COMPREHENSIVE ASSESSMENT OF THE NUTRITIONAL STATUS OF FIGURE SKATERS IN THE MODERN WORLD

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Monitoring and studying nutritional status is an important stage in the planning of dietary and metabolic support program for figure skaters. However, currently, there is no comprehensive approach to the assessment of this status that would have factored in the specifics of the given sport. In this regard, this study aimed to update the comprehensive figure skaters nutritional status assessment program. We invited male (n = 13) and female (n = 19) students of the Lesgaft National University, aged 19–20 years, to participate in the study; they all specialize in figure skating. At the first stage, we measured the subjects' anthropometric parameters (body mass index, body fat percentage), clinical indicators (based on the results of the health complaints survey), and speed of dark adaptation. The measurements have shown that the values of body mass index and body fat percentage were normal in all participants for their age. The survey revealed indirect signs of dietary deficiencies, in particular, insufficient amounts of vitamins A, C, P, and B_1. To make the nutritional status check more informative, we suggest completing the program with functional testing (general and special standards) involving registration of the dynamics of the respective indicators, and bioelectrical impedance analysis to learn body composition.

Keywords: figure skating, nutritional status, anthropometry, caliperometry, body composition, dark adaptation

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КОМПЛЕКСНЫЙ ПОДХОД К ОЦЕНКЕ ПИЩЕВОГО СТАТУСА ФИГУРИСТОВ В СОВРЕМЕННЫХ УСЛОВИЯХ

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Изучение пищевого статуса является важным этапом планирования нутритивно-метаболической поддержки спортсменов, специализирующихся в фигурном катании. Однако в настоящее время отсутствует комплексный подход к его оценке с учетом особенностей рассматриваемой специализации. Ввиду этого целью работы было актуализировать комплексную программу оценки пищевого статуса спортсменов-фигуристов. В исследовании приняли участие студенты (n = 13) и студентки (n =19) НГУ имени П. Ф. Лесгафта, представляющие фигурное катание, в возрасте 19–20 лет. На первом этапе тестирования были изучены такие характеристики испытуемых, как данные антропометрических измерений (индекс массы тела, процент жировой массы тела), клинические показатели (по результатам опроса жалоб на состояние здоровья), время темновой адаптации. Исследование показало, что значения индекса массы тела и процента жировой массы тела соответствуют нормативным показателям для данной возрастной группы как у женщин, так и у мужчин. При этом выявлены косвенные признаки дефицита в рационе питания фигуристов витаминов А, С, Р, B_1 на основании жалоб спортсменов на различные состояния. Для повышения информативности программы изучения пищевого статуса предложены дополнительные исследования таких показателей, как функциональное тестирование по общим и специальным нормативам с регистрацией динамики их изменений, а также расширение применяемых методик оценки компонентного состава тела за счет использования биоимпедансометрии.

Ключевые слова: фигурное катание, пищевой статус, антропометрия, калиперометрия, состав тела, темновая адаптация

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Lately, sports community has generally agreed on the confirmed importance of a balanced diet in ensuring the high level of physical performance of an athlete and optimization of post-training recovery [1]. Thus, it is obvious that in such a highly competitive sport as figure skating, a scientific approach to diet planning is essential.

Currently, individual dietary recommendations in figure skating should be based on the accurate assessment of the athlete's nutritional status and factor in the principal type of supply of energy for muscular activity [2], the specifics of microclimate peculiar to the training process [3], and the high risk of injury to the musculoskeletal system [4–6]. It is important to emphasize that today, nutritional status is considered to be an integral indicator that reflects consumption of nutrients, body composition, and metabolic processes at the level of the organism as a whole [7].

Over the past decades, nutritional status and the approaches to its assessment have undergone a number of changes. The abundance of various foods that do not necessarily offer the needed nutrients in the proper amounts, and frequent

violations of the dietary regime have a significant effect on a person's health and performance. The nutritional status of an athlete depends on many factors, and some of the most important of them are the specifics of the training process combined with adherence to the principles of adequate nutrition (quantity and quality) [8].

Thus, while the analysis of the diet is the key component of the nutritional balance assessment, it should be considered only in the context of a complete and comprehensive study of the athlete's health that involves collection of anthropometric, biochemical, clinical, physiological, and functional data [9].

The purpose of this study was to update the comprehensive figure skaters nutritional status assessment program.

METHODS

The study was conducted at the Department of Preventive Medicine and Fundamentals of Health at the Lesgaft National State University of Physical Education, Sports and Health. It involved figure skaters, 13 male and 19 female, aged 19 to 20 years, with qualifications from the first adult skill category to candidate master. We collected the anthropometric data using RP-150 MG standard medical scales (Vestech; Russia) and an RM height meter (TZMT; Russia), then calculated the body mass index (BMI, kg/m2) by the generally accepted formula. Skinfold assessment was done with the help of the Accu-Measure Fitness 3000 plastic caliper (AccuFitness; USA) at seven standard points (back of the shoulder, chest, armpit, under the shoulder blade, upper iliac region, abdomen, at the middle of the thigh). Subsequently, using formulas adjusted for athletes, we calculated the body fat mass [10].

At the next stage of the study, the participants' dark adaptation capabilities were learned. We use the Kravkov–Purkinje table for the purpose. As per the respective standard, athletes should distinguish the yellow square after 30–40 s, and then the blue one [11].

Subjective feelings and health complaints reported by the participants through a specially designed questionnaire were used to register the clinical indicators of nutritional status. The questions sought to reveal if the athletes had bleeding gums, keratinized skin, high secretion of sebaceous glands, bluish skin color, dry skin, pain in the leg muscles when walking, general weakness.

The MyOffice (New Cloud Technologies; Russia) was used for statistical processing of the results. Herein, the data are given as median (Me) and quartiles (25% and 75%).

RESULTS

An accurate assessment of an athlete's nutritional status is only possible when the criteria selected for the purpose factor in the specifics of the respective sport. In our study, at the first stage, we relied on anthropometric indicators as well as physiological and clinical markers of health status, which, it was assumed, could back a primary conclusion about the adequacy of nutrition of the participants. Next, we critically assessed the informative value of the program's components,

and suggested ways to make it more effective by introducing new methods and techniques.

In the context of grading the figure skaters' nutritional status, we registered BMI and body fat with the help of calipers. Table 1 gives the values of these indicators.

Dark adaptation was the selected physiological test contributing to the assessment of the nutritional status. The ability to adapt to darkness deteriorates if a person's diet lacks sufficient amounts of high-grade protein, vitamins A, C and B_2, which makes this test usable in the context of revealing the adequacy of intake of these nutrients [12]. It is important to emphasize that the dark adaptation test values registered in this study were optimal: 28.9 (28.2; 31.0) s for female participants, and 29.7 (28.3; 30.9) s for male subjects.

Health complaints collected with the help of a questionnaire are as informative in the general assessment of a person's condition [13]. The data shown in the Figure demonstrate that the athletes exhibit signs of vitamin deficiency. For example, dry skin and general weakness may indicate that the diet is deficient in vitamin A. In turn, bleeding gums, muscle pain during walking, and skin cyanosis are indirect signs of vitamin C and P hypovitaminosis, and high secretion of sebaceous glands points to a deficiency in vitamin B_1.

DISCUSSION

Experts have shown that morphofunctional characteristics of nutritional status, primarily body weight, affect competitive success in figure skating [14–16]. In this regard, BMI is of particular diagnostic importance: it is a universal anthropometric indicator widely used to assess the state of health and the adequacy of nutrition [17]. However, in sports, its informational value may be limited by the specific requirements of the given sport. For example, in figure skating, especially in women's singles, BMI values are typically close to the lower limit of the range recommended for the general population (18.5–25.0 kg/m²), because such is the condition of the body needed to performing multi-turn jumps [18, 19]. Out study involved figure skaters from various disciplines, so by this indicator, the nutritional status of all participants, male and female, can be considered "normal."

Body composition is an indicator that is informative in terms of nutritional status, and it defines the functional capabilities of the athlete's body [20]. However, currently, there is no consensus regarding the methodological approaches to the assessment thereof [21]. Bioelectrical impedance analysis is becoming increasingly popular, despite the need to use specialized equipment and ensure strict adherence to the preparation procedure in both laboratory and training conditions [22, 23]. Caliperometry, at the same time, does not lose its relevancy, since this technique yields values on par in accuracy with those obtained using other methods relying on hardware [24]. For figure skaters, body fat is a factor influencing how well they can perform complex technical elements. It is considered to be an indicator requiring systematic evaluation [25]. According to the literature, the percentage of body fat should be 8–10% in men and 11–13% in women [2].

Table 1. Anthropometric indicators, Me (Q1; Q3)

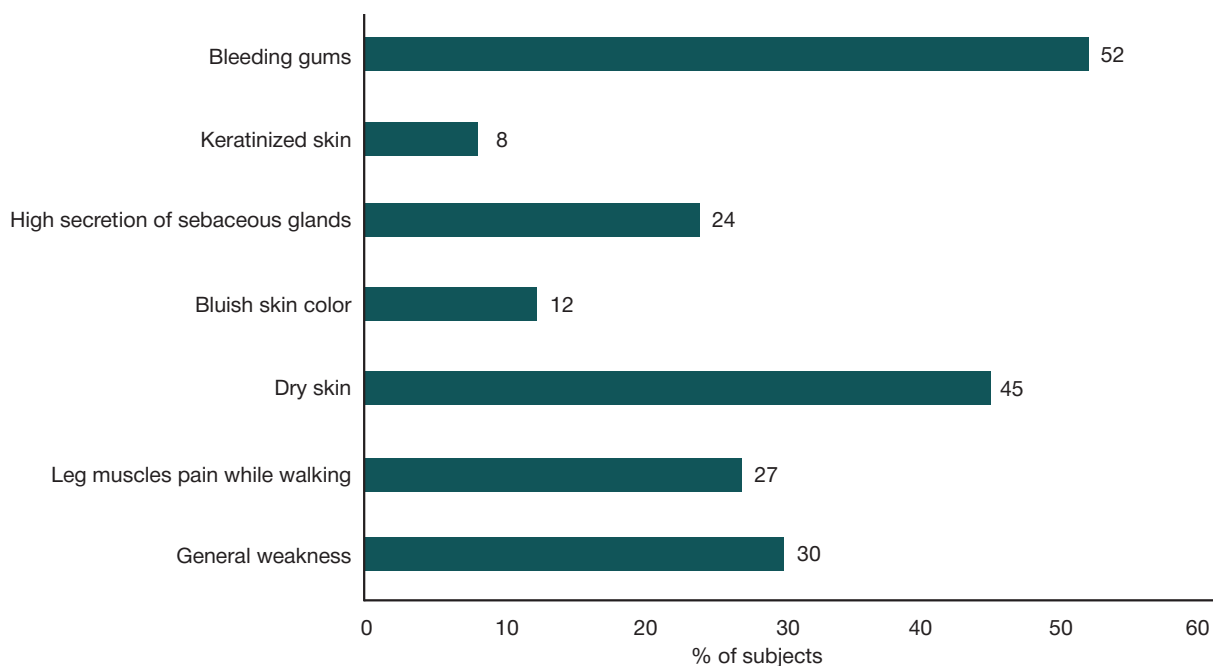| Indicator	Measured value	Standard values
BMI (men), kg/m²	21.1 (20.5; 21.3)	18.5–25.0
BMI (women), kg/m²	21.8 (21.3; 22.4)	18.5–25.0
Body fat mass (men), %	11.5 (10.9; 12.2)	8.0–10.0
Body fat mass (women), %	15.3 (14.3; 16.4)	11.0–13.0

Fig. Clinical signs of inadequate nutrition in athletes

According to the Order of the Ministry of Sports of the Russian Federation "On approval of the federal training standard in figure skating" (No. 738, of September 17, 2022), coordination and vestibular stability have a significant effect on the performance in the considered sport [26]. Therefore, this study pays special attention to the level of vitamin B_6 in the diet the participating athletes when assessing their nutritional status. In this connection, as part of clinical studies, it is necessary to reveal complaints about cheilosis, conjunctivitis, decreased appetite, anxiety, if any [27]. It can be assumed that vitamin B6 deficiency affects physiological tests, Romberg test in particular, which necessitates including it in the comprehensive figure skaters nutritional status assessment program.

Functional tests used to evaluate the physique can also be considered an approach to assessment of the nutritional status. Thus, it is necessary to adjust the set of exercises from such tests to the requirements of the given sport. In particular, the results of the exercise involving flexion and extension of arms while supine are known to positively correlate with how well a figure skater performs complex jumps [28]. Other exercises,

like the Tour jump, which involves complex motor coordination [29], can also yield values reflecting the adequacy of vitamin consumption in general and group B vitamins in particular.

Undoubtedly, the nutritional status study program should include clinical and biochemical blood tests, with their results compared to those of functional tests and 24-h assessment of the quantitative and qualitative characteristics of the diet.

Thus, a comprehensive program should include anthropometric measurements, body composition assessment, study of clinical and biochemical parameters, physiological and functional testing followed by analysis of the diet (Table 2).

CONCLUSIONS

This study aimed to identify possible disorders in the state of health of figure skaters in order to substantiate the selection of informative criteria needed to develop a nutritional status assessment program. The selected indicators characterized the health of figure skaters and how it depends on nutrition. Thus, we obtained the primary results that laid the foundation

Table 2. Figure skaters' nutritional status assessment program: components

Program components	Methods and studied indicators
1. Anthropometric measurements	– Height and weight; – BMI; – skinfold measurement (caliperometry)
2. Body composition	Bioelectrical impedance analysis (musculoskeletal body mass, body fat, total water, etc.)
3. Clinical indicators	Identification of clinical signs of dietary deficiencies
4. Biochemical parameters	– Protein metabolism; – carbohydrate metabolism; – lipid metabolism; – vitamin metabolism; – mineral metabolism
5. Physiological testing	– Dark adaptation; – the Romberg test
6. Functional testing	The dynamics of indicators based on the results of testing at different stages of sports training: – general standards (arms flexion and extension while supine; squat jumps); – special standards (Pistol, Tour)
7. Diet analysis	24-h food intake registration (determination of quantitative and qualitative adequacy of nutrition by macro- and micronutrients)

for the comprehensive nutritional status assessment program. According to the currently accepted concept, a comprehensive assessment of the nutritional status of an athlete can be given based on a wide range of anthropometric data, with the general functional indicators completing the picture given by the tests adjusted to the given sport, and the subjective feelings of an athlete and the results of a medical examination supporting clinical and biochemical parameters. Since there are other factors that can trigger changes in the health status of athletes, it is necessary to adjust the diet once its comprehensive assessment is complete, and follow up with the next round of assessment of the same indicators after such optimization of nutrition.

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