

Comparative analysis of actual nutrition and physical performance of volleyball players with organized and free menu

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Abstract. In the Republic of Kazakhstan there is no control over the menu of sports club athletes. An unbalanced diet affects physical performance during training and competitions and disrupts the recovery process in the post-training period. The purpose of the study is to conduct a comparative analysis of nutritional, anthropometric and physical indicators in female volleyball players with organized and unorganized nutrition. The group of athletes with organized nutrition was represented by female volleyball players of the Karken Akhmetov Republican Specialized College MST RK. The second group with unorganized nutrition was represented by female volleyball players of the sports club of the Academy of Sports and Tourism MST RK. The content of proteins, carbohydrates and monounsaturated fatty acids in the daily meal of students of the Karken Akhmetov Republican Specialized College exceeded the content of these macronutrients in the diet of female volleyball players of the Academy of Sports and Tourism. The diet of the Academy of Sports and Tourism players was not rational or balanced. The anthropometric and physical indicators of female volleyball students of the Karken Akhmetov Republican Specialized College exceeded the physical indicators of female volleyball players of the sports club of the Academy of Sports and Tourism.

1 Introduction

The real diet of Kazakhstani athletes does not always match the criteria of rational nutrition, according to a review of scientific publications on the subject [1-5]. In Kazakhstan there is practically no control over the menu of athletes in sports clubs and there are few organizations that would provide athletes with an organized and rational diet. One of the organizations that provides organized meals for athletes is Karken Akhmetov Republican Specialized College. We decided to conduct a comparative study of nutritional, anthropometric and physical indicators of female volleyball players of the Karken Akhmetov Republican Specialized College with organized nutrition and female volleyball players of the Academy of Sports and Tourism club with unorganized nutrition. The work's practical value is found in obtaining a

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substantiated conclusion about whether there is a need to organize and provide athletes with a rational balanced diet or whether athletes are able to provide themselves with a balanced diet.

2 Materials and Methods

2.1 Participants and Ethical statement

The targets of the study were:

1. Volleyball players from the Academy of Sports and Tourism sports club, part of the Department of Tourism and Sports of the Republic of Kazakhstan, aged 17-19-21 girls (AST group).

2. Volleyball players aged 17-19 years of the Karken Akhmetov Republican Specialized College of the Department of Tourism and Sports of the Republic of Kazakhstan – 21 girls (BSOR group)

All types of experiments were carried out in compliance with Helsinki Declaration: Ethical Principles for Medical Research Involving Human Subjects and by the protocol of the Local Ethics Commission of the Al-Farabi Kazakh National University No. 471 dated August 08, 2023 [6]. Each participant in the experiment voluntarily signed an informed consent to participate in the experiment.

2.2 Research methods

Information on daily food intake was collected using a self-report questionnaire that collected information on frequency of meals, quantity of food eaten, and food ingredients, scheduled by day over a 7-day period. When calculating the calories of a real diet, we used the food atlas of the Kazakhstan Academy of Nutrition (Kazakh Academy of Nutrition - Album of food portions, Almaty, 2018) and according to the calorie table [7, 8]. To conduct a comparative analysis of qualitative and quantitative indicators of athletes' nutrition, control indicators were taken from the "Methodology of nutritional standards and pharmacological support for athletes, including military personnel of all categories and law enforcement and special government bodies, during the educational and training process and sporting events" [9].

Collection of anthropometric indicators using a medical mechanical floor stadiometer RP "Economy", diagnostic scales "Picooc Mini V2", which determine various weight indicators based on bioimpedance. Full height (m^{-1}), total body weight (kg), fat mass (%), muscle mass (%), visceral fat mass (kg) were determined. Calculation of BMI (Quetelet index) (in conventional units) is carried out by finding the ratio of body weight to the square of height (m).

The collection of physical indicators of athletes was carried out during training: shuttle running (sec), standing long jump (m), number of jumps on a platform 50 cm high in 30 seconds (shown in numbers). These physical parameters are control standards for determining the physical fitness of athletes.

2.3 Statistical data processing

Utilizing "Statistica 6.0" software and Microsoft Excel, mathematical statistics techniques were used to the acquired data. The information is displayed as an average (M) $\pm$ standard deviation (SD). (n=21 girls/group). One-way (single factor) ANOVA (analysis of variance) was used to determine a statistically significant difference and the values were considered

reliable at $p < 0.05$ and $F > F_{crit}$.

3 Results and Discussion

3.1 Assessment of anthropometric indicators

The anthropometric indicators of the AST female volleyball players were not much inferior to those of the BSOR female volleyball players. The total height of the BSOR athlete was 175.95 ± 7.61 m⁻¹ versus the height of the AST female volleyball players 169.66 ± 5.47 m⁻¹ ($P = 0.0038$ $F > F_{crit}$ 9.43 > 4.08). The weight of the BSOR athletes was 65.44 ± 6.99 kg, and also did not significantly exceed the figure of the AST volleyball players 60.55 ± 6.33 kg ($P = 0.0224$ $F > F_{crit}$ 5.63 > 4.08). The BMI of girls in the BSOR group was not significantly higher 21.37 ± 0.91 conv. units than the BMI of girls in the AST group 20.38 ± 1.32 conv. units ($P = 0.0075$ $F > F_{crit}$ 7.91 > 4.08). It is interesting that in terms of the relative fat content of $27.23 \pm 4.15\%$, the BSOR female volleyball players were inferior to the AST athletes $30.17 \pm 3.47\%$ ($P = 0.0172$ $F > F_{crit}$ 6.17 > 4.08). But in terms of the relative content of muscle mass, $30.37 \pm 1.03\%$, BSOR volleyball players had the same indicator as AST athletes $29.64 \pm 2.34\%$. The absolute indicator of visceral fat was lower in BSOR athletes 1.66 ± 1.01 kg than in AST athletes 2.95 ± 1.35 kg ($P = 0.0012$ $F > F_{crit}$ 12.049 > 4.08).

Thus, anthropometric indicators of weight, height, BMI, relative fat content, relative muscle mass and absolute visceral fat content turned out to be optimal in BSOR female volleyball players.

3.2 Assessment of actual nutrition and physical indicators

The actual supply of nutrients in volleyball players of high sports skills was assessed. The results of the study showed that the amount of energy received per day averaged 4000 ± 346.4 kcal for AST volleyball players and 4800 ± 346.4 kcal for BSOR volleyball players ($P = 0.002$, $F > F_{crit}$, 37.21 > 7.70).

The first quality component of the diet of athletes is protein the importance of which is undeniable. Volleyball players of the AST club received a daily amount of protein of 160.00 ± 52.32 g. This amount of protein was sufficient since the average weight of volleyball players was 60.55 ± 6.33 kg. Protein for body weight was 2.66 g/kg in club volleyball players.

The daily protein intake for BSOR volleyball players was 240.00 ± 62.28 g. Volleyball players weighed 65.44 ± 6.99 kg on average. Daily protein intake was 3.66 g/kg body weight, which was 1.5 times higher than the daily protein intake among AST club athletes ($P = 0.0025$, $F > F_{crit}$, 45.33 > 7.70).

The relative amount of calories from protein was approximately equal in both groups: 16% in the AST club and 20% in the BSOR group. At the same time, animal proteins amounted to 151.3 ± 52.28 g for BSOR athletes, and 100.0 ± 42.28 g for volleyball players of the AST club. But the relative indicators of animal protein in the AST and BSOR groups were almost at the same level $61.52 \pm 19.21\%$ and $65.8 \pm 21.22\%$, respectively. During the survey, the girls did not express any negative comments about their well-being when consuming high amounts of protein. Trainers expressed the opinion that a relatively high protein intake is necessary to recover quickly after training, to rebuild muscle tissue, to form muscle relief, and to maintain endurance, strength, and other attributes during training and competition. It is animal proteins that contain essential amino acids, which play a huge role in the synthesis of protective, transport, and construction proteins [10].

Fats are necessary for human body for the formation of cell membranes, the synthesis of hormones, the formation of the body's energy potential, the regulation of body temperature,

the formation of supporting visceral fat in the abdominal cavity, the transportation of fat-soluble vitamins, the supply of linoleic and linolenic fatty acids, which our body cannot synthesize, but which are necessary for the normal functioning of the immune and support systems. The amount of fat in the diet of volleyball players was 150.00 ± 15.28 g in both groups. Fat calories in both groups were $33.8 \pm 12.4\%$ of the total diet. But vegetable fats amounted to 60.00 ± 12.28 g in AST club volleyball players versus 80.00 ± 14.22 g in BSOR athletes were observed ($P=0.0002$, $F>F_{crit}, 65.31>7.70$). The amount of animal fats was lower in the diet of volleyball players of BSOR 70.00 ± 16.21 g. The diet of AST athletes had a larger amount of animal fats (90.00 ± 24.32 g; $P = 0.0002$, $F>F_{crit}, 65.33>7.70$). Monounsaturated fatty acids (MUFA), specifically omega-3 and omega-6 fatty acids are particularly significant because they promote muscle growth and inhibit the deterioration of muscle fibers during exercise. MUFAs are necessary for the synthesis of eicosanoids and the formation of cell membrane structure. Among BSOR athletes MUFA consumption was 68.02 ± 12.02 g which is greater than 54.77 ± 9.00 g in the diet of AST club athletes ($P=0.001$, $F>F_{crit}, 15.02>7.70$). The amount of polyunsaturated fatty acids (PUFAs) was equal in both groups. The ratio of PUFAs to saturated fatty acids (SFAs) was 0.76 conventional units for the AST club, while for the BSOR athletes it was 0.95 conventional units. The diet of female BSOR athletes was more balanced in terms of fat consumption.

The results of the study showed that in the diet of AST volleyball players, the total amount of carbohydrates was 502.5 ± 94.02 g. Their contribution to the total amount of energy produced was $50.21 \pm 8.56\%$. Based on weight, the amount of carbohydrates was 8.29 ± 2.22 g/kg body weight. In the diet of BSOR volleyball players, the amount of carbohydrates was 622.5 ± 39.41 g. Similar to the first group, the percentage of calories from carbohydrates was 50.2% of the total number of calories. However, the BSOR female athletes' results indicated that their body weight was 9.51 g/kg of carbs, which was not much higher than that of the first AST group ($P=0.002$, $F>F_{crit}, 12.84>7.70$). Both groups' carbohydrate intakes are within the range of what is considered a typical game sports athlete's diet. Experts in nutrition advise that an athlete should consume 8 to 10 grams of carbs per kilogram of body weight. But we must take into account that the amount of carbohydrates depends on the duration of training and competitions. It is advised that team sports players increase their intake of easily digested carbohydrates by 4 g/kg body weight 48 hours before period of competition.

Also, in the post-workout period, the consumption of carbohydrates accelerates the process of protein synthesis; helps restore glycogen reserves in the muscles and liver, the main energy potential of the body. The body's energy supply is provided primarily by carbohydrates. It must be taken into account that the carbohydrate diet should combine mono- and disaccharides and polysaccharides. Of the total amount of carbohydrates, the amount of mono- and disaccharides was 142.26 ± 26.28 g in AST volleyball players, which is equal to $30.50 \pm 4.49\%$ of total carbohydrates. The other portion of carbohydrates were polycarbohydrates. However, it is important to consider that polycarbohydrates release energy slowly and are not equivalent in energy value to mono- and dicarbohydrates. In BSOR volleyball players, the share of mono- and dicarbohydrates was 242.5 ± 65.28 g, which made up $38.9 \pm 12.45\%$ of the total diet. But the surplus quantity of mono- and di-carbohydrates by 8% was due to the consumption of chocolate bars as a snack of boarding school athletes. This fact was news to the coaches. The average amount of dietary fiber in the diet of AST volleyball players was 32.08 ± 9.24 g, which exceeded the recommended daily allowance (25 g). The amount of dietary fiber in the diet of BSOR athletes was 46.1 ± 11.02 g, which significantly exceeded the fiber content in the diet of AST athletes ($P=0.02$, $F>F_{crit}, 15.16>7.70$). Polysaccharides are also important; they are needed for the gradual release of energy and detoxification of the body, as they are able to absorb toxins in the intestines. But an increased amount of fiber stimulates gas formation, which interferes with normal physical training and causes colic in the intestines.

It’s found that in the study groups, carbohydrate intake was within normal limits, despite snacking on fast foods and chocolate bars.

The actual nutrition of the volleyball players of the Karken Akhmetov of the Department of Tourism and Sports of the Republic of Kazakhstan exceeded consumption standards in protein, carbohydrates, and monounsaturated fatty acids recommended for athletes following the approved “Methodology of Nutrition Standards and Pharmacological Support for Athletes, including military personnel of all categories and employees of law enforcement and special government agencies, during the educational and training process and sporting events” [9].

Table 1. Physical indicators of female volleyball players

No.	Parameters	Groups	Indicators	P-value
1	Shuttle run, sec	AST	8.28±0.35	P=0.0021 F>Fcrit 10.84>4.09
		BSOR	7.96±0.25	
2	Long jump, m ⁻¹	AST	232.45±4.24	P=0.0000024 F>Fcrit 30.72>4.09
		BSOR	238.70±2.47	
3	Number of jumps on a platform with a height of 50 m ⁻¹ in 30 seconds, con. units	AST	22.05±1.02	P=0.0000002 F>Fcrit 360.09>4.09
		BSOR	27.85±0.85	

The physical fitness indicators of the studied athletes were assessed using three sports fitness tests. To evaluate volleyball players' level of physical fitness, a shuttle run of 3x10 m, a standing long jump and a jump with both feet on a platform 50 cm high were performed in 30 seconds. Each team engaged in 20 hours of physical activity weekly. There were 20 hours of instruction each week. For both groups, a single training session lasted an average of two hours.

Research has shown that the BSOR team of volleyball players excelled in physical indicators. The time spent on shuttle running was significantly less and better among female volleyball players of BSOR 7.96±0.25 sec than among female AST athletes 8.28±0.35 sec (P=0.0021 F>Fcrit 10.84>4.09). Long jump performance was also better among BSOR athletes 238.70±2.47 m⁻¹ than in female volleyball players of AST 232.45±4.24 m⁻¹ (P=0.0000024 F>Fcrit 30.72>4.09). According to the number of jumps from a place to a platform with a height of 50 m-1 in 30 seconds, BSOR students’ results were 27.85 ± 0.85 con.units which is also better than those of the AST athletes 22.05±1.02 con. units. (P=0.0000002 F>Fcrit 360.09>4.09) (Table 1).

Thus, the energy capacity and quantitative indicators of nutrients in the diet of BSOR athletes exceeded the diet of AST students. In terms of physical indicators, BSOR female volleyball players exceeded those of AST volleyball players.

4 Conclusion

Thus, BSOR volleyball players showed more optimal performance in anthropometric, physical and nutritional indicators than AST volleyball players. With the same training load, they showed higher physical performance and had optimal anthropometric parameters. They had higher relative muscle mass and lower relative total fat. An organized, balanced diet high in protein, carbohydrates and monounsaturated fatty acids corresponded to energy expenditure and promoted muscle development, which was reflected in better physical performance.

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