MIZERA, Krzysztof Maciej. Effect of diet on body composition and performance parameters - VO_2max, HR and power, among young football players. Journal of Education, Health and Sport. 2023;13(4):115-122. eISSN 2391-8306. DOI http://dx.doi.org/10.12775/JEHS.2023.13.04.012
https://apcz.umk.pl/JEHS/article/view/41981
https://zenodo.org/record/7650370

Received: 18.01.2023. Revised: 29.01.2023. Accepted: 10.02.2023.

Effect of diet on body composition and performance parameters - VO_2max, HR and power, among young football players

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Abstract

Nutrition acts an important role for soccer players as it provides energy and affects recovery after training.

Objective: The aim of the study was to assess the method and quality of nutrition of young football players and the impact of nutrition on VO2max, power, heart rate and somatic parameters.

Results: The obtained results indicate that with the increase in calories and nutrients, the percentage of water in the body decreases. In other cases, increasing the amount of calories consumed is associated with an increase in BMI, fat content, lean body mass and muscle mass. VO2max did not correlate with any of the dietary parameters as did the number of breaths per minute. Heart rate results in most cases, when correlated with dietary parameters, produce an inversely proportional fit. Resting heart rate (HR) correlates with eight of the eleven deictic parameters, giving a level of compliance in the range of -0.48 to -0.73.

In the case of the size of the change in heart rate after exercise, its size is greater the more calories and nutrients are consumed by the test subjects. These correlations are then proportional. These results range from 0.52 to 0.75.

Conclusion: It is not the amount of calories consumed, but mainly carbohydrates that influence the weight of soccer players. On the other hand, the amount of calories and proteins consumed have an impact on the maximum power generated by players. The diet used by the players does not affect their VO2max and the number of breaths per minute, and the amount of calories and carbohydrates consumed affects the recovery time of the circulatory system (heart rate decrease) immediately after exercise.

Key words: sports diet, sports nutrition, football, soccer, performance, VO2max

Introduction

Football is a discipline that increasingly uses new technologies, both on the pitch and in the process of training and regeneration. Physiological and biochemical elements as well as nutrition play a very important role, which has a direct impact on the form and regeneration of players [1, 2, 3].

Analyzes of football matches show that footballers cover an average of 8-12 km during a match, of which 24% is walking, 36% jog, 20% fast run and 11% sprint. In addition, it turns out that the aerobic capacity of footballers significantly influences their technical activities during the match and translates into the implementation of tactical assumptions [4, 5]

Carbohydrates in the diet of athletes practicing football, both at the recreational and competitive levels, play a significant role, because they generate a large part of the energy used during a match or training. The amount of energy obtained from carbohydrates, especially during high training loads, should reach 60-70% of the daily caloric value of the diet. In the case of footballers, the recommended amount of carbohydrates consumed varies - it depends on the training period, duration and intensity of exercise [6].

Research shows that young footballers provide energy primarily from the following food groups: grains, derivatives and potatoes; milk and dairy products; meat, poultry and products thereof; and oil. Together, these products provided 65% of the total daily energy consumption, with a marginal share of vegetables and fruit [7]. Other studies found that grains and derived products (rice, bread, and pasta); drinks other than water; milk and products thereof; and vegetables, potatoes and seaweed accounted for almost 85% of the total food consumed by soccer players (g), but did not provide information on the contribution of these food groups to energy or nutrient intake [8].

As you know, the amount of glycogen is crucial for the energy security of footballers. Clark showed that the dose of carbohydrates necessary for the most effective glycogen resynthesis after intense football training should be 7-10 g / kg bw / day [9]. It is glucose stored in the form of glycogen in the liver and, above all, in skeletal muscles that plays a very important role.

Although protein itself does not play a significant role in covering the energy needs of footballers, its adequate supply in the diet is essential. According to Tarnopolsky [10], the minimum dose of protein necessary to optimize muscle regeneration after training should be 0.8 g / kg bw / day. An individual with average physical capacity, who is not a competitive athlete, should consume protein in the amount of about 1 g / kg bw / day, which is commonly called "functional protein minimum", while approx. 0.5 g / kg body weight / day must be consumed in the form of animal protein [11].

Fats in a footballer's diet do not play a key role, however, as approximately 60% of the distance during a match is covered by a player jogging or walking, and then the energy is obtained mainly through oxygen metabolism, fats may be useful [6, 12]. The rate of fat consumption is influenced by the intensity and duration of exercise, as well as the ease of their mobilization and oxidation [13]. Due to the fact that fats have a high energy value, they are a good energy supplier.

Research methodology

Objective

Footballers aged 17 years old should be aware that nutrition is an important element of their development and physical condition, the more that the club conducts lectures on this subject from time to time. The aim of the study was to assess the method and quality of nutrition of young football players and the impact of nutrition on VO2max, power, heart rate and somatic parameters.

Material and Methods

19 players from one of the Warsaw clubs participated in the study. Each of them has been playing for the club for at least 2 years. The competitors were healthy, they had no contraindications to sports, they were 17 years old, and their average body weight was 68.6 (± SD 7.8) kg. The competitors were acquainted with the purpose of the research and each participated in the observation voluntarily and voluntarily. Participants were allowed to stop participating in the studies at any time. Each of the subjects also received detailed instructions and tables helpful for describing the quantity and quality of eaten food in a food diary, in which he was to accurately describe his diet, which he maintained for 14 consecutive days. For this purpose, the respondents were given special scales intended for weighing food with an accuracy of ± 2g. Subsequently, the quantitative and qualitative dietary data obtained in the observed people (on the basis of 14-day dietary records supplemented with a detailed interview) were compiled using computer programs (including the "Aliant" program) and energy and nutrition tables, in terms of their global calorific value and the weight, percentage and caloric content of proteins, fats and carbohydrates in them. Relevant daily data was obtained from the menus prepared in this way. Then, the actual research began. Each competitor underwent a body composition analysis on a professional TANITA TBF300 device. Then, each competitor performed an endurance test using the direct method using a Cyclus 2 cycloergometer and a Fitmate PRO analyzer. The study was as follows. Before the test, the competitors' resting heart rate was measured in a sitting position, then, after a 5-minute warm-up, the competitors performed an exercise test starting with a 60 Watt load, then the load increased by 30 Watt every 2 minutes, until complete fatigue and refusal. During the test, indicators such as VO2max, breaths / minute, maximum minute ventilation of the lungs, maximum heart rate and workload in Watt were monitored.

Statistical Analysis methods

Descriptive statistics are presented as mean (standard deviation), median (interquartile range). The Shapiro-Wilk test was utilised to verify the normality of the distribution of continuous variables. Groups were compared using the Pearson correlation or Spearman's rank correlation. The results are presented with correlation coefficient. All data were analysed using R software, version 3.6.3 (The R Foundation for Statistical Computing)

Results

Haracteristics of the group

Parameters such as: Total number of kilocalories consumed in 2 weeks [kcal]; Average daily value of consumed kilocalories [kcal]; Average daily amount of carbohydrates consumed [g] and Average daily value of carbohydrates consumed [kcal] are significantly correlated with all the variables at the level of the average fit. It turns out that only the percentage of water has an inverse correlation. The obtained results indicate that with the increase in calories and nutrients, the percentage of water in the body decreases. In other cases, increasing the amount of calories consumed is associated with an increase in BMI, fat content, lean body mass and muscle mass.

Tab. 1. Correlation analysis: BMI, body fat, lean body mass, muscle tissue and body water results against the results of the diet

Zmienna	Total number of calories consumed in 2 weeks [cal]	Average daily value of consumed kilocalories [cal]	Average daily amount of protein consumed [g]	Average daily amount of fat consumed [g]	Average daily amount of carbohydrates consumed [g]	Average daily value of consumed protein [kcal]	Average daily value of fat consumed [kcal]	Average daily value of carbohydrates consumed kcal	Average daily value of consumed protein [%]	Average daily value of fat consumed [%]	Average daily value of carbohydrates consumed [%]
BMI [kg/m2]	0,53	0,50	0,31	0,07	0,62	0,31	0,08	0,62	0,32	-0,34	0,17
Body fat [%]	0,55	0,54	0,30	0,09	0,68	0,30	0,10	0,68	0,29	-0,35	0,20
Body fat [Kg]	0,59	0,58	0,34	0,12	0,69	0,34	0,12	0,69	0,38	-0,34	0,17
Lean body mass [Kg]	0,58	0,56	0,43	0,19	0,57	0,43	0,20	0,57	0,29	-0,23	0,00
Muscle tissue [Kg]	0,58	0,56	0,43	0,19	0,57	0,43	0,20	0,57	0,29	-0,23	0,00
Body water [Kg]	0,58	0,56	0,43	0,19	0,57	0,43	0,20	0,57	0,29	-0,23	0,00
Water content [%]	-0,55	-0,54	-0,30	-0,10	-0,67	-0,30	-0,10	-0,67	-0,30	0,34	-0,20

Significant correlation marked in red (p<0,05)

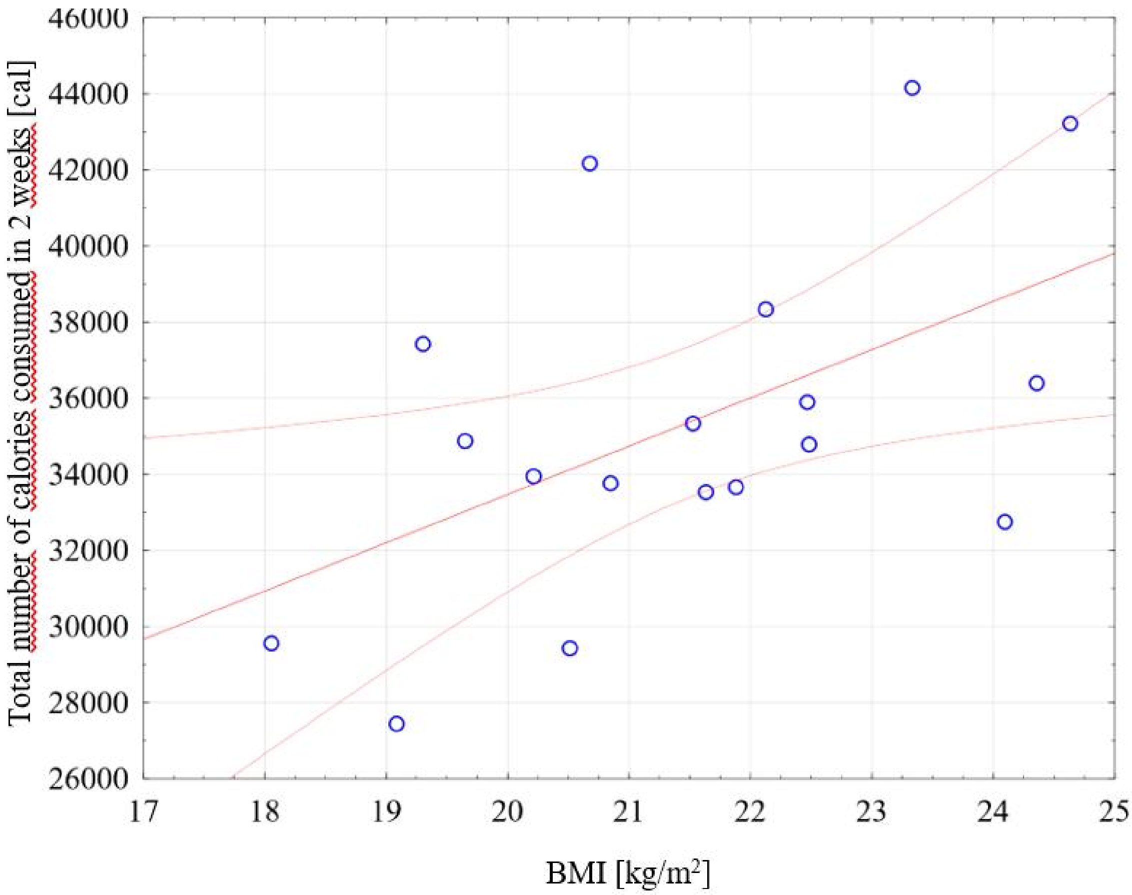

Fig. 1. Correlation of the BMI index to total number of calories consumed in 2 weeks [kcal]

Respiratory ventilation and maximum load

VO2max did not correlate with any of the dietary parameters as did the number of breaths per minute. Significant correlations, however, apply to the maximum load measured in watts with respect to parameters such as:

- Total number of kilocalories consumed in 2 weeks [kcal];
- Average daily value of consumed kilocalories [kcal];
- Average daily amount of carbohydrates consumed [g];
- Average daily value of consumed fat [kcal];
- Average daily value of carbohydrates consumed [kcal]; The above correlations range from 0.47 to 0.58, which means the average level of fit.

Maximum minute ventilation correlates with four dietary parameters, i.e .:

- Total number of kilocalories consumed in 2 weeks [kcal]
- Average daily amount of protein consumed [g]
- Average daily value of consumed protein [kcal]
- Average daily value of consumed protein [%] The above correlations range from 0.49 to 0.64, which means the average level of matching.

Tab. 2. Correlation analysis: VO_{2max}, Maximum load, Maximum respiratory minute volume, Number of breaths [1/min] results against the results of the diet

Zmienna	Total number of calories consumed in 2 weeks [cal]	Average daily value of consumed kilocalories [cal]	Average daily amount of protein consumed [g]	Average daily amount of fat consumed [g]	Average daily amount of carbohydrates consumed [g]	Average daily value of consumed protein [kcal]	Average daily value of fat consumed [kcal]	Average daily value of carbohydrates consumed kcal	Average daily value of consumed protein [%]	Average daily value of fat consumed [%]	Average daily value of carbohydrates consumed [%]
VO_{2max}	0,01	0,02	0,13	-0,03	-0,03	0,13	-0,01	-0,03	0,23	-0,07	-0,07
Maximum load [W]	0,58	0,57	0,26	0,46	0,50	0,26	0,47	0,50	0,21	0,11	-0,10
Maximum respiratory minute volume	0,49	0,47	0,64	0,35	0,21	0,64	0,36	0,21	0,57	0,05	-0,43
Number of breaths [1/min]	0,08	0,08	0,28	0,15	-0,11	0,28	0,16	-0,11	0,32	0,09	-0,31

Significant correlation marked in red ($p<0,05$)

Heart rate

Heart rate results in most cases, when correlated with dietary parameters, produce an inversely proportional fit. Resting heart rate (HR) correlates with eight of the eleven deictic parameters, giving a level of compliance in the range of -0.48 to -0.73. The maximum heart rate correlates with Average daily carbohydrate intake [g] ($r = -0.62$) and with Average daily carbohydrate intake [kcal] ($r = -0.62$). Heart rate 30 seconds after the end of exercise (HRR) and the amount of change in this heart rate correlate with variables such as:

• Total number of calories consumed in 2 weeks [kcal];
• Average daily value of consumed kilocalories [kcal];
• Average daily amount of carbohydrates consumed [g];
• Average daily value of carbohydrates consumed [kcal];

In the case of post-exercise heart rate (HRR), the correlations obtained are inversely proportional, which means that the obtained result is the smaller the more calories consumed by the subjects. These results range from -0.55 to 0.80. In the case of the size of the change in heart rate after exercise, its size is greater the more calories and nutrients are consumed by the test subjects. These correlations are then proportional. These results range from 0.52 to 0.75.

Tab. 3. Correlation analysis: HR, HRmax, HRR after 30sek, HR change - after 30sek. results against the results of the diet

Zmienna	Total number of calories consumed in 2 weeks [cal]	Average daily value of consumed kilocalories [cal]	Average daily amount of protein consumed [g]	Average daily amount of fat consumed [g]	Average daily amount of carbohydrates consumed [g]	Average daily value of consumed protein [kcal]	Average daily value of fat consumed [kcal]	Average daily value of carbohydrates consumed kcal	Average daily value of consumed protein [%]	Average daily value of fat consumed [%]	Average daily value of carbohydrates consumed [%]
HR [1/min]	-0,73	-0,71	-0,48	-0,67	-0,50	-0,48	-0,67	-0,50	-0,27	-0,26	0,32
HR max. [1/min]	-0,45	-0,42	-0,06	-0,07	-0,62	-0,06	-0,07	-0,62	-0,14	0,23	-0,28
HRR - after 30sek. [1/min]	-0,57	-0,55	-0,13	-0,07	-0,80	-0,13	-0,07	-0,80	-0,10	0,36	-0,37
HR change - after 30sek. [1/min]	0,52	0,53	0,19	0,04	0,75	0,19	0,04	0,75	0,23	-0,43	0,36

Significant correlation marked in red (p<0,05)

Discussion

Football players are one of the athletes who are required to be in top form at all times. It is extremely difficult, and one of the ways to stay fit are so-called invisible strategies to help optimize the health and performance of athletes [14]. Proper nutrition is one of the key elements influencing physical parameters during competitions and improving post-workout regeneration [15]. Nutritional education is very important for young athletes, including special programs to help target groups change their eating habits and / or deepen their nutritional knowledge, especially since athletes often use dietary supplements [16, 17]. According to research, popular supplements and the time of taking them affect the condition of footballers but it takes time to take electrolytes no effect on the fitness of the players [17]. In turn, improving eating habits may improve the performance of team athletes [18, 19]. Only a few studies are available that investigate the effects of the football season on anthropometry, body composition and fitness in elite young footballers [20, 21]. In line with the relevant literature [22, 23, 24, 25], we hypothesized that (i) football training (and / or growth / adolescence) contribute to changes in body composition and physical fitness during the football season as required by the appropriate training period, and (ii) the amount of different types of training / individual playing time is significantly related to the relative changes in the respective components of the body composition and physical fitness of young footballers. One study found large differences in training data and performance data, as well as anthropometry and body composition in elite youth footballers who finished the season as national champion under 17. In addition, body composition (i.e. lean body mass, body fat mass) varied according to the requirements of the respective training periods. Moreover, the anthropometry (ie body height) changed due to maturation during the season [26, 27]. Diet plays a very important role in this.

Conclusion

The conclusions that can be made based on the results are as follows:

1. A higher body mass index and a higher fat content (relative and absolute) as well as dry mass and muscle mass and water are on average correlated with the amount of calories consumed during the 2nd week and the daily average, as well as with the amount of carbohydrate intake in the diet - these are carbohydrates mainly influenced by the mass of people.
2. Maximum power and maximum minute ventilation depend on the amount of calories and protein intake - it may be directly related to the greater demand by the body, which also dictates a larger chest (lung volume);

3. Dietary parameters do not affect VO2max as well as the number of breaths per minute - this is confirmed by the fact that the maximum minute volume depends on the size of the chest of "larger" people.
4. The resting heart rate is lower the more calories are consumed by the subjects in various forms;
5. The size of the decrease in HR after 30 seconds after exercise depends on the amount of calories, especially carbohydrates.

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