

Towards an Understanding of the Barriers to Good Nutrition for Elite Athletes

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ABSTRACT

The objective of this study was to describe barriers influencing dietary practices of elite-level athletes using a focus-group design involving discussions with elite-level athletes, coaches and sports dietitians. The participants were sixteen male and thirty female elite athletes from an Australian State Institute of Sport, representing diving, netball, basketball and lawn bowls; twelve elite coaches representing swimming, diving, soccer, sailing, cycling and golf; and sixteen sports dietitians who consulted to state institutes/academies of sport with various sports. Focus groups were audio-taped and transcribed with in-depth notes also recorded during the groups. Thematic coding of transcripts and notes were undertaken by the primary coder and these themes were subsequently evaluated by the research team. A number of barriers to healthy eating were described. Lack of time for food preparation was a significant barrier raised by all groups. Financial limitations, inadequate cooking skills and difficulty with living arrangements also rated high among all three groups. Coaches were concerned with excess body weight and fat levels and perceived an impact on sports performance. Athletes reported concern about body shape due to societal pressures. Sports dietitians and coaches were concerned with issues relating to optimal dietary provision surrounding travel to and from training and competition. A range of barriers influence the diet of athletes, in particular time and financial constraints in addition to specific physique requirements. Health professionals working with elite athletes need to be aware of these barriers when assessing dietary intake, or designing nutrition interventions. Dietitians may need to advocate on behalf of athletes to facilitate increased financial or professional support to assist athletes to choose and then maintain healthy diet practices.

Key words: Dietary Practice, Focus Groups, Food Choice, Sports Nutrition

INTRODUCTION

The dietary intake of elite athletes is frequently reported in the scientific literature. Even if energy intake is adequate, the distribution of macronutrient consumption often follows population trends [1] with higher than optimal levels of fat and protein leaving carbohydrate intake inadequate [1-3]. Sub-optimal energy and micronutrient intake is also frequently reported particularly in athletes participating in 'higher risk' sports where low body-weight or extreme leanness is desirable [4]. These higher risk sports include: endurance (e.g. marathon or triathlon) [5]), aesthetic (e.g. gymnastics [6], ballet dancing [7], figure skating [8, 9]) or weight category sports (e.g., light-weight rowing [10, 11], horse racing [12]). Athletes may experience pressure to acquire and maintain a physique recommended, even idealised by their sport and be tempted to follow unbalanced or restrictive 'popular' diets [13, 14].

For many athletes, the coach remains a primary source of nutrition education, but the nutrition knowledge of the coach may be incomplete [13-15]. The controversial nature of nutrition science, particularly information filtering to coaches and athletes through the media, also perpetuates the challenge for sound and consistent athlete nutrition education.

Research documenting and exploring barriers affecting the food choices and intake of athletes is important as it helps to inform the sports science team on which factors make the most difference to dietary intake. It is often assumed that nutrition knowledge is the key to better intake, but evidence in other groups suggests this is not always the case [16, 17]. The relative importance of other barriers to eating in athlete populations is often mentioned in the literature, but has not been well researched. This study therefore aimed to identify barriers affecting the ability of athletes to consume a diet consistent with sports nutrition recommendations [18]. The study used focus groups with the major stakeholders in this process; i.e., athletes, coaches and sports dietitians. To our knowledge, there is only one other study to directly collect data on and evaluate perceived barriers influencing athletes' dietary practices [19].

METHOD

PROCEDURE

Focus-group research was chosen as a well accepted qualitative method that enables researchers to collect in-depth data to assist in the understanding of *why* athletes struggle with their nutritional intake [20, 21]. The study was approved by the University of Sydney Human Ethics Committee and informed consent was obtained prior to focus-group participation. A purposive sample was used to ensure focus groups were held with elite athletes and coaches participating in a variety of sports from an Australian state-based Institute of Sport and sports dietitians linked to state or national institutes of sport. Athletes were eligible for participation if they competed at national or international level and were in receipt of a monetary scholarship from the Australian government to support the development of their athletic careers. Athletes were not residential and most studied and/or worked full/part-time. Two separate focus groups were also conducted with elite, full-time coaches employed by a state institute, who have a close day-to-day relationship with the athletes supervising and advising their training programs. A further two focus groups consisted of sports dietitians who worked closely with elite-level athletes and coaches as paid consultants to state or national institute sports programmes. Groups were facilitated by the researcher (SH), who had formal training in conducting focus groups. Discussions were guided with the use of a theme list derived from the literature and clinical experience as a sports dietitian to elite athletes [22]. Sample questions included: "How easy or difficult is it for you (your athletes) to follow what you think is a healthy diet?", "What factors make it

hard for you (your athletes) to eat a balanced diet?”, “In what way does being an athlete make it more difficult to eat well compared with your (their) friends or family who aren’t athletes?”. Participants were prompted to expand and explain responses and indicate how this impacted on their dietary intake. Each focus group lasted up to 1¼ hours and was closed when themes were exhausted.

ANALYSIS

The focus groups were audio-taped and later transcribed verbatim into word files. Field notes were also taken at each session to enrich the data. Transcripts were coded for themes using the QSR N6 qualitative data analysis program [23]. Three of the research team members independently coded the data and then discussed any opposing views identified from the transcripts and notes. These alternative perspectives were explored until the research team agreed upon the final themes. Once thematic saturation was reached, the process was concluded.

PARTICIPANTS

Five focus groups were completed to provide a total athlete sample of 46, male (n = 16) and female (n = 30) scholarship holders from a variety of sports (netball, diving, basketball, and lawn bowls). Netball and basketball groups were younger (16 to 19 years), while divers (16 to 24 years) and lawn bowlers (16 to 45 years) were more heterogeneous groups with wider age ranges. Sports were chosen to represent team (netball and basketball) and individual (diving and lawn bowls) pursuits as well as aesthetic (diving) and non-aesthetic oriented sports (lawn bowls). Two focus groups were also held with elite coaches (n = 12) from diving, swimming, cycling, soccer, golf and sailing; and a further two groups with sports dietitians (n = 16).

RESULTS

PERCEIVED DEFINITIONS OF GOOD NUTRITION

Focus-group participants were initially requested to define “good nutrition”. Substantial agreement occurred among client groups and individuals, revolving around the concept of eating a “healthy diet” and achieving balance in the diet via eating a variety of foods from each of the core food groups. Sports dietitians’ definition of “healthy eating” and “good nutrition” related to balance and variety and meeting individual requirements for energy, macro- and micro-nutrients for both their sport in particular and health in general. Issues relating to athletic performance were raised in relation to eating sufficient carbohydrate to provide energy to train and compete. “Poor nutrition” definitions centred on high fat eating and weight gain; in addition to factors relating to performance, including fatigue. Weight gain and body fat were commonly raised by the female athletes and male coaches.

BARRIERS INFLUENCING ATHLETES’ ABILITY TO EAT AN APPROPRIATE DIET

Each of the informant groups (athletes, coaches and sports dietitians) identified a number of barriers believed to influence the capacity for athletes to eat an appropriate diet or maintain ‘good nutrition’. Strong concordance emerged among opinions of the informant groups, particularly in the barriers for maintaining ‘good nutrition’. The main barriers emerging from the focus groups were: time and financial constraints, lifestyle, physique, and nutrition knowledge. These themes are detailed in the following paragraphs.

Time, Financial Constraints and Food Access

Time was a major theme raised as a barrier for athletes in eating an appropriate diet and is strongly linked to other barriers such as food access and cost. This study group of amateur athletes competing at an elite (state or above) level, typically trained up to 20 hours per week in addition to balancing other commitments such as study and/or work. Lack of time was raised by each group as the most consistent barrier to eating a diet appropriate for their sport. Sports dietitians related this to time management issues and indicated in many cases, appropriate time management skills could overcome time limitations.

Coach

"If I was to say one thing it would be time...Time has become so precious...Money is the secondary thing and you can always get away with making a cheaper meal if you have the time to do it. Time is the biggest issue I have with all their problems of diet"

Divers (both university students)

Diver 1: *"...I never have time to grab anything."*

Diver 2: *"I never have time to make it. It takes so long to make your lunch at night."* (diver referring to preparing the next day's lunch the night before)

Lawn bowler

"You're always on the go. I just want to grab things really quick and it's more fast food and junk food and chips and chocolates that are readily available."

Sports Dietitian

"I think the issue about their time is incredibly important....how much work time, training time, that type of thing; or study time that they're doing as well, so you get an idea of how busy they are in their overall schedule"

Some younger athletes experienced difficulties with accessing appropriate meals as the typical diet provided in their dormitory or household did not meet sport-specific needs. Younger athletes had limited time or funds to rectify this situation.

Basketballer

"Their (appropriate food venues) location. Like how long it will take to get to the shopping centre. A lot of people our age can't drive..."

Athletes' financial constraints were raised as a barrier by coaches, dietitians and older athletes. Food cost was a more significant concern to athletes in a transitional phase from late adolescence to adulthood who were studying and living away from home for the first time.

Divers

"Funds, what funds? There are no funds."

Travelling also absorbed a substantial amount of time for the athletes and their support network (e.g., parents) who assist with shopping and preparing of meals. Coaches and sports dietitians raised this as a chronic problem for some athletes and one which negatively impacted on their ability to train, eat, and recover optimally. Organising and carrying the full days' worth of food was the only option to manage training and travelling demands.

Sports Dietitians

Sports Dietitian 1: *“going straight to training from school and you’ve got nothing to eat, but, you know, I’ve had so many athletes whose home is 20 kilometres in the other direction.”*

Sports Dietitian 2: *“when we moved (the academy) from the centre of the city out to... the suburbs ... the kids (athletes) have to get out of early morning weight sessions and go back through the city, they hit peak-hour traffic, and so time commitments become huge.”*

Apart from daily travel to training, work or study, long distance trips to national or international competition events provides an insecure food environment for the athletes. Catering for events was reported to vary widely both in quality, variety and quantity. Food safety was identified as a significant issue in some international destinations. Meals in transit on planes, airports and on the road were problematic because it was difficult to plan ahead. Customs regulations also restrict what can be carried to some destinations. Lack of familiarity with the food or changes to eating patterns and activity when competing away was raised by coaches as a risk for unhelpful weight changes.

Coach

Coach 1: *“One of our athletes living overseas got food poisoning. He got something to eat at the airport. A bit of chicken...”*

Coach 2: *“Better to have eaten at (a well known fast food outlet)”*

Physique

Coaches appeared more concerned with body weight and fat levels than athletes and sports dietitians. This was raised in relation to the aesthetic requirements of the sport and in relation to perceptions of the negative influence of excess weight/fatness on performance.

Coach

“In diving we have two problems. One is, as you said, the performance. You have to keep the energy levels high. But the other one is body weight... especially for women. That’s where there is a clash of ideas of what is good and what is bad.”

Coach

“... at the end of the day it seems to me the leaner the athlete, the faster they go.”

The female athletes in this study (netballers and divers) seemed to understand the importance of adequate energy intake and the negative consequences of disordered eating on performance.

Diver

Diver 1: *With diving, if you get a full-on eating disorder, you lose energy and don’t have enough strength.*

Diver 2: *You wouldn’t stay in the team.*

Despite recognising the need for strength and energy for performance, the perception of physique for some female athletes was not related to their sport, but to their shape, size and physical appearance or attractiveness in general.

Female netballer

"I don't want to be a heifer (cow). I don't think oh! It goes straight to my hips, but it always is an issue. It's always in the back of your head."

Sports Dietitians noted societal pressures, but more in terms of financial or sports marketing rewards for attaining a certain appearance.

Sports Dietitian

Sports Dietitian 1: *"Athletes who fit the "ideal" body image have better chances of attaining sponsorship deals despite the physique requirements of the sport."*

Sports Dietitian 2: *"...it isn't always the best athlete who has the most sponsors".*

Lifestyle

Domestic support was raised by all client groups as impacting on athlete nutrition. Among the most important lifestyle-related influences on nutrition were shopping and cooking skills, in addition to the nutrition knowledge and beliefs of others in the household. Some athletes were responsible for the food preparation of others in their household. However, many of the younger athletes relied on meals prepared by parents/guardians who were catering for the diverse needs and preferences of a family. Both sports dietitians and coaches recognised parents were often responsible for the provision of meals and were an appropriate target group for nutrition education. Younger athletes raised concerns about a lack of cooking skills, which contrasted to the older athletes who reported feeling confident in their ability to prepare nutritious meals.

Young netballer

Netballer 1: *"I burn toast."*

Netballer 2: *"My speciality is two-minute noodles."*

Sports Dietitian

Sports Dietitian 1: *"I think one of the key issues here is looking at their food skills and their lifestyle behaviours, whether they eat with their family, whether they cook for themselves, whether they've got shopping responsibility."*

Sports Dietitian 2: *"a really big risk group is the ones (the athletes) who have moved interstate or changing lifestyle at uni (university) or just starting work and haven't got much money but aren't at home."*

Shopping and cooking issues experienced by athletes were related to whether they lived at home with parents or a spouse, or lived alone. In addition, coaches expressed concern about the stress of exams, competitions or travelling overseas, and missing the support of family and friends.

Coach

"We had a situation overseas last year where it was very difficult for a lot of our athletes. But one athlete in particular... she was doing it tough coping and every time I walked into her room she was eating. Every time. ... Normally she's big on nutrition and diet and stuff like that but it was just, every time I walked in she was eating."

Nutrition Knowledge

Coaches believed the athletes' knowledge was a primary factor determining nutrition intake. In the current sample, athletes who reported confidence in their knowledge felt more secure in their ability to apply this knowledge and eat a nutritious diet, appropriate for their sport. Sports dietitians suggested that perhaps athletes who have better nutrition knowledge may tend to prioritise eating better than athletes who felt unsure.

Sports Dietitians (When asked about nutrition knowledge and how to/whether to screen for it)

Sports Dietitian 1: *"We actually did a follow-up survey after we did nutrition courses and the answers that we got for knowledge were just so poor that it made us think that the courses weren't worthwhile"*

Sports Dietitian 2: *"It's so hard to tell with the variety of the ages of the athletes as they come in as well. You get them maturing in their processes as they go through and they then may see that nutrition becomes a much more important thing and their attitude towards it changes at a certain place in their training."*

Male basketballer

"What to eat before and after games and the gym. If I want to work out I just go straight to the gym and I wouldn't eat and my mates would tell me you should eat, but I don't know what to eat, so I don't bother."

Divers – when asked how well they apply their nutrition knowledge

Diver 1: *"I go through phases when I can be bothered and then I can't, so sometimes for a couple of weeks I'll be all right and I'll make food and then I just get over it."*

Diver 2: *"A couple of weeks you just eat bad food with not a thought of nutrition but sometimes you are really cautious."*

Diver 1: *When you're stressed or tired, you just couldn't be bothered like making a proper meal, it's just convenience...*

DISCUSSION

Good dietary intake has long been linked with improved sporting performance, but may be a neglected area by athletes [1-3]. Coaches who have the most intense day-to-day contact with athletes may be able to assist athletes to obtain good nutrition through a better understanding of the barriers to good nutrition. Even if coaches have a good idea of what the athletes should be eating, understanding why they struggle to achieve this will allow them greater insight to the issues.

There was considerable agreement among groups around the definitions of healthy eating relating to a balance and variety of foods. This is in agreement with previous focus-group research investigating university students' perceptions of healthy eating who primarily identified good nutrition as being synonymous with moderation and variety [24]. Despite some discordance between groups of athletes, coaches and dietitians, when looking at healthy eating for performance some trends emerged. For example, dietitians highlighted the need for carbohydrate for fuelling sport, but coaches and female athletes were more focussed on body-weight and body-fat issues.

Time issues have previously been identified by university students as barriers to eating a healthy diet. In addition, access to healthy choices and cost of food [25] is well recognised

among dietitians as a barrier to good nutrition [22]. Time was the main barrier identified by all participant groups, indicating a strong need for time management to be part of the nutrition education of an athlete.

Financial factors were primarily identified by athletes (and coaches of athletes) who are living away from home and not working full-time (i.e., university students). University student-athletes, coaches and dietitians commented on the poor food choices made by athletes who study and have limited income. Access to fruit and vegetables has been linked to increased consumption of these nutritious foods [26]. Individuals experiencing food insecurity often have lower intakes of fruit, vegetables, milk and other dairy and higher levels of disordered eating [27, 28]. Food insecurity is a common theme among university students in general [29]. This problem is compounded for student athletes with greater energy requirements and less time available to shop and prepare foods or seek additional paid work. Government-supported study or sports scholarship allowances may not be sufficient to fund a nutritious diet. Financial management skills are typically not widely featured in athlete education programs in Australia, but may be beneficial in assisting athletes use funds wisely in selecting and consuming a healthy diet within a tight budget.

Athletes and dietitians identified poor access to appropriate foods as another major barrier. This has been in relation to the foods available at home or in dormitories (boarding schools or halls of residence) and also at sporting facilities where athletes may spend much of their time. Appropriate timing of nutrition is increasingly recognised as necessary to support recovery of carbohydrate stores or to optimise protein synthesis [30]. Typically, foods available at sporting venues are not suitable for athletes' fuelling requirements and are high in fat, sugar and salt [31]. Support staff can assist in rectifying this through the provision of appropriate foods for pre-event fuelling and recovery.

Despite athletes not perceiving travel as a barrier to nutrition, coaches and sports dietitians raised concerns relating to travel and nutrition such as competition changes and time delays. If athletes do not appreciate travelling as a problem, coaches and sports dietitians may need to look at alternate ways to promote messages regarding nutrition and travel, so that athletes are more aware of potential problems and have the skills to solve these as they arise.

Physique was raised as a barrier by all groups, but perceptions of how physique was important differed. Pressures to attain and maintain a physique appropriate for sport can often result in athletes adopting poor dietary habits [32, 33]. Coaches in our study tended to emphasise the need for leanness for sports-related aesthetic or performance reasons. The athletes tended to raise the issue of perceived societal pressures to attain an 'unrealistic' physique, but these same athletes placed a negative value on being 'too thin' and not being able to perform optimally. Dietitians also raised the issue of physique and attractiveness. Physique was linked strongly to the financial rewards that athletes receive in terms of sponsorships and endorsements for athletes who obtained a certain physique rather than for performance reasons. Communication between coaches, sports dietitians and athletes will be essential to reach a safe compromise between expectations of body shape and "goal weights" and attaining a nutritionally appropriate and adequate diet.

Coaches highlighted an established link between nutrition knowledge and appropriate nutrition behaviours. This is often reflected in requests for nutrition education for athletes by their coaches. However, discussions acknowledged multiple factors influenced the quality of the diet despite "knowing" better. One of the major factors concerned the practical and lifestyle skills of food shopping and preparation. These skills have been highlighted previously as affecting an athlete's nutritional intake [22]. Lifestyle issues remain a consistent problem for athletes in a transitional phase between home to more independent

settings, and who no longer rely on parents providing nutritious meals. Concomitantly, athlete age was reported by sports dietitians to impact on athletes' ability to apply nutrition knowledge, particularly during the transition from adolescence to adulthood.

Nutrition knowledge and education remain salient in providing the understanding and skills required to undertake appropriate eating behaviours. However, nutrition knowledge in athletes is difficult to measure [15, 34, 35] and based on research in other groups adequate knowledge may not always ensure athletes select an appropriate diet [16, 17]. Previous attempts to measure nutrition knowledge have highlighted the lack of validation and reliability of many questionnaires [15]. The changing nature of sports nutrition and different specific requirements for individual athletes make it difficult to develop a comprehensive and reliable nutrition-knowledge questionnaire. In agreement with responses from our athletes, nutrition knowledge was not always highlighted as driving appropriate intake [36]. Although nutrition knowledge has been measured in athlete populations [35-37], the influence of nutrition knowledge on athlete eating behaviours has been largely unexplored. Addressing nutrition knowledge without these other barriers may not translate into better dietary intake in most athletes, but this requires confirmation.

LIMITATIONS

A purposive, non-random sample was used which may limit generalisability. However, the recruitment process enabled the inclusion of representatives from both genders in each of the respondent groups and a mix of team and individual sports with and without a physique emphasis. The study did not include endurance or weight-category sporting groups. Future studies should include these groups to enrich the data. A further limitation was the use of athletes and coaches from only one elite sporting institution. Despite this, a number of the more experienced athletes and coaches in the sample had previously worked or trained at one or more other elite sports institutes. The opinions of sports scientists or other professionals responsible for the exercise testing and assessment of the athletes were not obtained in this study. Dietary advice is often provided by this group also, but in Australian elite sports institutes the advice is typically delivered in collaboration with the sports dietitian. Focus-groups use self-report and this is a limitation of most forms of qualitative research. Finally, the study respondents were elite Australian amateur athletes training in a non-residential setting and the experiences of these athletes may vary to those in other countries or settings.

CONCLUSION

Elite, amateur athletes experience significant challenges with time management, financial constraints, food access, nutrition when travelling, and the pressures to achieve a specific physique. All athlete groups reported lack of time as a major barrier. Dietitians, however, saw this more as a *time management* issue rather than lack of time. Financial constraints were a significant problem for those athletes transitioning from adolescence to adulthood, many of whom were studying and not working full-time but had moved away from the support of home. Dieting to attain a particular physique may be related as much to secular acceptability trends as sports performance, at least from the athlete perspective. This may be reinforced by marketing and sponsorship of athletes in the media where social acceptability is of key importance. These barriers are mentioned in nutrition texts, but this is the first study to evaluate and confirm this in a research context.

Although most dietitians have expert knowledge on planning diets for limited budgets and strategies to streamline shopping and food preparation time, the athletes may need more global education to support financial and time management in other areas of their life. While

extensive education and support is available to athletes throughout Australia, the potential impact of targeted education in financial and time management to health, nutrition and performance outcomes is probably underestimated.

Coaches are often the primary source of nutrition education for athletes, but coaches cannot be expected to maintain current knowledge in all the facets of nutrition. Alternatively, coaches may be in the best position to identify athletes who have significant barriers to healthy eating and to direct athletes towards professional, specialist support.

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REFERENCES

1. Hassapidou, M.N., Valasiadou, V., Tzioumakis, L. and Vrantza, P., Nutrient Intake and Anthropometric Characteristics of Adolescent Greek Swimmers, *Nutrition and Dietetics*, 2002, 59(1), 38-42.
2. Paschoal, V.C. and Amancio, O.M., Nutritional Status of Brazilian Elite Swimmers, *International Journal of Sport Nutrition and Exercise Metabolism*, 2004, 14, 81-94.
3. Farajian, P., Kavouras, S.A., Yannakoulia, M. and Sidossis, L.S., Dietary Intake and Nutritional Practices of Elite Greek Aquatic Athletes, *International Journal of Sport Nutrition and Exercise Metabolism*, 2004, 14, 574-585.
4. Sundgot-Borgen, J. and Torstveit, M.K., Prevalence of Eating Disorders in Elite Athletes is Higher than in the General Population, *Clinical Journal of Sports Medicine*, 2004, 14(1), 25-32.
5. DiGioacchino DeBate, R., Wethington, H. and Sargent R., Sub-Clinical Eating Disorder Characteristics Among Male and Female Triathletes, *Eating and Weight Disorders*, 2002, 7(3), 210-220.
6. Jonnalagadda, S.S., Bernadot, D. and Nelson, M., Energy and Nutrient Intakes of the United States National Women's Artistic Gymnastics Team, *International Journal of Sport Nutrition*, 1998, 8(4), 331-344.
7. Ziegler, P., Nelson, J.A., Barratt-Fornell, A., Fiveash, L. and Drewnowski, A., Energy and Macronutrient Intakes of Elite Figure Skaters, *Journal of the American Dietetic Association*, 2001, 101(3), 319-325.
8. Jonnalagadda, S.S., Ziegler, P. and Nelson, M., Food Preferences, Dietary Behaviours and Body Image Perceptions of Elite Figure Skaters, *International Journal of Sport Nutrition and Exercise Metabolism*, 2004, 14, 594-606.
9. Smolak, L., Murnen, S.K. and Ruble, A.E., Female Athletes and Eating Problems: A Meta-Analysis, *International Journal of Eating Disorders*, 2000, 27(4), 371-380.
10. Morris, F.L. and Payne, W.R., Seasonal Variations in the Body Composition of Lightweight Rowers, *British Journal of Sports Medicine*, 1996, 30, 301-304.
11. Slater, G.J., Rice, A.J., Sharpe, K., Mujika, I., Jenkins, D. and Hahn, A.G., Body-Mass Management of Australian Lightweight Rowers Prior to and During Competition, *Medicine and Science in Sports and Exercise*, 2005, 37, 860-866.
12. Leydon, M.A. and Wall, C., New Zealand Jockeys' Dietary Habits and Their Potential Impact on Health, *International Journal of Sports Nutrition and Exercise Metabolism*, 2002, 12(2), 220-237.
13. Juzwiak, C.R. and Ancona-Lopez, F., Evaluation of Nutrition Knowledge and Dietary Recommendations by Coaches of Adolescent Brazilian Athletes, *International Journal of Sport Nutrition and Exercise Metabolism*, 2004, 14, 222-235.
14. Corley, G., Demarest-Litchford, M. and Bazzarre, T.L., Nutrition Knowledge and Dietary Practices of College Coaches, *Journal of the American Dietetic Association*, 1990, 90(5), 705-709.
15. Shifflett, B., Timm, C. and Kahanov, L., Understanding of Athletes' Nutritional Needs Among Athletes, Coaches, and Athletic Trainers, *Research Quarterly for Exercise and Sport*, 2002, 73(3), 357-362.
16. O'Dea, J. and Wilson, R., Socio-Cognitive and Nutritional Factors Associated with Body Mass Index in Children and Adolescents: Possibilities for Childhood Obesity Prevention, *Health Education Research*, 2006, 21(6), 796-805.

17. Burns, C., Richmond, R. and Caterson, I., Nutrition Knowledge in the Obese and Overweight, *International Journal of Obesity*, 1987, 11, 485-492.
18. American College of Sports Medicine, American Dietetic Association and Dietitians of Canada, Joint Position Statement: Nutrition and Athletic Performance, *Medicine and Science in Sport and Exercise*, 2000, 32(12), 2130-2145.
19. Smart, L.R. and Bisogni, C.A., Personal Food Systems of Male College Hockey Players, *Appetite*, 2001, 37, 57-70.
20. Pope, C. and Mays, N., Qualitative Research: Reaching the Parts Other Methods Cannot Reach: An Introduction to Qualitative Methods in Health and Health Services Research, *British Medical Journal*, 1995, 311, 42-45.
21. Kitzinger, J., Qualitative Research: Introducing Focus Groups, *British Medical Journal*, 1995, 311, 299-302.
22. Burke, L., Practical Issues in Nutrition for Athletes, *Journal of Sports Sciences*, 1995, 13, S83-90.
23. N6, Qualitative Data Analysis Software [Computer Program], *QSR International*, 2002.
24. House, J., Su, J. and Levy-Milne, R., Definitions of Healthy Eating Among University Students, *Canadian Journal of Dietetic Practice and Research*, 2006, 67(1), 14-18.
25. Jabs, J. and Devine, C.M., Time Scarcity and Food Choices: An Overview, *Appetite*, 2006, 47(2), 196-204.
26. Kamphuis, C.B., Giskes, K., de Bruijn, G.J., Wendel-Vos, W., Brug, J. and van Lenthe, F.J., Environmental Determinants of Fruit and Vegetable Consumption Among Adults: A Systematic Review, *British Journal of Nutrition*, 2006, 96, 620-635.
27. Kendall, A., Olson, C.M. and Frongillo, E.A., Relationship of Hunger and Food Insecurity to Food Availability and Consumption, *Journal of the American Dietetic Association*, 1996, 96(10), 1019-1024.
28. Dixon, L.B., Winkleby, M.A. and Radimer, K.L., Dietary Intakes and Serum Nutrients Differ Between Adults from Food-Insufficient and Food-Sufficient Families: Third National Health and Nutrition Examination Survey, 1988-1994, *The Journal of Nutrition*, 2001, 131(4), 1232-1246.
29. Meldrum, L.A and Willows, N.D., Food Insecurity in University Students Receiving Financial Aid, *Canadian Journal of Dietetic Practice and Research*, 2006, 67(1), 43-46.
30. Burke, L., Kiens, B. and Ivy, J., Carbohydrates and Fats for Training and Recovery, *Journal of Sports Sciences*, 2004, 22, 15-30.
31. Cummings, N., Crawford, R., Cort, M. and Pelly, F., Providing Meals for Athletic Groups, in: Burke, L. and Deakin, V. eds., *Clinical Sports Nutrition*, 3rd edn., McGraw-Hill, Sydney 2006, 785-789.
32. Beals, K. and Manore, M., The Prevalence and Consequences of Subclinical Eating Disorders in Female Athletes, *International Journal of Sport Nutrition*, 1994, 4, 175-179.
33. Cobb, K.L., Bachrach, L.K., Greendale, G. et al., Disordered Eating, Menstrual Irregularity, and Bone Mineral Density in Female Runners, *Medicine and Science in Sports and Exercise*, 2003, 35(5), 711-719.
34. Zinn, C., Schofield, G. and Wall, C., Development of a Psychometrically Valid and Reliable Sports Nutrition Knowledge Questionnaire, *Journal of Science and Medicine in Sport*, 2005, 8(3), 346-351.
35. Rosenbloom, C.A., Jonnalagadda, S.S. and Skinner, R., Nutrition Knowledge of Collegiate Athletes in a Division I National Collegiate Athletic Association Institution, *Journal of the American Dietetic Association*, 2002, 102(3), 418-420.
36. Perron, M. and Endres, J., Knowledge, Attitudes, and Dietary Practices of Female Athletes, *Journal of the American Dietetic Association*, 1985, 85(5), 573-576.
37. Cupisti, A., D'Alessandro, C., Castrogiovanni, S., Barale, A. and Morelli, E., Nutrition Knowledge and Dietary Composition in Italian Adolescent Female Athletes and Non-Athletes, *International Journal of Sport Nutrition and Exercise Metabolism*, 2002, 12(2), 207-19.