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Original article

Effects of nutritional periodization on the body composition of middle-distance runners from Djibouti

Efectos de la periodización nutricional en la composición corporal de corredores de media distancia de Djibouti

Efeitos da periodização nutricional na composição corporal em corredores de média distância do Djibutiano

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ABSTRACT

Introduction: Body composition is a fundamental indicator to define the nutritional status of the runner.
Objective: The study aimed to evaluate the effects of the nutritional periodization intervention on the body composition of elite junior Djiboutian runners in middle distance.
Materials and methods: The sample consisted of 22 male runners, aged between 16 and 18 years. For the assessment, an experiment consisting of 11 subjects in the control group and 11 in the experimental group was designed. As anthropometric measurements, weight, height and six adipose tissue were taken to evaluate the percentage of fat, adiposity index, body mass index and active body substance index, since, in order to monitor the proposed intervention, an interview of reminder 24 hours seven days.
Results: A periodized diet was designed, with the manipulation of carbohydrates. Nutritional periodization with high and low carbohydrate intake for 12 weeks significantly ($p<0.05$) decreased percentage fat without altering body weight or active body substance index in juvenile middle-distance Djiboutian runners from the experimental group.
Conclusions: The exposed results contribute to improve the biomedical control of training in elite junior middle-distance runners in Djibouti, since there were data limitations on their body composition and the effect that periodized nutrition could have on these indicators.

Keywords: Nutritional periodization; Body composition; Runners; Middle distance.

RESUMEN

Introducción: La composición corporal es un indicador fundamental para definir el estado nutricional del corredor.
Objetivo: El estudio tuvo como objetivo evaluar los efectos de la intervención de periodización nutricional en la composición corporal de corredores juveniles djiboutianos de élite en distancia media.
Materiales y métodos: La muestra fue de 22 corredores masculinos, en edades comprendidas entre 16 y 18 años. Para la valoración, se diseñó un experimento constituido por 11 sujetos en el grupo control y 11 en el experimental. Como mediciones antropométricas se tomaron el peso, estatura y seis panículos adiposos para evaluar el porcentaje de grasa, índices de adiposidad, índice de masa corporal y el de sustancia corporal activa pues, para llevar el seguimiento de la intervención propuesta, se realizó una entrevista de recordatorio 24 horas de siete días.
Resultados: Se diseñó una dieta periodizada, con la manipulación de los carbohidratos. La periodización nutricional con alta y baja ingesta de carbohidratos durante 12 semanas disminuyó significativamente ($p< 0,05$) el porcentaje de grasa, sin alterar el peso corporal ni el índice de sustancia corporal activa en los corredores djiboutianos de media distancia juveniles del grupo experimental.
Conclusiones: Los resultados expuestos contribuyen a mejorar el control biomédico del entrenamiento en los corredores de élite juveniles de distancia media en Djibouti, ya que existían limitaciones de datos sobre su composición corporal y el efecto que pudiera tener la nutrición periodizada sobre esos indicadores

Palabras clave: Periodización nutricional; Composición corporal; Corredores; Media distancia.

SÍNTESE

Introdução: A composição corporal é um indicador chave na definição do estado nutricional do corredor.
Objetivo: O estudo visava avaliar os efeitos da intervenção de periodização nutricional sobre a composição corporal em corredores de elite júnior djibutianos de meia distância.
Materiais e métodos: A amostra consistiu de 22 corredores masculinos, de 16-18 anos de idade. Para a avaliação, foi projetado um experimento com 11 sujeitos no grupo de controle e 11 no grupo experimental. Como medidas antropométricas, foram tomadas medidas de peso, altura e seis panniculi adiposos para avaliar a porcentagem de gordura, índices de adiposidade, índice de massa corporal e índice de substância corporal ativa. Para acompanhar a intervenção proposta, foi realizada uma entrevista de lembrete de sete dias, 24 horas por dia.
Resultados: Foi projetada uma dieta periódica, com a manipulação de carboidratos. A periodização nutricional com alta e baixa ingestão de carboidratos por 12 semanas diminuiu significativamente ($p<0,05$) o percentual de gordura, sem alterar o peso corporal ou o índice de substância corporal ativa em corredores djibutianos juvenis de meia distância no grupo experimental.
Conclusões: Os resultados acima contribuem para melhorar o monitoramento biomédico do treinamento em corredores de elite de distância média júnior em Djibuti, já que havia limitações de dados sobre sua composição corporal e o efeito que a nutrição periodizada poderia ter sobre esses indicadores.

Palavras-chave: Periodização nutritiva; Composição corporal; Corredores; Distância média.

INTRODUCTION

In recent decades, there has been an increase in the number of publications related to sports nutrition research. Sterllingwerff *et al* (2019) state that sports nutrition is a dynamic area of science applied to sports that continues to grow with technical scientific development.

From the position of the *World Athletics,* formerly the *International Association of Athletics Federations (IAAF)*, Burke *et al.* (2019) emphasize a new area of study related to nutritional periodization in high-performance athletes. In this way, Jeukendrup (2017) explains in depth that there are various methods of nutritional periodization with different physiological objectives: training of the digestive system, dehydration, supplements, training with high intensity and high availability of carbohydrates or training with low to moderate intensity and Limited carbohydrate availability. The term nutritional periodization is applied in sports nutrition to plan and structure nutritional guidelines appropriate to the demands of exercise over a prolonged period of time. Periodized nutrition is described as a structured and planned nutritional strategy that combines physical training and nutrition with the aim of generating different adaptations that favor long-term sports performance (Burke *et al.,* 2019; Jeukendrup, 2017).

At present, intervention studies are fundamentally directed at training with high or low availability of carbohydrates to find effects of nutritional periodization on body composition (BC); this is because WC is a fundamental element to define the nutritional status of elite middle-distance runners. However, Stellingwerff *et al.* (2019, p. 112) state that "there is very little scientific information on how to optimally implement interventions around the periodization of body composition throughout a given year or during a season".

In accordance with the statement of Heikura *et al.* (2018), available studies on nutritional periodization methods are limited to team sports and endurance athletes, who have provided a snapshot of the micro and mesocycle during phases of training or competition. On the other hand, Tur (2019) developed a research on the effect of nutritional periodization in high-performance cyclists on the effects that periodization has on the body composition and performance of cyclists.

One limitation of the existing consensus documents on nutritional periodization methods in athletes is the scant data information on African runners, particularly from the East African area (Ethiopia, Kenya, Eritrea and Djibouti) where the best runners of the world in medium distance, from 1960 to the present are found; hence Mohamed *et al.* (2022) raised the need to collect novel study-based data on African and particularly Djiboutian athletes, to assess and possibly improve the applicability of current recommendations to elite athletes.

Similarly, there is no research on the body composition of East African middle-distance runners to assess the impact of nutritional periodization on its components during a competitive season. Thus, the study of the fitness of these athletes is limited due to lack of information that allows analyzing how the adaptive processes of the best exponents of this sport at an international level take place.

To design the nutritional periodized intervention, the IAAF consensus document (2007) was used, as well as the most recent Word Athletic consensus on nutritional periodization (Burke *et al.,* 2019). In addition, the consensus of the International Olympic Committee on carbohydrate intake in relation to training load was taken into account (Maughan and Burke, 2010); the approaches of Stellingwerff *et al.* (2019) on nutritional periodization at different stages of training for middle-distance runners, applying the criteria of high and low carbohydrate intake outlined by Jeukendrup (2017).

The main purpose of this study is to evaluate the effects of an intervention through nutritional periodization on the body composition of Djiboutian runners of the junior middle-distance national team.

MATERIALS AND METHODS

The research presents a quasi-experimental study design, inserted in a quantitative paradigm. The sample consisted of 22 male runners, aged between 16 and 18 years, where the experimental group (EG) was made up of 11 runners, another 11 made up the control group (CG). The inclusion in each group depended on the probabilities when classifying for each group, the one who selected an even (EG) or odd (CG) number.

Regarding the experiment, a nutritional periodization intervention was carried out for 12 weeks in which the experimental group was given a low diet and a high intake of carbohydrates [CHO] in a periodized manner, unlike the control group that consumed regular diets without any type of diet. of intervention. Both groups performed the same training designed by the trainer. Annexes 2 and 3 show examples of nutritional menus of the day, of high training load of the experimental group with nutritional periodization and of the control without nutritional periodization.

For the assessment of body composition in both groups (EG and CG), the *Withers method was used,* from which the estimate of kilograms of active body mass was obtained to get the Active Body Substance Index (AKS*,* in its German initials) from Tittel and *Wutscherk*. Previously, the adiposity index ("6pl) was obtained by adding the subscapular, triceps, supraspinal, abdominal, thigh and leg panniculus. The Body Mass Index (BMI) was also calculated for its assessment. Measurements were made first thing in the morning, always in the same place and under temperature and relative humidity controls.

Along the same lines, after getting the subjects of the study aware about the content of it through an informative talk, in the first week the data of anthropometric measurements of the pretest were obtained, and to follow up the intervention, a reminder interview was carried out 24 hours (R24) for seven days and repeated after every 3 weeks, see (Appendix 4). This interview consisted of defining and quantifying all the meals during the previous period of the interview and then using dietopro.com nutritional calculation software, in collaboration with the sports doctor of the study group in order to compare the results of the pretest and post-test data at the end of week 12. The data collection was carried out, the anthropometric instrument integrated by the Slim Guide caliper with a precision of ± 1 mm was used to evaluate the thickness of the skinfolds, a Tanita BF679 digital scale with a precision of ± 100 g, for body weight, a stadiometer SECA 213 with precision ± 1 mm for height and metallic GULICK anthropometric tape with precision ± 1 mm. to record the circles. Anthropometric measurements were performed according to the protocol of the International Society for the Advancement of Kinanthropometry.

For the statistical analysis, the statistical package IBM SPSS version 21.0 was used. The mean was used as a measure of central tendency, while the standard deviation was used as a measure of dispersion. This relationship was expressed as X±SD. To compare the pretest characteristics between the two groups, the Mann-Whitney U test for independent samples was used; Wilcoxon's rank test was applied to compare differences between pretest and posttest within each group.

RESULTS AND DISCUSSION

One Week Total Carbohydrate Intake Results

Figure 1 shows the results of the 24-hour recall interview (R24) of the total carbohydrate intake of seven days, precisely the third week of the intervention, according to the periodization adjustments. It was observed that the experimental group had an increase in CHO intake to sustain a high training load between 8.7 and 10.4 g/kg weight/day); for its part, the control group had an intake between 7.9 and 8.2 g/kg weight/day (Figure 1).

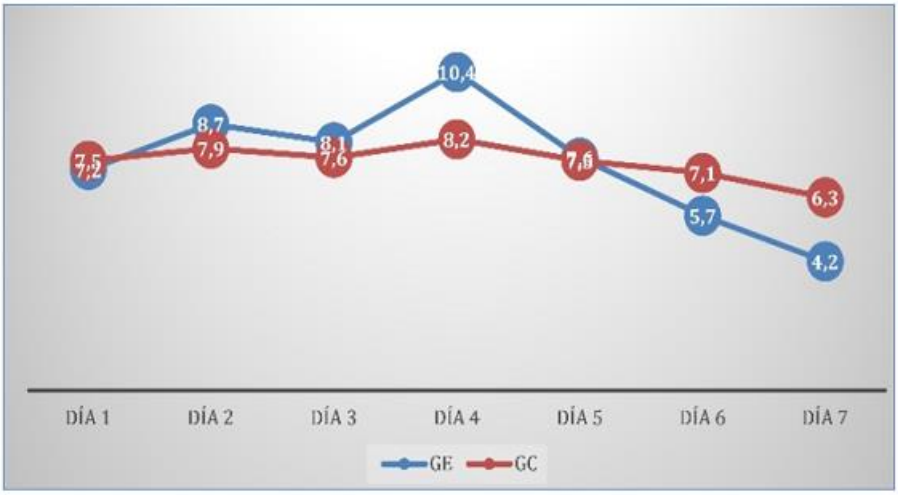

Fig. 1. - Results of total carbohydrate intake (g/kg weight/day) for one week
Note: EG: experimental group; CG: control group.

When comparing these results of (R24) with the recommendations of the International Olympic Committee (Maughan and Burke, 2010), the members of the control group showed intake levels at the limit of the IOC recommendations that suggest between 8 to 12 g/kg weight/ day for these athletes.

From the above, it can be deduced that the nutritional intervention applied in the experimental group took into account the training load, that is, it was periodized by applying the methods of high and low intake of CHO, both on days with very high and high training load. This was consistent with the results of Canadian, American, and Finnish junior middle-distance runners who developed this strategy, as reported in two articles by Heikura *et al.* (2018). On the other hand, the control group constantly maintained their high CHO availability diet, which coincided with studies carried out in Kenyan runners who had a diet based on the consumption of high levels of carbohydrates, between 70-77% of their diet daily (Christensen *et al.,* 2002; Onywera *et al.,* 2004).

Comparative results of the body composition of the pretest with the posttest in the groups studied

The assessment of body composition in both groups (GE and CG) followed the criteria of Carvajal *et al.* (2019), so the Withers method was used. Based on this method, the comparative results of the pretest body composition of the study groups were similar and did not present significant differences ($p<0.05$) in body weight, height, body mass index, adiposity index, percentages of fat and active body substance index (Table 1).

Table 1. - Body composition results of pre-test with post-test of the study groups

Parameters	pre-test	post-test	pre-test	post-test
	Cluster Experimental		Cluster Control	
Age (years)	17.12		17.36	
Weight(kg)	57.6±2.1	56.2± 1.6ns	57.2±1.8	55.5± 1.1ns
Height (cm)	172.3±4.1		173.2±3.3	
∑ 6pl (mm)	34.3±1.26	30.2±0.96*	33.4±1.08	32.2± 1.31ns
BMI (kg/ m^2)	19.4	18.9	19.1	18.5
% Fat	5.90±0.81	5.33±0.65*	5.78±0.92	5.68± 0.73ns
AKS(g/cm^3)	1.06±0.02	1.04± 0.05ns	1.04±0.03	1.00± 0.06ns

Note: ns, not significant; ***,** statistically significant differences for p<0.05
Body Mass Index (BMI); Active Body Substance Index *(AKS);* " 6pl.: adiposity index.

In research with Spanish athletes, Sánchez *et al.* (2003) determined the anthropometric profile of young elite middle-distance runners in the youth category (Age: 16.17 years, Weight: 57.43 kg, Height: 170.23 cm). Compared to this study, it is observed that the Djibouti runners had a slightly higher average age, their height was between 2 and 3 cm. higher, while body mass tends to be lower.

Posttest body composition results for both the experimental and control groups did not show significant changes in body weight when compared to the pretest (p<0.05). However, regarding adiposity index and fat percentage, a significant decrease was observed only in the experimental group (p<0.05). On the other hand, the values of the active body substance index (AKS) for both groups did not present significant differences (p<0.05).

Compared with the Cuban runners studied by Carvajal *et al.* (2018), there are similarities regarding the adiposity index ("6pl=36.5mm) and differences regarding the percentage of fat (%g=7.3) and active body substance index (AKS=1.08g/cm^3). These average differences are given by a higher average body weight (weight=58.5kg) and a lower average height (170.0cm) of the Cubans.

In three reports by Sterllingwerff *et al.* (2018, 2019) in both sexes, the limited ranges of body adiposity of elite middle-distance runners were pointed out: men are between 4 % and 6 % of body fat (30 to 40 mm in total of eight folds) in high season of competition. When comparing with the indicated researches, the studied sample was found within these ranges, but the difference arises from the sum of the skinfolds given in these investigations by eight and not by six skinfolds.

In both groups, the values of the Body Mass Index (BMI) behave in the normal range, both at the beginning and at the end of the nutritional intervention; however, the limited information provided by this indicator in athletes is corroborated, since it does not discriminate between the modifications between one component and another of the total weight, nor the adaptations of lean mass to training loads (León Pérez *et al.,* 2019).

The present study was limited to the male sex, so future nutritional periodization research should focus on the study of female athletes, being conservative in the lower age groups due to the possible imbalances that these experiments could bring to growth and development, if the studies are not carried out adequately in each case.

CONCLUSIONS

To conclude, the data obtained in post-test show that nutritional periodization, specifically with high and low carbohydrate intake for 12 weeks, significantly decreased the adiposity index and the percentage of fat, without affecting body weight and mass index. active body in the young Djiboutian middle-distance runners of the experimental group, which represents a positive effect of nutritional periodization in these athletes.

The exposed results contribute to improve the biomedical control of training in elite junior middle-distance runners in Djibouti, since there were data limitations on their body composition and the effect that periodized nutrition could have on these indicators.

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Contribución de autoría:
Gohar Mohamed Gohar: Concepción de la idea, búsqueda y revisión de literatura, confección de instrumentos, aplicación de instrumentos, recopilación de la información resultado de los instrumentos aplicados, análisis estadístico, confección de tablas, gráficos e imágenes, confección de base de datos, redacción del original (primera versión), traducción de términos o información obtenida, revisión de la aplicación de la norma bibliográfica aplicada.

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