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RESEARCH ARTICLE

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Analysis of the diet, weight-loss behavior, and nutritional knowledge of athletes and coaches in weightclass sports: influence of a coach's nutritional knowledge on athletes

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ABSTRACT

Background: This study was conducted to investigate the nutritional knowledge of elite athletes undergoing weight loss and to identify differences in weight-loss strategies according to nutritional knowledge.

Methods: The participants included 22 coaches and 88 elite athletes registered under the same affiliation. The survey involved translating the General Nutrition Knowledge Questionnaire (GNKQ), and interviews were used to confirm the diet and weight loss patterns of the athletes. The coaches and athletes were divided into high-rank (12 coaches and 57 athletes) and low-rank (10 coaches and 31 athletes) groups based on GNKQ scores. Paired t-tests, correlation analysis, and logistic regression analysis were performed.

Results: GNKQ results showed significant differences between high-ranking and low-ranking coaches ($p < 0.001$). Furthermore, a significant difference in nutrition knowledge scores was also noticed between athletes with high-ranking and low-ranking coaches ($p < 0.001$). A strong correlation was observed between the GNKQ scores of coaches and athletes ($r = 0.369$; $p < 0.001$). The nutritional knowledge of coaches was also correlated with weight-loss strategies (weight loss attempt frequency; $r = -0.235$; $p = 0.027$; weight loss duration; $r = -0.268$; $p = 0.012$). Additionally, differences were observed in the intake of all nutrients (carbohydrates, proteins, and fat) in the diets of athletes ($p < 0.001$).

Conclusion: Our study suggests that the nutritional knowledge of coaches indirectly affects athletes. Coaches have significant influence over athletes and possess experience with diet and weight-loss patterns. This insight should be effectively utilized to enhance the training and performance of athletes and coaches.

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1. Introduction

Even small increases in performance in sports can make a big difference, and nutrition is a crucial factor in the performance and physical health of athletes [1]. Proper nutrition improves physical performance, whereas a lack of it disrupts biorhythms, and leads to reduced performance [2]. Additionally, correct nutritional knowledge can lead to positive changes in athletes, including an improved diet, better performance, increased strength, and improved body composition. In contrast, incorrect nutritional knowledge can have negative effects.

In combat sports, where weight loss is often undertaken periodically to improve performance, inaccurate nutritional knowledge can result in inappropriate weight loss, which can worsen the physical condition, leading to poor performance and hindering weight reduction [3]. Malnutrition-induced weight loss may utilize extreme dehydration techniques, which can cause hyponatremia, kidney disease, loss of muscle mass, bone density issues, and nutrient deficiencies [4]. It may also increase the risk of potentially harmful behaviors such as fasting, vomiting, and the use of diuretics [5,6].

Although information is easily accessible in modern society, access to accurate, evidence-based information is challenging. Elite athletes often rely heavily on coaches for dietary and nutritional guidance [7]. When an athlete relies solely on the coach for nutritional information, the quality of the information is directly influenced by the knowledge of the coach, which can negatively impact training and performance.

To address this issue, it is necessary to determine the nutritional knowledge levels and weight-loss behaviors of coaches and athletes to guide systematic nutrition education. However, research on the relationship between nutritional knowledge and weight-loss strategies among athletes undergoing weight loss is lacking. Therefore, this study aimed to investigate the nutritional knowledge of Korean elite athletes and coaches who have experienced weight loss and to identify differences in diet and weight-loss behavior according to their nutritional knowledge.

2. Materials and methods

2.1. Participants

This study was officially conducted on male sports professionals, including 22 coaches (age, 43.84 ± 4.57; height, 174.87 ± 5.02; weight, 83.93 ± 9.98) and 88 professional athletes (age, 21.47 ± 1.47; height, 171.09 ± 5.84; weight, 62.89 ± 10.31) registered with the Korean Sports and Olympic Committee. We selected athletes who had not experienced any breaks due to injury in the last year and who regularly participated in training. The sports team categories included wrestling (n = 9), judo (n = 7), boxing (n = 2), and taekwondo (n = 4). Before the study commenced, all volunteers received a detailed description of the purpose, methods, and risks involved and were informed that they could withdraw from the study at any time, without any repercussions; subsequently, all participants provided written informed consent. All study procedures were approved by the Ethics Committee of the Yong In University Institutional Bioethics Committee (Approval no. 2-1,040,966-AB-N-01-2309-HR-331-3). This study was conducted in accordance with the principles of the Declaration of Helsinki.

2.2. Dietary survey and nutritional knowledge analysis

Participants completed an accepted nutritional knowledge survey. The General Nutrition Knowledge Questionnaire (GNKQ) used in this study was translated into Korean from the revised version [8]. The translated GNKQ was administered to assess the levels of participant nutritional knowledge. The GNKQ consists of 88 items and four sections. One point was awarded for each correct answer, and zero points were given for 'uncertain' or incorrect responses. The overall score consisted of the number of correct answers out of a total of 88. Each session comprised the following: Section 1 (18 questions): dietary recommendations; Section 2 (36 questions): food groups; Section 3 (13 questions): healthy food choices; Section 4 (21 questions): diet, disease, and weight associations. To analyze the differences in nutritional knowledge, the coach group was divided into high-rank (12 people) and low-rank (10 people) groups based on the survey scores. The athletes were divided into two groups according to their coach's affiliation: high-rank (57 people) and low-rank (31 people) groups. Dietary surveys were conducted to compare nutritional intake and percentage intake between groups. Dietary surveys were conducted for three days, including weekends, and included all meals and snacks consumed. The athletes were photographed with all foods consumed, and the amount and type of food consumed during the week were evaluated through interviews based on the 24-h recall method. The dietary intake data obtained were analyzed using CAN-Pro 4.0 software (Korea Nutritional Association, Seoul, Korea).

2.3. Weight-loss behavior assessment

Participants were interviewed on how to lose weight while being provided with photos of meals. Interview questions included six questions on weight loss: the total number of weight loss attempts in the last three years, average number of weight-loss attempts per year, average weight loss period duration, average weight loss in kg, diet control strategies, and their preferred weight loss method. Weight loss strategy survey data were classified according to the following criteria: the weight loss period (<6 days vs. >7 days), weight lost (kg) (<3 kg vs. >4 kg), and frequency of weight loss attempts (<3 times vs. >4 times per year).

2.4. Statistical analysis

Data analysis was performed using SPSS version 25.0. Descriptive statistics were used to define the ratio of responses to each question, and the mean and standard deviation of the total score for the GNKQ were calculated. Independent sample *t*-tests were conducted to confirm the difference between groups based on the nutritional knowledge scores, and correlation analysis was conducted to determine the relationship between nutritional knowledge, weight-loss, and the number of weight-loss attempts of coaches and athletes. In addition, logistic regression analysis was conducted to compare weight loss behavior based on the nutritional knowledge score. The statistical significance level for all data was set at $p < 0.05$.

3. Results

Regarding the athletes' weight-loss strategies 52 (59.1%) preferred short-term weight-loss (within a week), and 26 (41.9%) preferred long-term weight-loss (within a week or longer). For weight loss (kg), 48 people (54.5%) preferred losing less than 3 kg, and 40 people (45.5%) preferred losing more than 4 kg. In total, 48 people (54.5%) lost weight less than three times a year, and 40 people (45.5%) lost weight more than four times a year.

According to the GNKQ results, the coach's results showed differences between the high-ranking and low-ranking groups ($p < 0.001$). The difference in nutrition knowledge scores between high- and low-rank coaches averaged 10.19 points. In addition, the difference in nutrition knowledge scores between athletes of high- and low-ranking coaches averaged 6.62 points ($p < 0.001$) (Table 1). Table 2 shows an analysis of the distribution of scores by group according to the level of nutritional knowledge (Table 2).

There was a strong correlation between the GNKQ scores of coaches and athletes ($r = 0.369$; $p < 0.001$); the nutritional knowledge of coaches was strongly correlated with the frequency of weight loss attempts ($r = -0.235$; $p = 0.027$); and athlete nutritional knowledge correlated with weight loss duration (r, = -0.268; $p = 0.012$; Table 3).

Table 1. Characteristics and GNKQ score of participants.

Variable	Groups	High rank (50%↑)	Low rank (50%↓)	F	t	*p*
Age (years)	Coaches	44.41 ± 4.96	43.33 ± 3.36	–	–	–
	Athletes	17.83 ± 0.69	17.92 ± 0.65	–	–	–
Height (cm)	Coaches	174.22 ± 5.38	174.8 ± 5.13	–	–	–
	Athletes	170.00 ± 5.24	172.41 ± 6.31	–	–	–
weight (kg)	Coaches	81.27 ± 9.55	86.30 ± 10.91	–	–	–
	Athletes	60.05 ± 8.03	66.31 ± 11.72	–	–	–
BMI (kg/m2)	Coaches	26.72 ± 2.37	27.87 ± 2.93	–	–	–
	Athletes	20.69 ± 1.81	22.26 ± 3.53	–	–	–
GNKQ	Coaches	63.17 ± 4.18***	52.98 ± 61.70	85.751	14.448	**<0.001**
	Athletes	53.39 ± 6.86***	46.77 ± 7.92	0.002	4.199	**<0.001**

Values expressed as M ± SD ***$p < 0.001$ using *t*-test; BMI, body mass index; GNKQ, general nutrition knowledge questionnaire.

Table 2. Analysis of the distribution of scores by group according to the level of nutritional knowledge.

		Nutrition knowledge section (max possible score)														
		Overall (88)			Section 1 (18)			Section 2 (36)			Section 3 (13)			Section 4 (21)		
Variables		Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD	%
A	**HR (*n* = 48)**	63.17	4.18	71.6	9.75	1.06	53.8	26.56	3.55	73.6	9.50	0.97	73.1	16.67	2.25	79.1
	LR (*n* = 40)	52.98	1.70	60.1	8.89	1.04	48.9	23.75	3.84	65.8	8.06	2.62	61.3	16.56	2.63	78.6
	F		85.751			0.035			0.750			9.076			1.362	
	t		14.448			2.533			0.636			2.078			0.124	
	p		<0.001**			0.016			0.530			0.046			0.902	
	Effect size[a]		3.3			1.05			3.7			2.0			2.4	
B	**HR (*n* = 48)**	53.40	6.86	60.6	7.7	1.34	42.7	22.21	3.79	61.6	8.25	1.99	63.4	14.94	2.68	70.9
	LR (*n* = 40)	46.78	7.93	53.1	7.38	1.55	41.1	19.50	4.11	54.2	7.50	1.93	57.7	12.30	3.26	58.5
	F		0.002			2.030			0.021			0.229			0.673	
	t		4.199			2.095			3.212			1.780			4.168	
	p		<0.001**			0.039***			0.002			0.079			<0.001	
	Effect size[a]		1.4			3.9			1.9			2.9			0.3	

Values expressed **$p < 0.01$, ***$p < 0.001$ HR vs LR by t-test; A, Coach groups; B, Athlete groups; HR, High rank group; LR, Low rank group; Section 1: dietary recommendation; Section 2: food groups; Section 3: healthy food choices; Section 4: diet, disease, and weight associations;[a]Cohen's effect size.

Table 3. Correlation between CGNKQ, AGNKQ, and weight loss strategies.

Variable	CGNKQ	AGNKQ	Weight loss period	Weight loss (kg)	Weight loss frequency
CGNKQ	–	–	–	–	–
AGNKQ	**0.369*****	–	–	–	–
Weight loss period	0.037	**−0.268***	–	–	–
Weight loss (kg)	−0.093	0.053	−0.042	–	–
Weight loss frequency	**−0.235***	0.043	−0.131	0.157	–

Significant difference, *$p < 0.05$; CGNKQ, Coaches General Nutrition Knowledge Questionnaire; AGNKQ, Athletes General Nutrition Knowledge Questionnaire.

Table 4. Logistic regression analysis of nutritional knowledge and weight loss strategy.

Variables		*B*	*S.E.*	*OR*	*95%CI*	*p*
Weight loss period	CGNKQ	0.058	0.041	1.060	(0.977–1.149)	0.162
	AGNKQ	−0.091	0.033	0.913	(0.855–0.975)	0.007**
-2LL = 105.770, NagelKeeke R2 = 0.126, Hosmer & Lemeshow test: χ2 = 36.424(p < 0.001)						
Weight loss-KG	CGNKQ	−0.108	0.043	0.898	(0.826–0.976)	0.012*
	AGNKQ	0.064	0.032	1.067	(1.001–1.136)	0.045*
-2LL = 104.836, NagelKeeke R2 = 0.122, Hosmer & Lemeshow test: χ2 = 23.245(p = 0.003)						
Weight loss frequency	CGNKQ	−0.098	0.043	0.906	(0.834–0.985)	0.021*
	AGNKQ	0.077	0.033	1.080	(1.013–1.151)	0.019*
-2LL = 104.560, NagelKeeke R2 = 0.125, Hosmer & Lemeshow test: χ2 = 11.651(p = 0.167)						

Significant difference, **$p < 0.01$, *$p < 0.05$; CGNKQ, Coaches General Nutrition Knowledge Questionnaire; AGNKQ, Athletes General Nutrition Knowledge Questionnaire.

Logistic regression analysis of the GNKQ and weight-loss period indicated that the GNKQ scores of coaches had no influence on athlete weight-loss period duration; athlete GNKQ scores were related to the weight-loss period ($p = 0.007$). Analysis of GNKQ and weight loss (kg) indicated that coach and athlete GNKQ scores were related to athlete weight loss (kg; coach, $p = 0.012$; athlete, $p = 0.045$). Coach and athlete GNKQ scores resulted in a difference in athlete frequency of weight loss (coach, $p = 0.021$; athletes, $p = 0.019$; Table 4).

The differences in dietary intake between athletes with high-ranking coaches versus those with low-ranking coaches was found in carbohydrates: g/day (high-rank, 658.65 ± 53.62; low-rank, 715.09 ± 107.25; $p = 0.003$), carbohydrates: kcal/day (high-rank, 2634.69 ± 214.54; low-rank, 2860.50 ± 429.01; $p = 0.003$), and carbohydrates: Energy % (high-rank: 53.56 ± 6.10; low-rank, 59.04 ± 6.02; $p < 0.001$); protein: g/day (high-rank: 248.26 ± 45.99; low-rank, 211.90 ± 47.83; $p = 0.001$), protein: kcal/day (high-rank: 1014.65 ± 202.79; low-rank, 861.78 ± 215.00; $p = 0.01$), and protein: Energy % (high-rank: 19.85 ± 2.56; low-rank, 17.23 ± 2.60; $p < 0.01$); fat: g/day (high-rank: 147.61 ± 27.34; low-rank, 129.21 ± 27.85; $p = 0.03$), fat: kcal/day (high-rank: 1328.50 ± 246.07; low-rank, 1162.90 ± 250.73; $p = 0.03$), and fat: Energy % (high-rank: 26.57 ± 3.66; low-rank, 23.71 ± 3.70; $p < 0.01$; Figure 1).

4. Discussion

In the field of sports, nutrition encompasses not only dietary considerations but also factors such as exercise, rest, and various elements that are essential to the journey of an athlete from pre-game preparation to the post-game phase. The management of sports nutrition and dietary practices of athletes directly influences their overall performance [5]. Therefore, it has recently been recognized that effective nutrition management is crucial

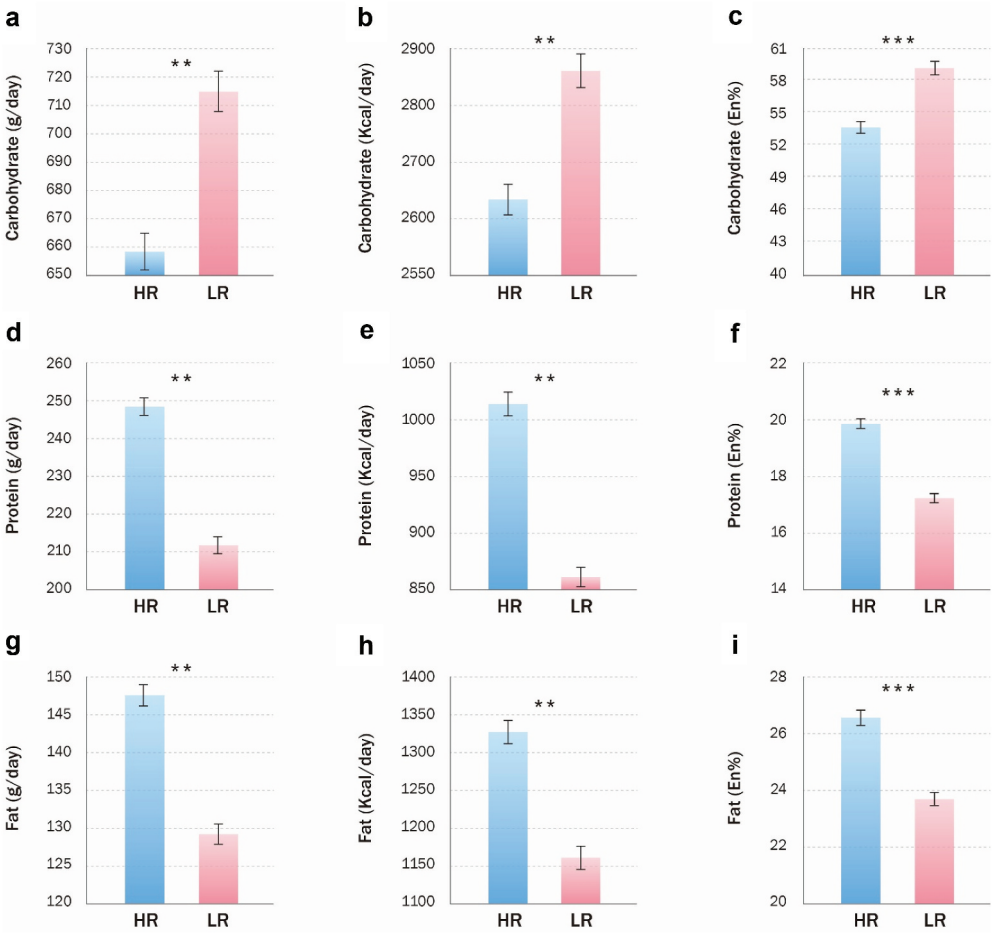


Figure 1. Change in physical activity according to G-test result: (a) vigorous activity (reps/week), (b) vigorous activity (min/day), (c) moderate activity (reps/week), (d) moderate activity (min/day), (e) light activity (reps/week), and (f) light activity (min/day). GP, G-test pass group; GF, G-test fail group.

for improving performance, and there is an emerging need for nutritional education to support individuals in managing their nutrition [9].

Nutritional knowledge can directly affect the diets of athletes [10]. Recently, Danielik et al. [11] reported that acquiring nutrition knowledge induced behavioral changes in athletes, reinforcing the pivotal role even minimal nutritional awareness plays in maintaining healthy dietary practices. However, rapid weight loss accompanied by an unhealthy diet can have negative consequences [12]. Similarly, Spendlove et al. [13] reported that a primary strategy for promoting optimal dietary habits in athletes involves providing targeted nutrition education. They emphasized that the fundamental purpose of such education is to equip athletes with the requisite knowledge to make informed decisions regarding their dietary choices.

According to Thomas et al. [14] and Phillips and Van Loon [15], strength and power athletes are typically recommended to consume protein amounts at the higher end of the

range. Temporary consumption of even higher amounts during intense training periods may provide additional benefits. This study confirmed that athletes with high nutritional knowledge consumed fewer carbohydrates and more protein and fat. Combat sports, which involve weight loss, require high energy intake. In this case, athletes with more nutritional knowledge tended to consume a diet rich in protein and fat, thereby receiving more adequate nutrition after high-intensity training.

The dietary intake ratios (carbohydrates, lipids, and protein) and weight-loss strategies of athletes also differed. We found that athletes trained by coaches with high nutritional knowledge scores also had high nutritional knowledge scores themselves. These results suggest that the nutritional knowledge of a coach can impact an athlete's performance. Despite the increased availability of online nutrition information, elite athletes still rely on coaches instead of seeking knowledge themselves [7].

This study also shows that differences in the nutritional knowledge of coaches affect the weight loss strategies (period, kg, frequency) of athletes. For athletes in weight-loss sports, losing weight is aimed at improving performance, not just to compete. Instead, combat sports athletes use weight loss as a strategy to gain an advantage over athletes in the same weight class, primarily by regaining a certain amount of body mass after the official weigh-in [3]. Failure to achieve the desired weight loss can prevent athletes from performing at their best. Therefore, weight loss is a crucial factor that can greatly influence performance. Previous studies indicate that almost all elite athletes obtain nutritional information from books, teachers, and coaches, with very few seeking advice from nutritionists [16]. Coaches have a potentially large impact on the performance of athletes [17]. The interpersonal relationship between coach and athlete is at the heart of the coaching process and is important for improving the performance of athletes in competition [18]. Its significance becomes even more important, especially under the hierarchical structure of elite sports. Therefore, to better guide athletes, coaches, and trainers must have appropriate nutritional information [19]. Understanding the variables of the direct nutritional information that coaches provide to athletes, their training methods, and the personal knowledge acquisition process by athletes requires further research. Follow-up studies should focus on these crucial aspects to improve the performance of athletes in combat sports.

5. Conclusion

Sports and nutrition are separate concepts, yet they are often neglected compared to topics such as training and rest. This study focused on nutrition, weight loss, and dietary intake in athletes. The aim was to confirm the relationship between the nutritional knowledge of elite sports coaches and athletes and their weight loss strategies. We feel that this study can be used to develop educational materials that coaches and athletes can actively use for nutritional education and management. Based on our research results and previous international educational materials, we believe our study will assist in the development of educational materials to improve the nutritional knowledge of coaches and athletes.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Author contributions

All authors were well-informed about the WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects – and confirmed that the present study complied with the declaration. None of the authors have any financial or private relationships with commercial, academic, or political organizations or people that may have inappropriately influenced this research. J.-Y. S. was involved in the overall planning of the research, data acquisition, analysis, and interpretation, and major drafting and revision of the manuscript submission; J.-H. L. contributed to data acquisition, analysis, and interpretation, as well as major drafting and revision of the manuscript submission; K.-L. L. contributed to the anatomical and clinical expertise for the conception, overall organization, and direct supervision of the research.

Data availability statement

The data presented in this study are available on request from the corresponding author(s).

References

1. Kim J, Kim J. Nutritional supplement for athletic performance: based on Australian institute of sport sports supplement framework. Exerc Sci. 2019;28(3):211–220. doi: 10.15857/ksep.2019.28.3.211
2. Vitale K, Getzin A. Nutrition and supplement update for the endurance athlete: review and recommendations. Nutrients. 2019;11(6):1289. doi: 10.3390/nu11061289
3. Sung JY, Oh TW, Lim SG. Effects of natural iron supplement intake on EPO, HP, and iron metabolism during rapid weight-loss in university wrestlers. J Mens Health. 2022;18(5):114. doi: 10.31083/j.jomh1805114

4. Adrogué HJ, Madias NE. Hyponatremia. N Engl J Med. 2000;342(21):1581–1589. doi: 10.1056/NEJM200005253422107
5. Sung JY, Lee DR. Effect of the COVID-19 pandemic on weight-loss of Korean athletes: changes in athletes' physical activity and eating behavior. Phys Act Nutr. 2023;27(1):9–15. doi: 10.20463/pan.2023.0002
6. Roklicer R, Rossi C, Bianco A, et al. Prevalence of rapid weight loss in Olympic style wrestlers. J Int Soc Sports Nutr. 2022;19(1):593–602. doi: 10.1080/15502783.2022.2119095
7. Bakhtiar M, Masud-Ur-Rahman M, Kamruzzaman M, et al. Determinants of nutrition knowledge, attitude, and practices of adolescent sports trainee: a cross-sectional study in Bangladesh. Heliyon. 2021;7(4):e06637. doi: 10.1016/j.heliyon.2021.e06637
8. Kullen CJ, Iredale L, Prvan, et al. Evaluation of general nutrition knowledge in Australian military personnel. J Acad Nutr Diet. 2016;116(2):251–258. doi: 10.1016/j.jand.2015.08.014
9. Little JC, Perry DR, Volpe SL. Effect of nutrition supplement education on nutrition supplement knowledge among high school students from a low-income community. J Community Health. 2002;27(6):433–450. doi: 10.1023/A:1020653202522
10. Condo D, Lohman R, Kelly M, et al. Nutritional intake, sports nutrition knowledge and energy availability in female Australian rules football players. Nutrients. 2019;11(5):971. doi: 10.3390/nu11050971
11. Danielik K, Książek A, Zagrodna A, et al. How do male football players meet dietary recommendations? A systematic literature review. Int J Environ Res Public Health. 2022;19(15):9561. doi: 10.3390/ijerph19159561
12. Trivic T, Roklicer R, Zenic N, et al. Rapid weight loss can increase the risk of acute kidney injury in wrestlers. BMJ Open Sport & Exerc Med. 2023;9(2):e001617. doi: 10.1136/bmjsem-2023-001617
13. Spendlove JK, Heaney SE, Gifford JA, et al. Evaluation of general nutrition knowledge in Elite Australian athletes. Br J Nutr. 2012;107(12):1871–1880. doi: 10.1017/S0007114511005125
14. Thomas DT, Erdman KA, Burke LM. Position of the academy of nutrition and dietetics, dietitians of Canada, and the American college of sports medicine: nutrition and athletic performance. J Acad Nutr Diet. 2016;116(3):501–528. doi: 10.1016/j.jand.2015.12.006
15. Phillips SM, Van Loon LJ. Dietary protein for athletes: from requirements to optimum adaptation. J Sports Sci. 2011;29;Suppl 1:S29–S38. doi: 10.1080/02640414.2011.619204
16. Roiland K, Koszewski W, Hingst J, et al. Nutritional supplement use among college athletes and their sources of information. Int J Sport Nutr Exer Metab. 2004;14(1):104–120. doi: 10.1123/ijsnem.14.1.104
17. Choi H, Jeong Y, Kim SK. The relationship between coaching behavior and athlete burnout: mediating effects of communication and the coach–athlete relationship. Int J Environ Res Public Health. 2020;17(22):8618. doi: 10.3390/ijerph17228618
18. Mageau GA, Vallerand RJ. The coach–athlete relationship: a motivational model. J Sports Sci. 2003;21(11):883–904. doi: 10.1080/0264041031000140374
19. Azizi M, Rahmani-Nia F, Malaee M, et al. A study of nutritional knowledge and attitudes of elite college athletes in Iran Braz. J Biometricity. 2010;4(2):105–112.