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Assessment of Nutritional Knowledge, Dietary Habits and Nutrient Intake of University Student Athletes

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Abstract: Despite the importance of physical activity and training, the optimum nutrient intake and good nutritional knowledge have been recognized as important factors in improving the athletic performance and health status of athletes. The present study was conducted to assess the nutritional knowledge, dietary habits, nutrient intake and nutritional status of Sultan Qaboos University student athletes. A cross-sectional study design was used to achieve the objectives. Seventy one (49 male and 22 female) student athletes with a mean age of 21.0±1.81 and 19.32±0.72 years and body mass index (BMI) of 22.51±1.98 and 20.34±2.97 kg/m^2 for male and female respectively, participated in study. All subjects were interviewed in person. The study questionnaire consisted of questions related to demographic information, nutritional knowledge and a 7-days food diary to identify nutrient intake, food frequency and variety of food consumption. Significant differences ($p<0.05$) were observed in the main sources of nutrition information used by the male and female athletes. The male subjects had most of the nutrition information from friends (17%) as compared to female subjects who relied on the family members (20%). Significant ($p<0.05$) differences were also observed in nutritional knowledge and dietary habits scores of male and female athletes (57 and 49%, respectively). Male athletes were classified to have fair nutritional knowledge and dietary habits, whereas the female athletes had poor nutritional knowledge and dietary habits. Mean daily energy (2595±358 kcal/day) as well as the macronutrients intake in male student athletes was within the recommended dietary intake allowance. Study identified some gaps in nutritional knowledge, dietary habits and barriers in physical activity among student athletes and suggests a need for developing strategies in counseling and teaching of athletes to improve their athletic performance and health promotion.

Key words: Nutritional knowledge, dietary habits, nutrient intake, assessment, student athletes

INTRODUCTION

Optimum nutrient intake and good nutritional knowledge have been recognized as the key factors that play critical role in improving the athletic performance in terms of improved quality of training and a speedy recovery from exercise in athletes (Cotugna *et al*., 2005; Martin *et al*., 2006; ADA/DC/ACSM, 2009; Jessri *et al*., 2010). Adequate nutrient intake is not only critical for the normal growth and development processes but is also important to optimize the health, physical fitness and athletic performance and is considered as an important element of any physical fitness program (Rosenbloom *et al*., 2002; Nazni and Vimala, 2010). Insufficient dietary intake can result in delayed growth, disturbed muscle development, alter the normal pattern of pubertal development and can affect the overall athletic performance (Rankinen *et al*., 1995; ADA/DC/ACSM, 2009; Maughan and Shirreffs, 2013). Azizi *et al*. (2010) reported that the nutritional knowledge of elite Iranian athletes was poor, especially in the area of nutrient functions as indicated by their poor food choices and dietary practices. Although the energy contribution from macronutrients (carbohydrate, protein and fat) has been reported to be within the recommended intakes for Acceptable Macronutrient Distribution Ranges (AMDR), yet overall lower mean daily energy intakes were observed in various athlete groups (Burke *et al*., 2006; Martin *et al*., 2006). The energy intake of female soccer players from UK was found to be lower than the recommended intakes (Martin *et al*., 2006). Similarly the mean daily intake of energy in female synchronized skaters from 2002 US National Synchronized Skating Teams was found to be less than the recommended intake for 11-18 years of female athletes exercising for 10-20 h/week (Ziegler and Jonnalagadda, 2006). Low daily energy intakes might result in weight loss, disruption of endocrine function, loss of strength and endurance, compromised immune system, menstrual dysfunction, failure to gain bone density and may increase the risk of fatigue, injury and illness (Burke *et al*., 2006; ADA/DC/ACSM, 2009). Hydration and dehydration are also the important concepts that

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athletes should understand well as the dehydration can reduce the athletic performance and may increase the risk of heat stroke (Von Duvillard *et al*., 2004; ADA/DC/ACSM, 2009). Fluids intake is essential for athletes before, during and after the exercise to maintain their hydration status and electrolytes balance as they lose fluids and electrolytes by sweating during the exercise (Sawka *et al*., 2007).

Variable results have been reported from various parts of the world about the nutrition knowledge, sources of nutrition information, dietary habits/behaviours and nutritional status of student athletes (Heaney *et al*., 2011; Reading *et al*., 1999; Walsh *et al*., 2011; Torres-McGehee *et al*., 2012; Sedek and Yih, 2014; Webb and Beckford, 2014). Majority of athletes have been reported to get the nutrition information from their friends, coaches and trainers or depend on popular books, magazine and newspapers. It has been pointed out that the student athletes as well as their advisors, trainers and coaches have misconceptions about the nutrition requirements of athletes (Cotugna *et al*., 2005). Studies show that nutrition knowledge and attitudes have an effect on eating habits and inadequate nutritional knowledge may contribute to poor dietary behavior (Sakamaki *et al*., 2005; Heaney *et al*., 2011; Sedek and Yih, 2014). Sakamaki *et al*. (2005) observed that 85.6% of students were aware of the concept of nutritionally balanced food, but only 7% applied it when selecting foods from the menu. Very limited information is available from Arabian Gulf region, in particular from Oman regarding the nutritional knowledge, sources of nutrition information, dietary habits and behaviours and nutritional status of student athletes (Waly *et al*., 2013). One study from Kuwait explored the sources of nutrition information of athletes used for their nutritional knowledge (Abdullah and Mal-Allah, 2011). There is a need to conduct studies in order to gain a better understanding of dietary habits, nutritional knowledge and nutrient intake of athletes to recommend positive interventions to improve their health status and athletic performance. The present study was therefore conducted to assess the nutritional knowledge, dietary habits, nutrient intake and nutritional status of Sultan Qaboos University (SQU) student athletes.

MATERIALS AND METHODS

Study design and subjects: A cross-sectional study design was used for this research. A total of 71 (49 male and 22 female) student athletes from the Department of Physical Education, College of Education, Sultan Qaboos University, participated in this study. The mean age of the participants was 21.0±1.81 and 19.32±0.72 years for male and female, respectively. The student athletes were involved in Football, Volleyball, Cross-country, Basketball, Swimming, Weight-lifting and other sports activities. The study was approved by the Research Ethical Committee of Sultan Qaboos University, Muscat, Oman.

Data collection: A study questionnaire consisting of 2 sections was developed, tested and verified at pilot scale before the start of final study. Section I included 18 questions regarding the demographic information (age, gender, weight, height, sources of nutrition information and duration of exercise) whereas the Section II consisted of 20 questions regarding the nutrition knowledge and dietary habits. The questions were selected based on the already published data on the subjects. The final questionnaire was further examined by a physical fitness professor; two physicians specialized in the area of sports medicine and three dietitians for the contents, clarity and face validity of the questions. The study questionnaire was then distributed to the selected student athletes, who volunteered for the study and the aims and objectives of the study were explained to them. An informed consent was obtained from all the participants and they were explained about their rights as participants.

Dietary intake evaluation: The dietary intake of male participants was collected by using a 7-days food diary identifying the frequency as well as the variety of food consumption for the past 7 days. Participants were required to answer about the type of food, how many times and how much quantity of each type of food eaten per day within the 7 days. The dietary intake data was collected in personal interviews with the student athletes and all the entries were verified and unified for any ambiguity on food quantification. The dietary intake of female student athletes couldn't be taken due to some social and cultural barriers. Dietary nutrient intake analyses were done using computerized software (NutriBase v.6).

Statistical analysis: All the data collected was subjected to statistical analysis using analysis of Variance (ANOVA). The data is expressed as means±standard deviation (SD). The Chi-square test was computed for categorical data analysis. Chi-squared (P^2) test was used to analyze the categorical variables. The unpaired Student's *t*-test was quantified for assessing means comparisons between different variables. $p<0.05$ is considered statistically significant. The data was analyzed using the software Statistical Package for Social Sciences (SPSS, v.16).

RESULTS

The data on the anthropometric assessment of the university student athletes is presented in Table 1. The results showed that the selected student athletes were within the normal weight category for their height. The mean body mass index (BMI, kg/m^2) in female was 20.34±2.97 whereas in males was 22.51±1.98 and they were classified within the normal BMI category (18.5-24.9 kg/m^2). Figure 1 demonstrates the main sources of nutrition information used by the university student athletes. Significant differences ($p<0.05$) were

Table 1: Anthropometric assessment of the study subjects

Characteristics	Females (n = 22)	Males (n = 49)
Age (years)	19.32±0.72	21.0±1.81
Weight (kg)	51.95±9.38	66.9±7.57
Height (m)	159.18±6.17	172.3±6.93
BMI (kg/m^2)	20.34±2.97	22.51±1.98

observed in the main sources of nutrition information used by the male and female student athletes. The main sources of nutrition information used by the female student athletes were family (20%), TV (20%), magazines (14%) and books (14%), while the male athletes mainly relied on friends (17%), books (17%) and lectures/seminars (15%). Male student athletes had more information from their coaches (12%) as compared to female student athletes (5%). Both the male and female student athletes had little information from dietitians and physicians (only 5-6 and 2-4%, respectively).

The data on the actual daily total energy and macronutrients intake for male student athletes collected through 7 days food diary and the calculated recommended dietary allowances (RDA) based on the average age, height, weight and physical activity levels is shown in Table 2. The average actual total daily energy intake of male student athletes was 2595±358 kcal/day, which was less than the calculated DRI values (2624±201 kcal/day). The male student athletes consumed more carbohydrates and less fat as compared to their calculated DRI values. However, the contribution of actual total daily energy intake from macronutrients (carbohydrates, fats and proteins was 64, 22 and 14%, respectively) was within the recommended Acceptable Macronutrients Distribution Ranges (AMDR). The data on the type of macronutrients consumption such as simple or complex carbohydrates, animal or plant proteins and saturated or unsaturated fats intake collected through the 7 days food diary indicated that the complex carbohydrates formed 64% whereas the simple carbohydrates formed 36% of the total daily carbohydrates intake. Almost 67% of protein intake came from animal protein sources, while only 33% from plant food sources. The average daily intake of unsaturated fat contributed 66%, whereas the saturated fat formed 34% of the total fats intake.

The details on the nutritional knowledge and dietary habits of athletes are shown in Table 3. The results indicated that 18% of the male student athletes always took their breakfast, whereas 8% never took their breakfast. In contrast, only 5% of the female student athletes were always taking their breakfast or never had their breakfast. About 56% of the male student athletes never took vitamins or minerals supplements, whereas more female student athletes (86%) never took vitamin or minerals supplements. The nutrition knowledge and dietary habits scores of male and female student athletes were 57 and 49%, respectively. Significant

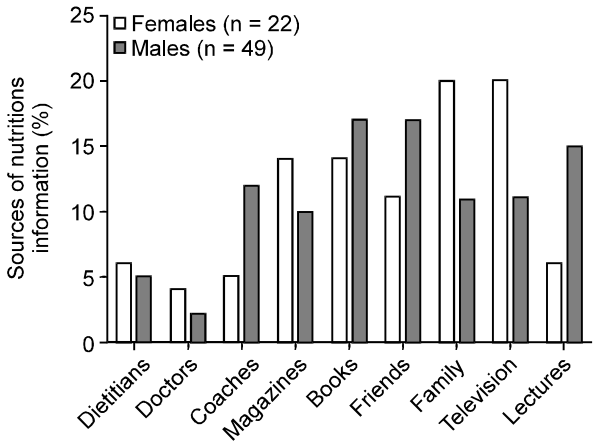

Fig. 1: Sources of nutrition information among the study subjects

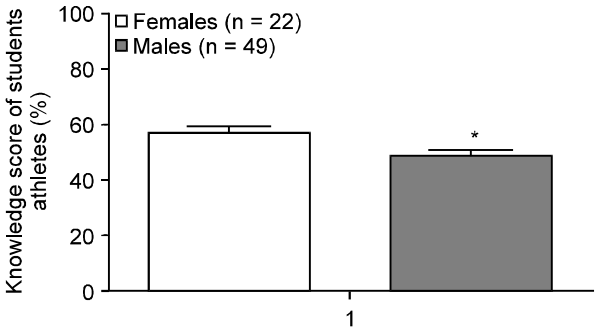

Fig. 2: Nutrition knowledge and Dietary scores of SQU student athletes. *Significantly different, p<0.05, Based on Student's unpaired t-test

(p<0.05) differences were observed in the nutritional knowledge and dietary habits of male and female student athletes (Fig. 2). The male student athletes were classified as to have fair nutrition knowledge and better dietary habits, whereas the female student athletes had poor nutrition knowledge and dietary habits.

DISCUSSION

Understanding the nutrition knowledge of athletes and its influence on dietary intake is important for developing the nutrition-education programs to improve their dietary intake and athletic performance. Inadequate nutrition knowledge and misconceptions about nutrition can have serious impact on nutritional status and performance of athletes. The sources of nutrition information play a significant role in building up the nutrition knowledge and dietary habits of athletes. Depending on the sources of nutrition information (whether reliable or unreliable), the athletes can have either positive or negative impacts on their nutrient intake, exercise, training and athletic performance (Abdullah and Mal-Allah, 2011; Ozdogan and Ozcelik, 2011; Webb and Beckford, 2014).

Table 2: Daily total macronutrients and energy intake of male student athletes

Nutrient	Calculated intake based on RDA*	Actual intake based on 7-days food diary	Test of significance
Carbohydrate (g)	365.7±24.5	413.27±50.0	t = 4.29, p = 0.001*
Protein (g)	99.5±6.4	93.61±18.9	t = 1.41, p = 0.162
Fat (g)	88.4±5.8	64.84±19.4	t = 5.55, p = 0.001*
Total energy (kcal)	2624±201	2595±358	t = 0.37, p = 0.71

*Otten *et al*. (2006) Dietary Reference Intakes (DRI): www.nap.edu

Table 3: Scoring and assessment of nutrition knowledge and dietary habits of SQU student athletes

	Male					Female						
Questions	I	II	III	IV	V	I	II	III	IV	V	P^2	p-value
Do you take breakfast regularly?	18	16	29	29	8	5	18	36	36	5	9.66	0.04
Do you take meals regularly?	10	37	33	18	2	18	32	27	18	5	4.53	0.33
Do you take any vitamins or minerals supplements?	4	8	8	20	59	0	0	0	14	86	26.08	0.0001*
Do you eat fruits?	29	24	33	14	0	9	23	32	36	0	20.24	0.0002*
Do you eat vegetables?	37	29	18	16	0	45	9	18	18	9	20.42	0.0004*
Do you take snacks?	43	24	22	10	0	41	23	18	14	5	6.12	0.191
Do you drink tea after meals?	4	8	14	41	33	0	5	5	50	41	10.71	0.03*
Do you take protein supplements?	10	12	16	22	39	0	5	14	32	50	16.21	0.003*
Do you drink soft drinks?	29	8	14	27	22	27	9	27	27	9	9.67	0.046
Do you drink power or sport drinks before or during competition?	6	4	16	33	41	0	5	0	5	90	61.68	0.0001*
Do you eat banana, sweets or any other sources of energy during competition?	6	22	16	33	22	9	9	18	32	32	8.03	0.09
Do you skip any meal before competition?	6	20	16	41	16	5	5	27	45	18	12.20	0.016*
Do you eat fast foods?	12	20	29	29	10	5	32	27	36	0	16.48	0.024*
Do you search for nutrition information?	22	27	20	20	10	5	5	32	50	9	41.49	0.001*
Do you follow any diet plan?	6	6	43	39	27	0	5	9	27	59	40.78	0.001*
Do you drink water before or during competition?	47	20	27	6	0	23	23	18	32	5	33.02	0.001*
Do you eat foods with carbohydrate before or during competition?	12	31	24	24	8	9	9	18	45	18	23.62	0.001*
Do you eat foods with protein after competition?	4	18	22	37	18	0	0	14	45	41	33.52	0.001*
Do you reduce fat intake before competition?	8	24	18	33	16	5	0	18	45	32	31.87	0.001*
Do you reduce salt intake before competition?	10	14	22	27	27	0	0	9	27	64	44.50	0.001*

*Significantly different, p<0.05. The scores were assigned as: I: always; II: often; III: usually; IV: sometimes and V: never

According to the existing height and weight guidelines, the SQU student athletes (age group 19-21 years), who volunteered in the present study, fall within the normal height and weight category. Based on their BMI values (20.34±2.97 and 22.51±1.98 kg/m^2 for females and males, respectively) they were classified within the normal BMI category (Yajnik and Yudkin, 2004; ADA/DC/ACSM, 2009). Overall, the general physical characteristics of SQU student athletes were comparable to those reported in other studies (Mullinix *et al*., 2003). The results of the present study showed significant differences (p<0.05) in the main sources of nutrition information used by the male and female SQU student athletes. The main sources of nutrition information used by the female student athletes were family (20%), TV (20%), magazines (14%) and books (14%), while the male athletes mainly relied on friends (17%), books (17%) and lectures/seminars (15%). Male student athletes had more information from their coaches (12%) as compared to female student athletes (5%). Only few male and female student athletes sought information from dietitians and physicians i.e., only 5-6% and 2-4%, respectively. Female student athletes relied heavily on TV and family for their nutrition information, whereas the males depended on friends, books and seminars that might be responsible for their differential nutritional knowledge and dietary behaviours.

The results of this study partially confirm the data reported from various parts of the world about nutritional knowledge, sources of nutrition information, attitudes, practices, behaviours and dietary habits of athletes (Heaney *et al*., 2011; Reading *et al*., 1999; Walsh *et al*., 2011; Torres-McGehee *et al*., 2012; Sedek and Yih, 2014; Webb and Beckford, 2014). Our results are similar to Abdullah and Mal-Allah (2011), who studied the nutrition information sources used by female athletes of the Girls Sports Club in the State of Kuwait. They found that female athletes had their nutrition information mainly from websites, newspapers and magazines. Similar results have been reported by Sedek and Yih (2014) from Malaysia. Medical doctors and nutritionist have been reported to be rarely consulted by athletes. Walsh *et al*. (2011) observed poor nutritional knowledge and dietary practices among young athletes from Ireland. They reported that most of the players had nutritional information from their coaches followed by magazines, websites, peers and family. Very few athletes had nutrition information from health professionals. They observed that the athletes showed a positive attitude towards nutrition; however, a better nutritional knowledge did not correlate with their positive dietary behaviours or attitudes. The nutrition knowledge of athletes and its impact on their dietary intake is equivocal. Only a weak positive association has been

reported between the nutrition knowledge and dietary intake in the literature. Studies show that nutrition knowledge and attitudes affect the eating habits and inadequate nutritional knowledge may contribute to poor dietary behaviors (Walsh *et al*., 2011). Significant differences were observed in the nutrition knowledge and dietary habits scores of the SQU male and female student athletes. The present study found that the SQU athletes had fair to poor nutrition knowledge and dietary habits scores. Male athletes had significantly higher nutrition knowledge and dietary habits score (57%) than female athletes (49%). Our findings however do not confirm the results reported by Jessri *et al*. (2010) and Yoeching and Yi-Chia (1999), who indicated that female students had higher nutrition knowledge scores and better nutrition attitude than male students. Our results also showed that only few student athletes sought information from Dieticians and Physicians. The athletic trainers as well as lectures/seminars were the primary sources of nutrition information for men. Hornstrom *et al*. (2011) observed that Mid-American Conference (MAC) Softball players were most likely to use a physician as their preferred source of nutrition information followed by athletic trainer, nutrition/health courses and dietitians. The difference in the results of these studies and results from our study may be due to the ethnic and regional differences as well as in training and professional behaviors and attitudes of the athletes. The MAC Softball players are the elite professional players whereas our study group was the university student athletes. Fast foods have been shown to be the most common choice when eating out. Jonalagadda *et al*. (2001) suggested that athletes may require education about healthy dietary practices and proper use of dietary supplements to promote healthy dietary practices. Our findings are in line with the findings of Jessri *et al*. (2010) and Azizi *et al*. (2010) who reported that college athletes did not have enough nutrition knowledge, suggesting that athletes may benefit from taking a nutrition course or from receiving additional information for achieving optimal health and better athletic performance. Based on the result of our study the nutrition knowledge and dietary habits of SQU athletes is generally poor in comparison to student from other countries and need improvement. Developing appropriate nutrition education programs could be an effective way to improve the nutrition knowledge, dietary habits and athletic performance of university student athletes. As a large variability exists in the assessment methodology of nutrition knowledge and dietary intake of athletes, there is a need for high quality, contemporary research using validated tools to measure the nutrition knowledge and its impact on dietary intake in athletes.

The average total daily energy intake of the enrolled study subjects in this study was within the recommended daily intake of energy for athletes, who had light to moderate physical activity level (Otten *et al*., 2006). Mullinix *et al*. (2003) reported that the actual daily energy intake (2014 kcal/day) of soccer player was less than the estimated energy requirements (2716 kcal/day) derived from the Harris-Benedict equation plus an activity factor. Martin *et al*. (2006) reported that the actual energy intake of elite women soccer players was 30.9±5.5 kcal/kg body weight (BW) per day that falls below the recommended allowance (47-60 kcal/kg BW/day) for female soccer players. ADA/DC/ACSM (2009) recommended that athletes should take 6-10 g of carbohydrates per kg BW per day. Participants in our study had average carbohydrate intake of 6.2 g/kg BW/day (64% of daily energy intake), which is within the generally recommended for high intensity/endurance athletes. Our results suggest that the observed carbohydrate intake of male athletes is adequate to replenish and maintains their glycogen reserves. The average protein intake of male athletes in this study was 1.4 g/kg BW/day (14% of daily energy intake), which is within the recommended levels (1.2 to 2.0 g/kg BW/day) for athletes. The ADA/DC/ACSM (2009) recommends that fat should contribute from 20 to 35% of total energy intake for athletes. The average fat intake was about 1.0 g/kg BW/day (22% of daily energy intake), which is also within the recommended intake. Appropriate levels of carbohydrate, protein and fat should therefore be maintained in the daily diets of athletes for optimal synthesis of muscle glycogen and protein and to increase the athletic performance. Martin *et al*. (2006) reported that the macronutrients intake of female soccer players in UK were in line with the recommendations. Our results are in accordance with these reported findings from previous studies.

Conclusion: The present study assessed the nutrient intake, nutritional knowledge and dietary habits of Sultan Qaboos University (SQU) student athletes. Significant differences were observed with respect to main sources of nutrition information used by the male and female athletes. The male subjects had most of their nutrition information from friends and books as compared to female subjects who relied on the family members and TV. Male athletes were classified to have fair nutritional knowledge and dietary habits, whereas the female athletes had poor nutritional knowledge and dietary habits. The average total daily energy intake as well as the contribution of energy from macronutrients for male athletes was within the recommended dietary intake. Inadequate nutritional knowledge of SQU student athletes suggests that there is a need for developing strategies in counseling and teaching the student athletes to improve their nutritional knowledge, dietary habits, athletic performance and overall health promotion.

Recommendations: Continuing educational workshops and courses are necessary to improve the nutritional knowledge, attitudes and dietary practices of athletes in both genders. The practical and applied information, related to basic nutrient requirements, contribution of nutrients from different food groups and their portion size as well as on the use of nutritional supplements, should be provided. Further research using large cohort is need to address the athletic performance in relation to nutrition.

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