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Research Article

Nutritional Aspects in Ultra-Resistance Athletes: An Integrative Review

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ABSTRACT

Ultra-resistance exercise is classified as a prolonged activity lasting more than 4 hours, and most commonly involves activities such as running, swimming in open water and cycling. Due to the fact that ultra-resistance exercises demonstrate great physical and mental wear to the athlete, nutrition, and the use of an appropriate strategy, demonstrates a significant role in performance, and in preventing the impacts generated on athletes' health. The objective was to understand the nutritional aspects surrounding the exercise of ultra-resistance. To this end, an integrative literature review was carried out, selecting articles available in the databases, medical literature analysis and retrieval system online-medline, national center for biotechnology information NCBI, scientific electronic library online scielo, using the keywords exercise, resistance, nutrition, energy, exercise, ultra-endurance, nutrition and training and as an inclusion criterion studies that were within the 2013-2018 period, in english, spanish and portuguese, and exclusion articles and research were used in animals and repeated. A total of 106 articles were found, of which 12 met the pre-established criteria. Based on the studies carried out, it was possible to identify the metabolic and physiological changes generated by an activity of ultra-resistance, verifying that nutrition can bring positive and negative aspects. Although the available studies present reduced samples when compared to practitioners of other types of physical activity. Beneficial results were attempted with the use of specific nutritional strategies before, during and after these types of activities.

Keywords: Nutrition; Ultra-resistance; Long duration; Physical exercise; Athletes

INTRODUCTION

Ultra-resistance exercise is classified as a prolonged activity lasting more than 4 hours, and most commonly involves activities such as running, swimming in open water and cycling. These types of events are gaining more and more popularity among recreational and professional athletes [1,2].

The increase in oxygen demand, lactate production, maximum power and movement economy are important physiological variables that influence performance in resistance activities [3,4]. The duration, intensity and environmental conditions found in these types of ultra-resistance tests combine, forming several physiological stresses, much greater when compared to the short-duration tests [5]. Changes such as body temperature, blood volume, glycogen levels, blood glucose concentrations and in cases of high altitudes tissue oxygenation are common due to the stimulus generated during this type of activity [6].

A high energy demand, accompanied by the physiological stress of exercise is the most important aspects that must be considered in nutrition [7]. Ultra-resistance exercises generate a very high energy deficit, where the energy needs exceed the intake, which can cause exhaustion [8]. Another aggravating nutritional factor is dehydration 2% to 5% of the loss of body water, due to the increase in metabolism in exercise and heat production, thus causing a higher rate of sweating and a drop in the concentration of plasma sodium [2].

Meeting the nutritional and fluid demands is the first priority in these athletes in order to improve performance and recovery. Guidelines currently recommend carbohydrates as the main source of energy consumed before and during ultra-resistance

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tests in order to maintain endogenous levels of muscle and liver glycogen, also contributing to the maintenance of blood glucose levels [2]. A change in body composition is also very common among these athletes, considering that there is a loss of body mass, it is evident that a poor nutritional strategy together with inadequate hydration (hyper hydration or hypo hydration) can bring a series of consequences, among them hypernatremia, characterized by a low concentration of sodium in the plasma.

In view of this evidence, a series of questions arose about what would be the role of nutrition in relation to the physiological responses generated by ultra-resistance exercise, and if it shows significant results in performance and prevention of damage to the athlete.

As a hypothesis, due to the fact that ultra-resistance exercises demonstrate great physical and mental wear to the athlete, nutrition, and the use of an appropriate strategy, demonstrates a significant role in performance, and in preventing the impacts generated on the athletes' health.

Thus, this research is justified by presenting a non-drug alternative in improving the performance and health of athletes, being relevant for providing direct health benefits, as well as representing a strategy for better performance in sports. Thus, the present study aimed to investigate through a bibliographic survey involving nutritional aspects in ultra-resistance athletes.

MATERILAS AND METHODS

Type of study

For the development of this study, an integrative literature review was used. Where the identification of studies on nutritional aspects in ultra-resistance athletes was sought.

Location and period

The selection of the articles used was carried out, initially, by a previous reading of the abstract and methodology, in order to investigate its relationship with the theme, and then proceed to read the entire article.

The scientific survey was carried out between April and October 2018 in the following databases: Scientific Eletronic Library Online (SciELO) and medical literature analysis and retrieval system on-line (Medline) from 2013 to 2018, in english is Portuguese. Based on the theme: Nutritional aspects in ultra-resistance athletes, it was used as descriptors indexed and registered in the database descriptors in sciences and health, in the languages of english and Portuguese, physical exercise, athletes, nutrition, long duration, ultra-resistance, exercise, athletes, ultra-endurance and nutrition, combined.

Data collect

The following guiding question was considered: What are the nutritional aspects and physiological changes involved in ultra-resistance athletes? As inclusion criteria, we opted for articles or publications on clinical studies, published in english, spanish and portuguese, published in the last 5 years and that answered the guiding question. All articles and experimental studies, articles that after reading the abstracts did not correspond to the theme and repeated articles were excluded.

In the search, 19 articles were obtained from SciELO, and 87 from MEDLINE totaling 106, after applying the filters, SciELO articles went to 6 and MEDLINE 37, of which 63 did not meet the criteria. After reading the titles and abstracts, 34 articles were pre-selected and read in full. Of these, 26 made up the final sample of the review. Scheme detailed in Figure 1.

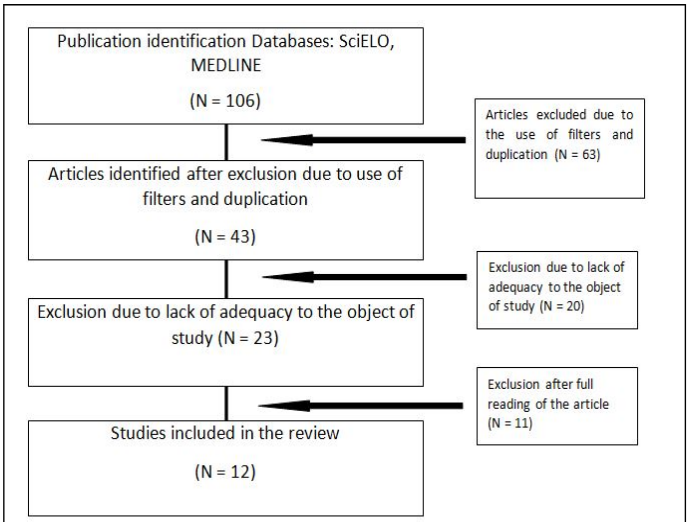

Figure 1: Flowchart of the main stages of the integrative review.

RESULTS

All 12 selected articles were published in english. Through Tables 1 and 2, the characteristics of the articles included in the study can be observed, and it is possible to observe the information of the authors, year of publication, objective, sample and primary result of the study, on the nutritional physiological effects and nutritional aspects in ultra-athletes resistance.

The results showed that the practice of this type of exercise, can cause a series of physiological changes, related to the stress generated during long term exercise and nutrition, demonstrating a fundamental role, which can highlight as most pointed out: Changes in specific inflammatory markers and strategies nutrition with direct link in a better performance, simultaneously with the reduction of the damages caused and a better recovery.

Table 1: Studies related to physiological effects generated by the practice of ultra-resistance exercises.

Author/year/database	objective	Participants	Primary
Bach, et al./MEDLINE	Investigate blood glucose kinetics and the physiological effects experienced by a type 1 diabetic in an ultra-resistance (UR) triathlon	1 adult, male	The athlete passed had fluctuations between hyper and hypoglycemic state during the 3 stages of the race, there was also a significant increase in creatine kinase (CQ), cortisol, C-Reactive Protein (CRP) and aldosterone.
Gill, et al./MEDLINE	Determine as concentracoes circulantes de endotoxinas, o perfil de citocinas e os sintomas gastrointestinais nos corredores de UR.	17 adults, both sexes	24 hours of an ultra-marathon resulted in circulatory endotoxin and pro-inflammatory cytokinesis, neutralized by a compensatory anti-inflammatory response.
Papadopoulou, et al./MEDLINE	Investigate and evaluate the nutritional practices of open water swimmers, during the preparation and competition period, and implications for performance, anthropometric parameters according to their age.	36 adults, male	Significant differences were found in relation to BMI and other anthropometric data when compared to the pre-competition period, followed by a significantly negative energy balance.
Rama, et al./MEDLINE	Examine and compare changes in resting hematological variables in UR runners in a competition.	19 adults, both sexes	Linear increases were observed for leukocytes, monocytes and lymphocytes; Granulocytes showed a growth exponent. Hemoglobin and hematocrit showed linear decreases in all competition. There were no changes in erythrocytes and platelets.
Ramos-Campos, et al./MEDLINE	Determine the biochemical and physiological changes in runners after an UR test.	11 adults, male	After the run, the concentration of myoglobin and QC, troponin I and lactate dehydrogenase increased. Platelet and leukocyte counts also increased, in addition, after the competition, the athletes had a negative energy balance of 3704 kcal.

Abbreviations: UR: Ultra-Resistance; CQ: Creatine Kinase; PCR: C-Reactive Protein; BMI: Body Mass Index; Kcal: calories.

Table 2: Studies related to nutritional aspects and nutritional strategies used in the practice of ultra-resistance exercises.

Author/year/database	objective	Participants	Results
Birkenhead, et al./MEDLINE	Describe the changes in diet throughout the life of UR practitioners and the relationship between diet and physical activity.	120 adults, both sexes	There was a positive correlation between UR exercise and consumption of vegetables and fruits throughout life.
Kumstat, et al./NCBI	Provide new ideas, describing the feeding strategies adopted by an elite swimmer at the Grand Prix in open water.	1 adult, female	It was established that the continuous intake of high doses of CHO and sodium and moderate dose of caffeine were an essential part of the feeding strategy for the UR open water swimming competitions in the elite.

Martinez, et al./NCBI	Evaluate and compare the energy and water intake of participants in three UR runs.	213 adults, both sexes	There were no significant differences between competitions. A higher percentage of lipid energy in the trail and ultra-participants was found. Significant differences in water consumption per hour of competition, with the lowest value for consumption during competition.
Mccubbin; Cox; Broad./NCBI	Describe the nutritional plans, intakes and experiences of five ultramarathon runners who completed the des Sables marathon.	5 adults, male	The main problems encountered by runners included the difficulty of consuming food due to the taste of sweet foods (energy gels, sports drinks) when heated in the sun.
López-Gómez, et al./SCIELO	Describe the dietary, nutritional and detailed planning aspects of an ultra-strength athlete in a mountain race.	1 adult, male	Food and nutritional planning in UR events is important to successfully perform the competition, tolerating and consuming food/supplements properly, avoiding nutritional risk, dehydration, fatigue, GI disorders, etc.
Pedrinolla, et al./MEDLINE	To evaluate the metabolic, bioenergetic and psychological characteristics of a world record holder of UR during three different UR events characterized by different durations.	1 adult, male	The study shows how the walker was able to withstand the three different UR events characterized by different durations, applying physiological and psychological strategies that allow him to reach the goal of carrying out each UR event.
Volek, et al./MEDLINE	Estudar os efeitos metabólicos em uma dieta com baixo teor de CHO em atletas de UR.	20 adults, male	The peak of fat oxidation was higher in the LC group, and occurred in a higher percentage of VO_2 max. Mean fat oxidation during submaximal exercise was higher in the LC group, corresponding to a greater relative fat contribution.
Wilson,Rhodes, Ingraham./ MEDLINE	Quantify the sources of saccharide used during an UR triathlon and provide a resource for athletes who wish to manipulate the CHO saccharide content consumed during training and competition.	20 adults, both sexes	Twenty participants consumed ≥ 50 g/h of CHO during swimming and cycling, and significant correlations with GI discomfort within 1 mile of the run were found for glucose and fructose

DISCUSSION

In general, it is possible to observe that ultra-resistance exercises have metabolic and physiological effects that can lead to a series of adaptations and complications, when these types of activities are associated with recommended nutritional strategies, a better health response is perceived. And athlete's performance. In addition, it can be said that nutrition plays a fundamental role in protecting against the damage caused by this type of activity, combating factors such as negative energy balance, gastrointestinal changes and dehydration.

The use of nutrition and dietary strategies has become increasingly evident in ultra-resistance tests, where over the years the popularity and the number of registrations in these types of events have been growing [9].

Researchers found that there was a calorie deficit in all ultra-resistance athletes, with only one athlete consuming the adequate amount of carbohydrates and concluding that nutrition and intervention through qualified professionals have a guaranteed effect [10].

In an ultra-resistance triathlon race, athletes who reported consuming>50 g/hr of carbohydrates between swimming and

cycling had a positive correlation with gastrointestinal discomfort. Most of these foods and drinks consumed during the race did not contain an ideal saccharide profile. In addition, glucose intake was associated with greater gastrointestinal discomfort among participants who consumed a high carbohydrate rate [11].

Continuous intake of high doses of CHO and sodium and moderate dose of caffeine were an essential part of the feeding strategy for swimming competitions in elite high-intensity ultra-resistance open water [12].

Food and nutritional planning in ultra-resistance events is important to successfully perform the competition, tolerating and consuming foods/supplements properly, thus avoiding nutritional risk, dehydration, fatigue and gastrointestinal disorders [13].

A strong indication that the increase in performance and less damage caused to health in ultra-resistance competitions are linked to nutrition and specific nutritional strategies or managements. Recent studies suggest that the use of energetic substrates during a race can be preserved through low carbohydrate dietary supplements depending on the athlete's level and intensity [14]. Researchers observed that the peak of fat oxidation was higher in athletes who consumed a low-carbohydrate diet, countering a greater relative contribution of fat as an energy substrate [15].

In the study with the largest number of participants, it was found that there was no difference between the nutritional parameters used in each ultra-endurance test (marathon, trail and ultra) [16]. However, a higher consumption in the percentage of lipids was seen, in addition, a significant difference in water consumption was observed, especially during competition. Another observing factor was the question of the acceptance of nutritional strategies by athletes in terms of food choices and supplementation during the tests.

Another study with runners found the difficulty of consuming food, mainly due to the sweet taste of carbohydrate and energy gels exposed to heat. Researchers found there was a positive correlation between ultra-resistance exercises and the consumption of fruits and vegetables throughout life, characterizing an improvement in the quality of food consumption of these athletes [17].

When observing ultra-resistance activities with anthropometric parameters, results demonstrated that significant differences were found in relation to BMI and other anthropometric data when compared to the pre-competition period [18]. Stands out that there is severe malnutrition during the preparatory phase and during the ultra-endurance swimming event, in ultra-resistance swimmers.

In another study, there was an increase in the levels of creatine kinase, myoglobin, troponin I and lactate dehydrogenase increased, along with the platelet and leukocyte count, in addition, after the race, the athletes had a negative energy balance of 3074 Kcal. In this study, parameters were evaluated before, during and after the race, such as muscle damage, lactate concentration (during), energy balance, evaluation of perceived effort (PSE), Heart Rate (HR) (during), Heart Rate Variability (HRV) (during), changes in body composition and jumping performance.

Another survey observed linear increases for leukocytes, monocytes and lymphocytes; granulocytes also showed an increase, and hemoglobin and hematocrit showed a linear decrease, during a 5 days test, demonstrating an inflammatory reaction to tissue damage [19].

Within 24 hours of an ultra-marathon, the studies 21 resulted in circulatory end toxemia and pro-inflammatory cytokinesis, neutralized by a compensatory anti-inflammatory response [20,21].

CONCLUSION

Based on the studies carried out, it was possible to identify that metabolic and physiological changes are generated by an activity of ultra-resistance, observing that nutrition can bring both positive and negative aspects. Although the available studies present reduced samples when compared to practitioners of other types of physical activity. Beneficial results were attempted with the use of specific nutritional strategies in this type of activity. Further studies are needed to test the effectiveness of more individualized strategies, about a lesser impact generated by ultra-resistance exercises and improved athlete's performance.

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