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Nutritional knowledge and nutritional status of the recreationally active population

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Abstract:

Introduction. Adequate nutrition combined with physical activity is the foundation of a healthy lifestyle. Recreational sportspersons should know how to adjust their nutrition to physical activity in order to benefit their health. The aim of the study was to assess the nutritional knowledge of recreationally active people and to assess the influence of BMI and gender on the level of nutritional knowledge. **Material and methods.** The study was conducted with the use of 200 participants aged 15-55 years living in the city of Katowice. The respondents were physically active at least 3 times a week for at least 1 hour. Nutritional knowledge was assessed through a self-administered questionnaire. Nutritional status was assessed by means of the BMI index, and for its assessment, the ranges recommended by the World Health Organization were adopted. **Results.** Most of the respondents - 33.5% (n=77) declared that they practiced weight training, 15.5% (n=31) attended group fitness classes, 14.5% (n=29) practiced running, fewer people practiced team sports and cycling. The nutrition knowledge of the majority of the respondents was at a sufficient level (n=136), 44 respondents had good nutrition knowledge and 22 respondents had insufficient nutrition knowledge. None of the respondents had very good nutrition knowledge. More than 70% of respondents had normal BMI (n=142), more than 25% (n=51) were overweight, and 7 subjects had BMI values below normal. **Conclusions.** There was no relationship between gender, BMI, and level of nutritional knowledge. The study shows that there is a need for nutritional education for recreational sportsmen.

Keywords: nutrition knowledge, nutritional status, recreative active people

Introduction

The proper level of hydration during sports is a truly essential factor that affects the efficiency of an organism and An essential element of a healthy lifestyle is a proper diet, reduction of stimulants, adequate quantity and quality of sleep, and regular physical activity (Heaney et al., 2011, Kerksick et al., 2018). According to the latest WHO recommendations, adults aged 18-64 years should perform moderate-intensity aerobic exercise for at least 150-300 min per week or high-intensity aerobic exercise for at least 75-150 min per week. In addition, adults in this age range should also perform exercises that strengthen all muscle parts at least 2 days per week (Bull et al., 2020). Time spent sitting should be kept to a minimum. The implementation of physical activity even of low intensity is more beneficial for the human body than its complete lack (Bull et al., 2020).

Nutritional recommendations for physically active people are presented in the Food Pyramid for Athletes developed by the Swiss Nutrition Society. It is based on dietary recommendations for non-exercisers, supplemented with additional portions for people with increased physical activity (average activity of at least 5 h per week). It specifies which food products and at what times should be consumed additionally due to increased energy expenditure (Smith et al., 2015).

According to the recommendations, 4-5 meals a day should be eaten at regular, fixed times. However, it should be remembered that this number depends on the lifestyle and should be determined individually. Breaks between meals should be about 2-3 hours, but you should not eat less frequently than every 5 hours. Breakfast is recommended within the first hour after waking up. If you are exercising on an empty stomach, breakfast should be taken after the activity. The last meal should be eaten 2-3 hours before going to bed (Smith et al., 2015, Dickson-Spillmann et al., 2011).

Vegetables and fruit are an important part of everyone's diet. The consumption of 5 servings of vegetables and fruits per day is recommended for people with increased physical activity, just as for people without increased activity. There are no additional recommendations regarding the intake of these products for active people (Frączek et al., 2019, Włodarek et al., 2015). It is recommended that the ratio of vegetables to fruit should be 3:2, with at least one serving of vegetables consumed raw, for example as a snack between meals. The total amount of fruit and vegetables consumed should be about 600 g/day. One serving can also be replaced by a glass of fresh fruit and vegetable juice without added sugar (Włodarek et al., 2015, Vitale & Getzin 2019). In addition to vitamins and minerals, they also contain large amounts of water. Fresh fruits, brassicas and leafy vegetables have 75-95% water and root vegetables have 80-90% (Frączek et al., 2020). Vegetables and fruits are also a source of antioxidants, which have health-promoting effects. Antioxidants in vegetables and fruits include polyphenols, carotenoids, and phytates, among others. Natural antioxidants provided with food may form a protective barrier for the body against the development of diseases such as cardiovascular diseases (Travis et al., 2016).

In people who undertake intensive physical activity, the basic source of energy should be complex carbohydrates, mainly contained in cereal products, groats, and potatoes. Considering the recommendations for moderate-intensity exercisers, whole grain products should be consumed in three portions during the day, including the consumption of pasta, groats, and rice, but 2 out of 3 portions should be made of whole-grain (Moore et al., 2022).

People who train intensively (at least 1 h per day for 5 h per week) should additionally consume one portion of these products for every hour of training. This portion is defined as 75-125 g of bread, 45-75 g of dry groats/pasta/rice/cereal flakes, or 180-300 g of potatoes (Smith et al., 2015, Moore et al., 2022). For each additional hour of training one portion of complex carbohydrate products should be included in the diet. One serving of such food items is for example 60-90 g bar, 50-70 g carbohydrate gel, or 300-400 ml functional drink. Thanks to them, the body gains energy for training in a short time (Spriet et al., 2014).

Protein is a particularly important macronutrient for people who train. It allows for quick muscle regeneration and also improves adaptation to exercise. Good sources of this element of the diet are milk and its products, lean meats, fish, and eggs. According to the recommendations of the pyramid, 1 portion of eggs, meat, fish, cheese, or another source of protein, such as tofu, should be consumed interchangeably throughout the day: 100-120 g raw meat, 2 to 3 eggs, about 60 g yellow cheese or about 200 g cottage cheese (EFSA Panel on Dietetic Products 2012). Moreover, physically active people should consume 3 servings of low-fat milk or dairy products. An example ratio is 1 glass of milk (200 ml) or 150-180 g of natural yogurt (Smith et al., 2015, Philips 2016).

Fats of plant origin should constitute 2/3 of the whole-day dietary supply of fatty acids (Włodarczyk et al., 2017). The main sources of this macronutrient should be vegetable oils and oils, nuts, seeds, fatty sea fish, or avocado. Products such as butter, lard, hard margarine, or red meat should be avoided. The recommendations for non-trainees are 1 serving of high-quality vegetable or olive oil (10-15g fat) as a food additive and 1 serving for use in cooking (Smith et al., 2015, Burke et al., 2017). For adults who train for at least 1 hour per day, an increased supply of fat products by ½ serving for each additional hour of exercise is recommended (Jager et al., 2017).

The **aim** of this study was to assess the nutritional knowledge of recreationally active people participating in selected sports and to analyze the correlation between gender, BMI, and level of knowledge.

Material & methods

Participants. The study was conducted with the participation of 200 people between the ages of 15-55 years living in the city of Katowice. The study included 126 (63%) women and 74 (37%) men. The inclusion criteria for the study were defined as:

- consent to participate in the study,
- Residence in the city of Katowice,
- practicing a chosen sport discipline at least 3 times a week for 60 minutes of activity,
- not belonging to a professional sports club.

Participation in the study was voluntary and anonymous.

Procedure/Test protocol/Skill test trial/Measure/Instruments. **Nutritional status** was assessed using the Body Mass Index (BMI). Height was measured using a SECA 213 stadiometer, while body mass was obtained by measuring with a SECA 769 balance. The results provided a basis for the assessment of height-weight ratios in relation to standards for the European population and WHO recommendations (WHO "Body Mass Index – BMI").

BMI was calculated using the formula (WHO "Body Mass Index – BMI"):

$$\text{BMI} = \frac{\text{body mass [kg]}}{(\text{height [m]})^2}$$

According to the WHO (World Health Organization), the following ranges of values for BMI were adopted:

- <18.5 – below normal,
- 18.5 - 24.9 - normal,
- >25,0 – above normal

To assess the **nutritional knowledge** of the study group, a questionnaire method was applied using the author's validated survey questionnaire. The questionnaire consisted of 18 single-choice closed questions. The questions concerned: the number of meals consumed during the day, the number of servings of vegetables and fruit consumed during the training day, the amount of liquids consumed during the day of increased physical activity, as well as product groups with the highest content of protein, complex carbohydrates and valuable fats. The above questionnaire was extended with a metric containing questions about gender, age, education, existing medical conditions, and medications are taken.

The following levels of awareness were distinguished based on the number of correct answers:

- 18 - 15 points - very good knowledge
- 14 - 9 points - good knowledge
- 8 - 5 points - sufficient knowledge
- 4 - 0 points - unsatisfactory knowledge

Data collection and analysis / Statistical analysis. Statistical analyses were performed using Statistica v.13.3 programs (Stat Soft Polska) and R v. 4.0.0 package (2020) under GNU GPL license (The R Foundation for Statistical Computing).

In order to present quantitative data, mean values and standard deviations - $X \pm S$ - were calculated. For qualitative data, percentage notation was used. Compliance with normal distribution was checked using the Shapiro-Wilk test). The χ^2 test with variations depending on the sample size or Fischer's test was used to assess correlations. A value of $p < 0.05$ was used as a criterion for statistical significance.

Results

A total of 200 questionnaires with anthropometric measurements were the complete study material. The following age groups were identified: 15-25 years (n=125; 61.5%), 26-35 (n=30, 15%). 36-45 (n=27, 13.5%) and 46-55 years (n=20; 10%). Respondents declared no chronic diseases or constant pharmacotherapy. Most respondents had secondary education (n=118; 59%), followed by higher education (n=72; 36%) and primary education (n=20; 10%).

Figure 1 shows the activities that study participants perform.

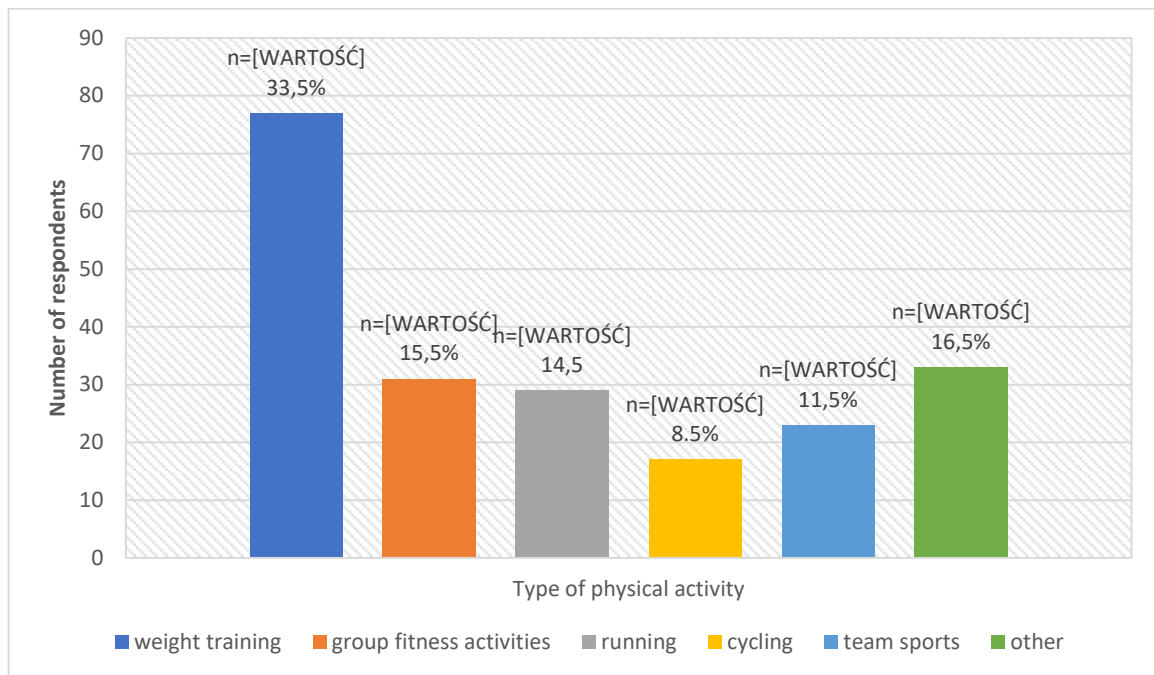


Figure 1. Type of physical activity practiced in the study group (n=200)

The majority of the respondents - 42% (n=84) exercise 3-4 times a week, 37% (n=74) exercise 5-6 times a week, 5% (n=10) of the respondents declare daily physical activity. Analysis of the nutritional status of the subjects showed that 72.5% are of normal weight (n=145), while 21.5% (n=43) of the subjects have a BMI value above normal. 12 (6%) of the study subjects had BMI values below normal.

The majority of respondents (n=173; 86.5%) thought that 4-5 meals should be consumed per day, while the highest number of respondents thought that 2-3 hours should be taken between meals (n=156; 78%). Only 40% (n=80) of the respondents said that vegetables should be included in every meal, while more than half of the respondents (n=106; 53%) thought that 2-3 portions of fruit should be consumed during the training day.

Only 22.5% (n=43) of respondents believe that 4 servings of cereal products should be consumed per day with increased physical activity. The highest percentage of people (n=65; 32.5%) say that 3 portions of these products should be consumed during the training day. 32% (n=64) said that 1 portion of protein-rich foods such as meat, fish or eggs should be included in the diet on a training day. A much smaller percentage of respondents, 14% (n=28) and 3% (n=6) respectively, think that 3 and 4 servings of these foods are appropriate.

The highest percentage of respondents (n=74; 37 %) claim that on a training day 2-2,5 l of water should be drunk. However, 36 % (n=72) of the respondents think that 1,5-2,5 l of water should be consumed on a training day and 27 % (n=54) think that more than 2,5 l of water should be drunk.

Results about the time between meal and workout showed that the largest number of respondents (n=106; 53%) believe that the break should be more than 1-2 hours, with only 24.5% (n=49) of respondents thinking that it is best to consume a meal up to an hour after the end of physical activity. Almost half of the participants (n=92, 46%) said that a recovery meal should be consumed up to 1h after training and just over 40% (n=83) said that this meal should be consumed up to half an hour after training.

Analysis of the questionnaire showed that the nutritional knowledge of the majority of respondents (n=136; 67.0%) was sufficient, 22.0% (n=44) had good nutritional knowledge and 11.0% (n=22) had insufficient knowledge. None of the respondents scored very good in nutrition knowledge.

10% (n=20) males and 12% (n=24) females had good score while 35% (n=70) females and 19.5% (n=39) males had sufficient knowledge. Insufficient knowledge was demonstrated by as many as 15.5% (n=32) of women and 7.5% (n=15) of men. These differences are not statistically significant (p=0.38). Figure 2 shows the nutritional knowledge of the respondents by gender.

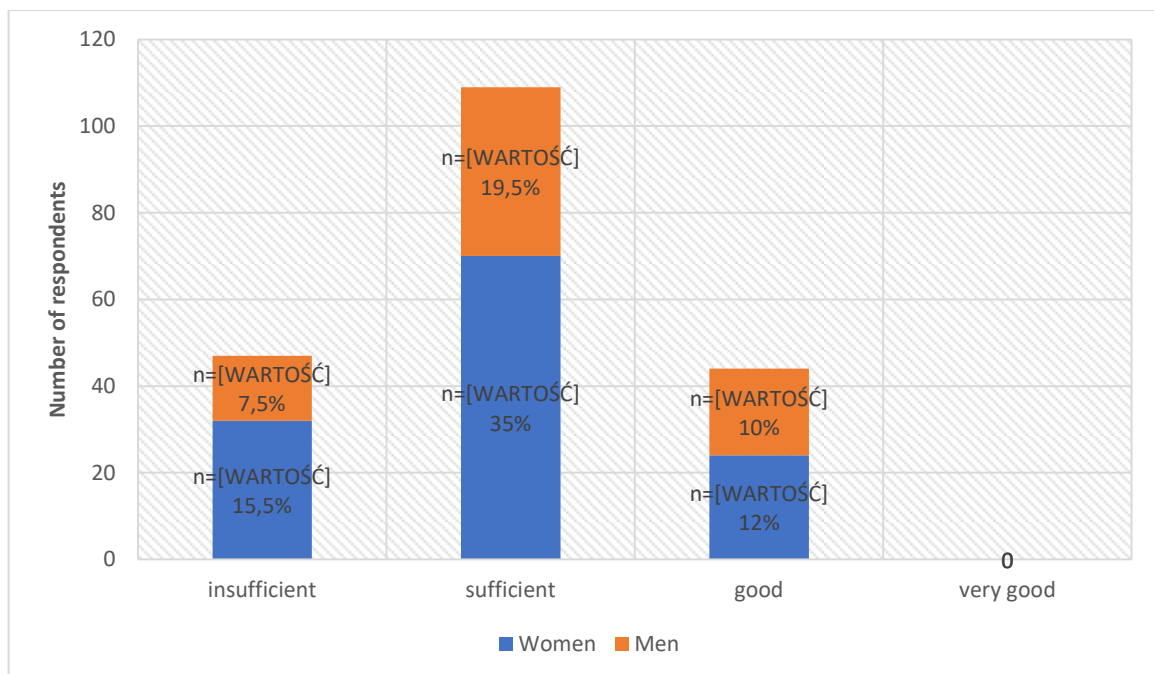


Figure 2. Nutrition knowledge of respondents by gender (N=200).

Table 3 provides information on the correlation between BMI and the respondents' nutrition knowledge classification.

Table 1. Nutrition knowledge and BMI of respondents.

Classification of nutrition knowledge	Interpretation of BMI values				p
	Below normal	Normal	Above normal	Total	
	n=7 (3.5%)	n=142 (71.0%)	n=51 (25.5%)	n=200 (100%)	
insufficient	n=2 (28.6%)	n=35 (24.7%)	n=10 (19.6%)	47 (23.5%)	0,53
sufficient	n=2 (28.6%)	n=76 (53.5%)	n=31 (60.8%)	109 (54.5%)	
good	n=3 (42.9%)	n=31 (21.8%)	n=10 (19.6%)	44 (22.0%)	
very good	n=0 (0.0%)	n=0 (0.0%)	n=0 (0.0%)	n=0 (0.0%)	

Discussion

In our study, the majority of respondents (n=173; 86.5%) answered that 4-5 meals per day should be consumed. In a study by Niewierska et al, 91% of female and 84% of male respondents believed that 4-5 meals per day should be consumed (Sawka et al., 2007). Similar results were obtained in their study by Bębnowicz et al (Niewierska et al., 2016)

In our study, 53.5% (n=107) claimed that the intervals between meals should be 2-3 hours, while 42.5% (n=83) that the time separating meals should be 3-4 hours. Similarly, in the study by Bębnowicz et al. 96% of the respondents claimed that the intervals between meals should be from 2 to maximum 4 hours (Bębnowicz et al., 2015). The study by Panasiewicz and Grochowicz showed that only 52% of the respondents reach for their meals every 4-5 hours, whereas 20% do not pay attention to the intervals between meals and eat them when they feel hungry (Panasiewicz & Grochowicz 2016). The above-mentioned studies show that physically active people do not have enough knowledge about the regularity of eating meals and the breaks that should be kept between them.

The analysis of the question regarding the amount of vegetables that should be eaten per day in our study showed that only 25% (n=50) of people know that 3 portions should be eaten. Considering the question about the proportion of fruit in the daily diet, 54% (n=108) of the respondents believe that 2-3 portions should be consumed. In the study by Bębnowicz et al. more than half of the respondents (57%) were of the opinion that fruits and vegetables should be consumed 2-3 times a day and 29% of the respondents thought that they should be consumed 5 times a day (Bębnowicz et al., 2015). Other results were obtained by Ostachowska - Gąsior et al. who in their study showed that as many as 64.8 % claimed that fruits should be consumed 2 - 3 times a day, while the majority (80.6%) of people believed that vegetables should be included in every meal (Ostachowska-Gąsior et al., 2014). Referring to the above results, the knowledge of the respondents regarding the amount of fruit and vegetables consumed is insufficient.

Drinking 1.5 - 2 l of water during the day, and at increased exercise, an additional 400 - 800 ml for each hour of exercise is necessary for proper functioning. Small fluid deficiencies may lead to dehydration and cachexia, therefore drinking large amounts of water, especially during increased activity is so important (Ostachowska-Gąsior et al., 2014).

In our study, 37% (n=74) of the respondents indicated that 2 - 2.5 l of water should be drunk, with 36% (n=72) believing that 1.5 - 2 l of water per day should be consumed, and 27% (n=54) that more than 2.5 l of water per day is adequate. For people who train at moderate intensity, 2 - 2.5 l of water per day is recommended, while for those who train at lower or higher than moderate intensity, water intake within the values given above is also correct. Therefore, it can be concluded that the knowledge of the respondents about hydration during physical activity is correct.

Only 18.5% (n=35) of the respondents in our study believed that a meal should be consumed at least 2 h before exercise. Analyzing the results of Ostachowska - Gašior et al. 54.7% of respondents know that physical activity should be performed half an hour after eating a light digestible meal and 1.5 - 2 h after eating a heavy meal (Ostachowska-Gašior et al., 2014). Analyzing the results of adolescents in the study by Leonkiewicz et al. 36.6% of girls and 43.2% of boys consumed the main meal 1-2 hours before the competition or intensive physical exercise (Leonkiewicz et al., 2015).

A post-workout meal is necessary to replenish deficiencies and regenerate the body after exercise. It should be a complete meal to replenish glycogen stores and allow muscle growth. It is recommended to consume a carbohydrate meal 30 min after the workout, and up to 2 h after the activity to consume a complete meal rich in essential nutrients (EFSA Panel on Dietetic Products 2012). Analyzing the results of the author's study, only 5.5% (n=11) of respondents believed that a meal should be consumed up to 2 h after the end of physical activity.

The level of nutritional knowledge of 67% (n=134) of the respondents is at a sufficient level, which equates to the respondents having 78% - 50% correct answers. None of the respondents have very good knowledge of nutrition with increased physical activity. In the study by Ostachowska - Gašior et al. the majority (60%) of the respondents had sufficient knowledge (Ostachowska-Gašior et al., 2014). These results demonstrate the need for nutritional education of people who recreationally practice various physical activities.

Conclusions

The respondents were characterized by sufficient nutritional knowledge regarding the nutrition of physically active people. Most of the respondents had BMI value in the normal range. There were no statistically significant differences between gender, BMI, and nutrition knowledge of the respondents.

Despite the increasing interest of society in the principles of proper nutrition and the influence of physical activity on health, the knowledge of people who train is often still insufficient. The study shows that there is a need for nutritional education for recreationally active people. Increasing the nutritional knowledge of physically active people will have a positive impact on their health, fitness, body shape, and sports performance.

Conflicts of interest - The authors declare no conflict of interest.

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