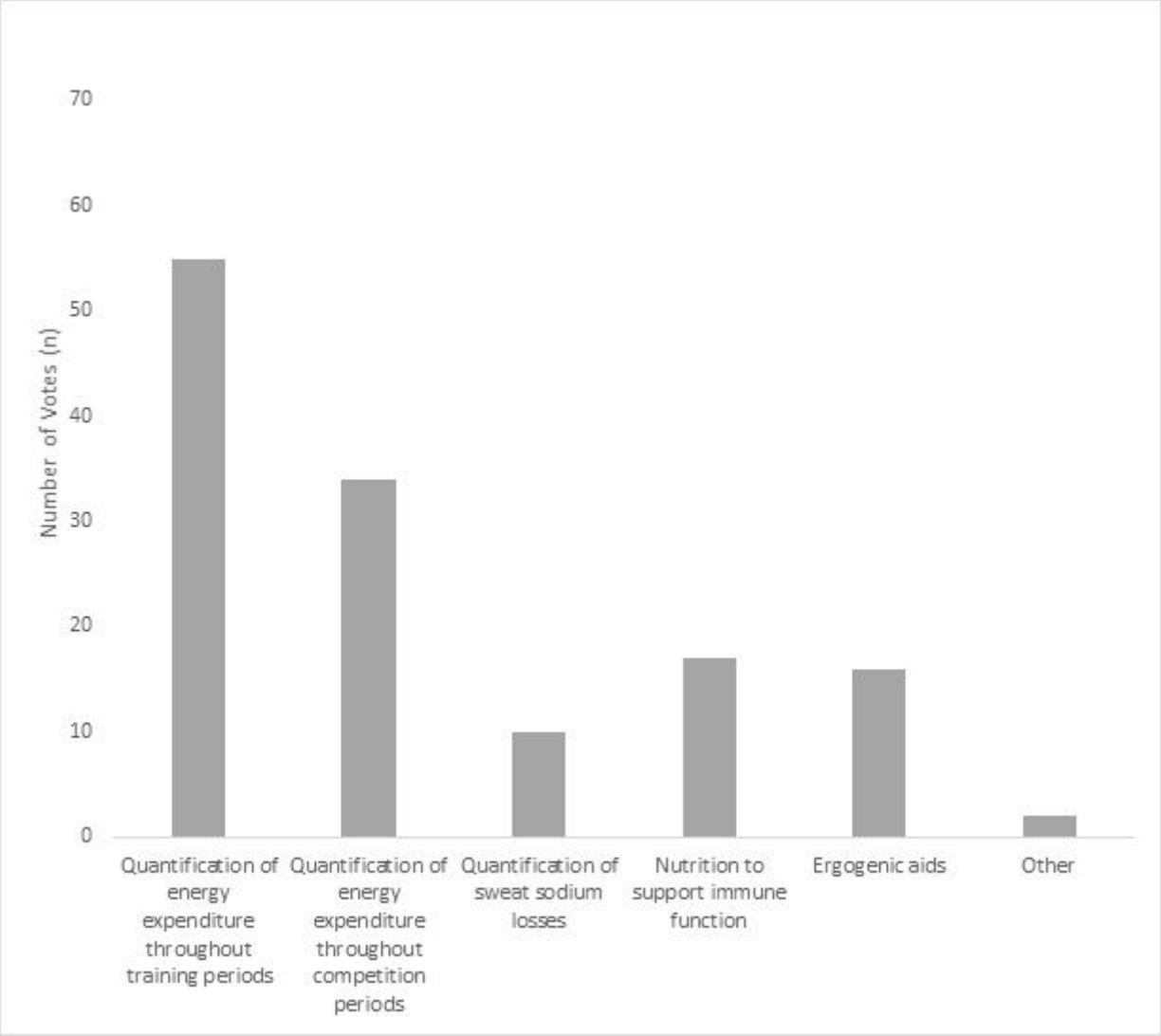


Figure 6

What sports nutrition research would elite squash players like to be conducted in the future

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- IndividualQuestionScores.docx