Original article

Nutrition and dehydration: players should learn how to bring them to life.

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Summary. *Objective:* In the present study, it is aimed to investigate the relationship between nutritional knowledge, hydration, food frequency with their gender and body mass index among students from sports department. *Methods:* This cross-sectional study was conducted 127 randomly selected undergraduate students in Spring 2019. Participants completed sociodemographic form, and Nutrition Knowledge Level Survey for Adults (NKLSA) questionnaires that included questions related to their eating habits, nutritional knowledge etc. Body weight and height of participants were measured. *Results:* In the present study, 66.1% of the participants were female and 33.9% were male, the mean age was 20.5 ± 4.15 years; mean body mass index (BMI, kg/m²) was 21.49 ± 2.13; 22.35 ± 2.35 in males and 21.06 ± 1.87 in females ($p < 0.05$). Distributions in the BMI classification were, mostly (91.3%) normal (NW) and there was a significant difference between gender ($p < 0.05$). There was no statistically significant difference between mean Nutrition Knowledge Level Survey for Adults (NKLSA) scores of males (50.00 ± 5.57) and females (50.16 ± 6.36) ($p > 0.05$). UW group was found to be having high NKLSA scores than the other BMI classes but it was not statistically significant. More than 50% of participants want to have an education about nutrition, mostly based on sports nutrition ($p < 0.05$). Most of female and male participants (65.5% and 60.5%) had a moderate score on NKLSA. Training hours were higher in normal weight group ($p < 0.001$). Hydration states of participants found as females drink more water before ($p < 0.05$) and during training than males, but males drinking more water in a day than females ($p < 0.05$). There was no statistically significant difference between mean NKLSA scores of males and females ($p > 0.05$). Females and males ate CHO but females have more protein than males ($p < 0.000$) after trainings. Pre-obese group had more carbohydrate and protein than other groups ($p < 0.001$). All gender and BMI groups found mostly drink just water during trainings. There was only one significant correlation between water intake and liquid intake daily ($p < 0.001$). *Conclusion:* Adolescence is an important because lifelong eating habits can build in this part of life. Increased body mass index, eating and nutrition can be impaired based on sports performance. Nutritional knowledge assessment tools are crucial to detect athlete's nutritional and fluid intake as well as endurance and performance during trainings and matches.

Key words: Nutrition, hydration, nutritional knowledge, body mass index, sports.

Introduction

Sports nutrition is the adequate and balanced intake of nutrients with the arrangements that are adjusted amounts according to age, gender, physical activity and sports type, training and competition periods (1). For athletic population, nutrition has an important place for both performance and a healthy life (2). The performance of the athlete may be positively and negatively affected due to nutrition (3). In addition to training, performance improvements can be done with a balanced diet (4,5). A well balanced adequate nutrition plan should be organized considering training and competition timings.

Players and athletes generally have special energy and nutrient needs that support energy system for greater energy expenditure, increased macronutrient requirements (6). Muscle glycogen appears to be the main source of energy during matches (7) and enhancing energy stores with carbohydrate can maximize muscle protein synthesis (8). Therefore, an inadequate carbohydrate intake may negatively affect performance. Higher grain consumption with a consistency in sports nutrition recommendations, promotes adequate intake of carbohydrate to enhance performance (9,10). Carbohydrates are vital for sports performance (11,12) to reach optimal performance due to aerobic nature of physical activity (13,14) by having a positive effect on cardiovascular system, too (15). Players and athletes seem to not meeting recommended carbohydrate intakes (1). It has been suggested that daily nutrient intake should be based on CHO (16,17) and organized specially for athletic performance for sports training and match schedules (18). Depending on individual levels of activity, for footballers 6-10g/kg a day intake of CHO may be enough for plenish glycogen stores and provide supplementary fuel (15). Protein intakes of players and atheletes varies in researches (1,16,19). There are recommendations for intake (16) but sometimes it can be exceeding (13). Greater than 1.5g/kg a day intake of protein may cause health problems and especially using protein powders (19). In a review, percentage of macronutrients to be taken according to energy mentioned as 53.1% CHO, 15.3% protein and 28.5% fat (6).

Water, which is an essential nutrient for human life, is also important for the performance of athletes. Hydration is important before, during and after trainings (20). The rate of sweating during the match; match duration and intensity differ depending on environmental conditions. Water consumption promotes adequate hydration for athlete and it makes performance safer and optimal (16). Especially the loss of sweat of elite athletes often exceeds fluid intake and in this case results in dehydration (21). Even in a 2-3% dehydration causes a decrease in performance. A fluid intake above the loss of fluid in the body caused by sweating is a cause of hyponatremia, also known as water poisoning. For this reason, athletes should drink 500-600 ml of water 2-3 hours before training or competition and during, every 15-20 minutes 200-300 ml.

Nutritional information can be reached by anyone or anywhere (22). The source of information is vital because information should be accurate and practicable to be usable (23,24). In a big review, it was implied as there are so many misconceptions about the roles of nutrients and their contents (energy, cholesterol, fiber etc), and especially protein usage for energy (25). In a study it is found that only 22% percent of players knew that fat is the most energy densed food (26). Nutritional information source is a factor that determines nutritional knowledge quality (2,27,28). Athlete's, players' and coach's nutritional information status is unclear. In a review, it was implied that having previously nutrition course correlated with higher scores of knowledge (13). Athletic performance must meet all recommendations (16) and include sufficient energy, nutrients, hydration and meal times (2). Nutritional knowledge is correlated with a higher quality of diet (29,30) and counseling should be made by dietitian or sports dietitian (8). For athletes and players, there should be general and sport nutrition educations regularly (4,9)

The aim of this study was to investigate the relationship between nutritional knowledge and dehydration.

Materials and Methods

In the present study, a questionnaire form consisting of 20 questions including age, gender, sports branch, nutrition education status, training nutrition

and hydration informations were used and body mass index that was calculated after measurement.

Nutrition Knowledge Level Survey for Adults (NKLSA)

Nutrition Knowledge Level Survey for Adults was developed by Batmaz (2018) as Turkish version. It has 20 items with likert type (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree). The maximum score that can be obtained under the basic nutrition title is 80. And at the end of the scale, participants evaluated the relationship between nutrition and health and the accuracy of food preferences in daily life with a separate VAS scale that ranges from 0 to 10. In the original form of NKLSA, cronbach alpha value was found as 0.72, in our study we found 0.797 with a good consistency. The level of knowledge of the participants with a total score of less than 45 was poor, the level of knowledge of those with a score of 45-55 was moderate, the level of those with a score of 56-65 was good, and the level of knowledge of those with a score of 65 was very good.

Statistical analysis

In the study, Skewness and Kurtosis, Student t-test, one-way ANOVA, chi-square analysis, Pearson correlation analysis were used to evaluate the data obtained. Skewness and Kurtosis values falling outside the range of -1.5 to +1.5 indicate a normal distribution. Pearson correlation and regression was used to NKLSA total scores and their correlations with the score groups. Body Mass Index (BMI): body weight (kg)/ height² (m^2) calculated with the formula. The World Health Organization (WHO) classification was used for BMI. Data were analyzed by using the IBM SPSS Statistics version 21 software for Windows. Significance level was $p < 0.05$.

Results

In the present study, 127 students were participated, 66.1% of the participants were female and 33.9% were male, the mean age was 20.5 ± 4.15 years. Mean body mass index (BMI, kg/m^2) was 21.49 ± 2.13; 22.35 ± 2.35 in males and 21.06 ± 1.87 in females ($p < 0.05$). Distributions in the BMI classification were, 3.1% were under weight (UW), 91.3% were normal (NW) and 5.5% pre-obese (PW); 86.0% of males were NW, 94% of females were NW ($p < 0.05$).

Participants were gathered in four groups as football, volleyball, basketball and handball players and a significant difference was found between females and males. Although 60.6% of the participants responded not being educated, the percentage of educated from whom question's response increased to 87.4%. There was no significant difference between participants who received, did not receive, and partially received nutrition education ($p > 0.05$). Most of participants that received a nutrition education as females-males (23.4-26.3%) had a course/ lesson during their college life, and others had information from social media (18.1-12.5%), dietitian (12.3-18.8%), doctor (12.9-15.0%), TV (13.5-13.8%), newspaper/magazine (11.1-7.5%), family (8.8-6.3%). More than 50% of female-male participants want to have an education about nutrition, mostly based on sports nutrition, and females (63.6%) want more sports nutrition education than males (37.1%) ($p < 0.05$). Most of females (76.2%) and males (81.4%) were not on diet ($p > 0.05$).

Nutrition Knowledge Level Survey for Adults (NKLSA) scores divided originally to four categories as poor, moderate, good, and very good knowledge. But as it can be seen on the Table 1, there were no 'very good' answer group for this categorization. Most of female and male participants (65.5% and 60.5%) had a moderate score on NKLSA.

There was a significant difference between genders' mean BMI, and males had higher BMI than females ($p < 0.001$). Training hours were significantly higher in normal weight group than other BMI classes ($p < 0.001$). Hydration states of participants found as females drink more water before ($p < 0.05$) and during ($p < 0.001$) training than males, but males drinking more water in a day than females ($p < 0.05$). There was no statistically significant difference between mean NKLSA scores of males (50.00 ± 5.57) and females (50.16 ± 6.36) ($p > 0.05$). UW group was found to be having high NKLSA scores than the other BMI classes but it was not statistically significant.

Table 1. Distribution of sports branch, nutrition education, diet status and NKLSA score groups according to gender

Variables	Gender				
	Female (n=84)	Male (n=43)	χ^{22}	p	Total
Sports branch					
Football	8.3%	20.9%	28.442	0.000**	12.6%
Volleyball	66.7%	30.2%			54.3%
Basketball	11.9%	46.5%			23.6%
Handball	13.1%	2.3%			9.4%
Nutrition Education					
Educated	35.7%	51.2%	3.255	0.196	40.9%
Partly educated	45.2%	30.2%			40.2%
Not educated	19.1%	18.6%			18.9%
Educated from					
TV	13.5%	13.8%	3.690	0.815	13.5%
Newspaper-magazine	11.1%	7.5%			10.0%
Lesson-course	23.4%	26.3%			24.3%
Family	8.8%	6.3%			8.0%
Doctor	12.9%	15.0%			13.5%
Dietitian	12.3%	18.8%			14.3%
Internet-social media	18.1%	12.5%			16.3%
Want education	61.9%	58.1%	0.169	0.681	60.6%
Do not want education	38.1%	41.9%			39.4%
Education topic					
Weight loss	10.6%	22.9%	11.234	0.024*	14.8%
Sports nutrition	63.6%	37.1%			54.5%
Healthy nutrition	22.7%	28.6%			24.8%
Others (Dieases etc)	3.1%	11.4%			5.9%
Diet Status					
Dieting	23.8%	18.6%	0.442	0.503	22.0%
Non-dieting	76.2%	81.4%			78.0%
NKLSA					
Poor	20.2%	23.2%	0.309	0.857	21.3%
Moderate	65.5%	60.5%			63.8%
Good	14.3%	16.3%			14.9%
Very Good	0.0%	0.0%			0.0%

*$p < 0.05$, **$p < 0.001$ NKLSA: Nutrition Knowledge Level Survey for Adults.

Participants were asked open-ended questions about the foods they consumed before, during and, after training. Afterwards, the answers were divided into nutrients (carbohydrates, protein, water and others). Foods such as pasta, banana, dried fruit were in the carbohydrate (CHO) group; toast, sandwich, main meal in CHO+protein group; meat products and chicken were evaluated in the protein group. The remaining answers included answers such as energy drinks, nuts and coffee, but their frequency were low.

Table 2. Distribution of age, BMI, training features, hydration and nutrition status, nutrition & health relationship, and NKLSA score according to gender, and BMI classification

Variables	Gender				BMI (Body Mass Index)				
	Female (n=84)	Male (n=43)	F	p	UW (n=4)	NW (n=116)	PW (n=7)	F	p
Age	20.69 ± 3.82	20.25 ± 4.77	45.078	0.000**	20.00 ± 3.65	20.69 ± 4.24	18.28 ± 1.97	1.153	0.319
BMI	21.06 ± 1.87	22.35 ± 2.35	18.196	0.000**	18.02 ± 0.68	21.30 ± 1.64	26.74 ± 1.54	46.476	0.000**
Training hour	2.21 ± 0.69	1.94 ± 0.35	1.526	0.218	1.62 ± 048	2.16 ± 0.61	1.64 ± 0.38	3.914	0.022*
Hydration BT	1.86 ± 4.50	0.95 ± 0.47	9.209	0.003*	0.75 ± 0.29	0.97 ± 0.45	1.03 ± 051	0.542	0.583
Hydration T	1.17 ± 0.47	0.91 ± 0.42	32.743	0.000**	1.12 ± 0.48	1.08 ± 048	1.00 ± 2.89	0.129	0.879
Hydration AT	0.92 ± 0.41	1.03 ± 0.47	2.455	0.118	0.87 ± 0.25	0.96 ± 043	0.93 ± 0.53	0.092	0.912
Daily liquid	3.32 ± 1.17	3.58 ± 1.30	0.368	0.545	2.62 ± 0.94	3.44 ± 1.20	3.35 ± 1.65	0.864	0.424
Daily water	2.65 ± 1.12	2.71 ± 1.07	11.159	0.001*	1.87 ± 0.85	2.71 ± 1.11	2.46 ± 0.91	1.254	0.289
Nutri-tion-Health	8.58 ± 1.53	8.28 ± 1.98	2.037	0.156	7.50 ± 1.91	8.50 ± 1.67	8.57 ± 199	0.692	0.502
Total scale	50.16 ± 6.36	50.00 ± 5.57	0.625	0.430	51.25 ± 10.99	50.11 ± 5.99	49.43 ± 5.38	0.112	0.894

*p < 0.05, **p < 0.001
BMI: body mass index, BT: before training, T: during training, AT: after training, UW: underweight, NW: normal weight and, PW: pre-obese.

Table 3. Nutrients that mostly eaten training related according to gender and BMI

	Gender				BMI (Body Mass Index)				
	Female (n=84)	Male (n=43)	χ2	P	UW (n=4)	NW (n=116)	PW (n=7)	χ^2	p
BT	45.2% CHO	55.8% CHO	10.328	0.243	25% Nothing	50% CHO	42.9% CHO	29.207	0.023*
T	85.7% Water	90.7% Water	1.733	0.630	100% Water	86.2% Water	100% Water	1.736	0.942
AT	41.7% CHO + protein	32.6% CHO	33.844	0.000**	50% Protein	31.9% Protein	57.1% CHO + protein	51.027	0.000**

*p < 0.05, **p < 0.001
BT: before training, T: during training, AT: after training, UW: underweight, NW: normal weight and PW: pre-obese, CHO: Carbohydrate.

Before trainings most of the participants had CHO based nutrition. Evaluating by gender, it was found that females and males ate CHO but females have more protein than males (p < 0.000) after trainings. By BMI groups, it is stated that pre-obese group had more carbohydrate and protein than other groups (p < 0.001). All gender and BMI groups found mostly drink just water during trainings.

There was only one significant correlation between water intake and liquid intake daily (p < 0.001). Both training hour and NKLSA scores were negatively but not significantly correlated with body mass index (p > 0.05).

Table 4. Correlations between age, BMI, training hour, daily liquid and water consumption, and NKLSA scores

Variables	1		2		3		4		5		6	
	r	p	R	p	r	p	r	p	r	p	r	p
Age												
BMI	0.022	0.805										
Training hour	0.158	0.075	-0.153	0.087								
Liquid intake	0.038	0.672	0.010	0.913	0.091	0.308						
Water intake	0.118	0.187	0.003	0.977	0.134	0.134	0.858	0.000**				
NKLSA	-0.014	0.873	-0.089	0.321	-0.077	0.392	-0.160	0.073	-0.114	0.200		

**$p < 0.001$

Discussion

Present study was aimed to determine relationships between gender, body mass index, hydration status and nutritional knowledge of football, volleyball, basketball and handball players that studying and training in the sports department. Literature comparisons were discussed below.

Original form of NKLSA was published by Batmaz (2018), it was found NKLSA scores as min 35, max 76 and mean 53 ± 8.1, and in our study it was 30, 65 and 50.11 ± 6.09, respectively. In that study, NKLSA scores were divided into four group, too. Batmaz (2018) studied with 51% females, and couldn't find any differences between BMI by gender ($p > 0.05$). In this study, males had higher BMI values ($p < 0.05$).

Nutrition education is crucial for life-long eating and hydration habits especially for athletes and sports performance. In a study, it was found that 48.1% of participants had a nutritional education, and 27% from TV or radio, 18% from newspaper or magazine, 17% from dietitian. In the same study, 68.3% of participants said that they want to have a nutritional education, and most of them asked for the topic about weight loss (31). Devlin and Belski (2015) found that 98% of athletic population obtained their nutritional information from dietitians, and it was a good percentage. In a study that conducted in Brazil, it is reported that most of the table tennis players use had nutritional information from their families Argôlo et al. (2018). Abbey et al. (2017) stated that only 11.5% of their participants had a nutrition course and their mean knowledge score were higher. Hull et al. (2016) showed less percentage as 39.7% of their participants used non-dietitian sources. Additionally, Blennerhassett et al. (2019) stated that 96% of ultra-endurance athletes had never received a nutritional education. In our study, we found mostly educated from lessons or courses during college education and although some of the participants responded not being educated, from whom educated response increased. It can be said that the first two result were not showing education; it is just nutritional information. Most of the participants said they want to have an education about nutrition, mostly based on sports nutrition, and females (63.6%) want more sports nutrition education than males ($p < 0.05$).

Batmaz (2018) stated that there was no significant difference between educated and non-educated, dieting and non-dieting individuals' mean NKLSA scores. In our study, females (76.2%) and males (81.4%) were not on a diet, and there was a similar result about scores but not shown in tables. In a study, similar to our study, it was reported that 79% of participants were on a diet and most of them for weight loss (31).

Nutrition Knowledge Level Survey for Adults (NKLSA) scores divided into four categories as poor, moderate, good, and very good knowledge. Other questionnaires used in different studies, Devlin and Belski (2015) implied that nutritional knowledge of athletic population was low as in other studies found (17, 23 27, 28). They found that more than 50% of the participants gave right answers to nutrients

questionnaires but it was not enough for performance. Folasire et al. (2015) stated that more than half of their participants had good nutritional scores. Alaunyte et al. (2015) found that athletes who have poor nutritional knowledge had higher liquid and water consumption. Magee et al. (2017) studied with 409 athletes and found that overall nutritional knowledge of the participants was poor. Condo et al. (2019) showed that Australian football players did not have high nutritional knowledge as it is mentioned in other studies. Similar to previous studies we could not even detect any 'very good' answer group, and most of the participants (62.5%) had a moderate score on NKLSA. Batmaz (2018) found significant difference between NKLSA scores of males (55.1±7.9) and females (50.9 ± 7.9) (p=0.008). Spronk et al. (2015), Zaborowicz et al. (2016) and Citarella et al. (2019) stated a significant difference between gender and found as females have more high scores ($p < 0.05$). In our study we couldn't find any difference between gender. Similar to this study, anlıer et al. (2009) and Batmaz (2018) found no significant difference between BMI groups for NKLSA scores. We found UW group had higher NKLSA scores than the other BMI classes but it was not statistically significant. Folasire et al. (2015) couldn't find any correlation between nutritional knowledge and body weight. In our study, training hour and NKLSA scores were not significantly but negatively in a correlation with BMI. It shows us that when BMI increases training hours and NKLSA scores may decrease. Not being statistically significant may be due to the small numbers of participants and not having high body mass index values.

Magee et al. (2017), Argôlo et al. (2018) and Blennerhassett et al. (2019) found in their studies that training sessions of participants was ranging between 1 and 2 hours. In the present study, we found similar training hours, additionally training hours were significantly higher in normal weight group. This may be because individuals who are at normal weight can perform better. Of course, there are no very low or high weighted participants, however, there is still a difference in their daily training hour ($p < 0.001$).

Dehydration of >2% body weight loss impairs performance significantly (21). Athletes can remain dehydrated during trainings because of not wanting to waste their precious time for drinking or lack of important knowledge of drinking liquid. Salici et al. (2019) didn't state any difference between liquid consumption during trainings ($p > 0.05$). Hull et al. (2016) found that males drink more juice during the week than women (p=0.001). Devlin and Belski (2015) found that hydration knowledge of their participants was good. In this study, it is found that females drink more water before and during training than males, but, in a total day males drinking more water than females ($p < 0.05$). All gender and BMI groups found mostly drink just water during trainings. Nascimento et al. (2016) stated their participants had 400-575 ml of water during trainings. Hydration of athletes is crucial for performance and drinking water or liquid before or during training can be difficult for them because of the volume it creates in the stomach.

Hull et al. (2016) stated in their post-workout nutrition results, males were more likely to consume carbohydrate based (rice or pasta) than females. Condo et al. (2019) reported CHO intake was minimum especially on training days of football players. In this study, females have more protein than males after trainings, pre-obese group had more carbohydrate and protein than other BMI groups ($p < 0.05$). After intense physical activity, carbohydrate and protein should be taken together for muscle regeneration and for our energy system. Nutritional deficits and poor eating habits in sports may contribute to injuries (7). In this present study, it is reported that before trainings most of the participants had CHO, and it was proper for physical performance. There is a need about tools improvements to assess athlete's awareness about carbohydrate recommendations (26), and of course types of carbohydrates that should be eaten before and after trainings or matches.

Without guidance from scientific recommendations, dietary habits can be detrimental, it may be resulted in unfavorable changes in body composition and performance problems (20). Spendlove et al. (2012), have reported nutrition knowledge in elite athletes is very important for their daily life and performance. Individuals who have high nutritional information are almost 25 times more likely to meet recommendations and have a healthier diet, as a naturally healthy and quality life (4, 25, 28).

Conclusion

There is a gap about nutritional knowledge of athletes and players in literature, that is why there is a need for more detection and intervention for eating and lifestyle habits especially supported with educations. Nutrition educations and courses that are given in the university period make adulthood life much more qualified and for athletes it is much more important. Good and practicable knowledge of nutrients will improve sports performance.

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