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REVIEW ARTICLE

# Influence of the vegan diet on sports performance: Review article

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## ABSTRACT

Being healthy is a prerequisite for becoming a successful athlete. Most scientific evidence strongly associates a well-planned Vegan diet with health, successful body weight control, a preventive measure and, in some cases, the end and reversal of some of the most common noncommunicable chronic diseases. However, despite the solid health benefits of these diets, Vegan athletes are often confronted with prejudices for unfounded doubts and motives. Through the analysis of existing literature, the objectives of the present study were to explore the various advantages and risks of the Vegan diet for the health of sportsmen and women, whether in the context of competition or not and analyse the influence of this type of diet on the sports performance of athletes, when compared to omnivorous athletes. As can be seen, the literature on this topic is quite scarce and, apparently, performance is not boosted depending on the type of diet adopted. With this knowledge intended to demonstrate that vegan diets are compatible with sports performance, thus being able to encourage athletes and their families, coaches and health and sports experts to have a more open mind when an athlete expresses their desire to adopt a Vegan diet.

**Keywords**: Vegan Diet, Sports performance, Athletic performance.

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## INTRODUCTION

Adequate food and a generally healthy lifestyle (no smoking, regular physical activity (PA), and controlled alcohol intake) are the basis for preventing 90% of type 2 diabetes, 80% of cardiovascular diseases, 70 to 90% of strokes and 70% of instances of bowel cancer (Willett, 2002), and 90 to 95% of all cancers (Anand et al., 2008).

Vegan diets consist of complete exclusion of animal and animal products from the diet. In general, the number of Vegans has been growing at even faster rates than expected, due to the constant emergence of scientific evidence that supports the health benefits of a well-planned Vegan diet (Melina, Craig and Levin, 2016).

On November 24, 1944, it was founded in London by Watson et al. the Vegan Society, due to the lack of understanding with the Vegetarian Society, for allowing the consumption of milk, dairy products and eggs. This society, a pioneer in the world, emerged with the aim of combating violence, injustice and exploitation of man against animals (vegansociety.today). Later, other vegan societies emerged: in 1948 the American Vegan Society; in 1953 the German Vegan Society; in 1957 the Indian Vegan Society; in 1960 the Vegan Society of New Jersey (vegansociety.today). Although each nation has its own version of a plant-based diet, with its own history, influences, ingredients and typical dishes, the Vegan diet is deeply rooted in tradition, religious beliefs and cultural landmarks (Associação Vegetariana Portuguesa, 2021). Despite the growing expansion of vegan food around the world, India, China, Japan, Greece, Jamaica and Israel are among the countries with the greatest cultural history of meatless food and growing vegan demography (Associação Vegetariana Portuguesa, 2021).

In the United States of America there are approximately 3.7 million adherents to the Vegan diet, while in Europe about 10% of the population, approximately 75 million people, adhere to some type of Vegetarian diet (Wirnitzer, 2020). It is estimated that in the United Kingdom, vegan persons have trebled since 2006, corresponding to 1% of the adult population (Woodbridge, Konstantaki and Horgan, 2020).

It is important to mention that there are different definitions for Vegetarian practices, such as the Ovolactovegetarian diet, which excludes meat and fish, but includes eggs and dairy products; the Semi-vegetarian, or Flexitarian diet, which includes the infrequent consumption or small amounts of meat, usually fish and poultry; and the Vegan diet, that excludes any animal products from the diet, and which our study will focus on. Non-vegetarian eating practices with the frequent consumption of meat are called omnivorous diets (Ferreira, Burini and Maia, 2006) (Table 1).

Table 1. Types of diets.

| Type of diet | Included products | Excluded products |
|---|---|---|
| Omnivorous (Non-vegetarian) | Red meat, white meat, fish, dairy and eggs | - |
| Lacto-ovo vegetarian | Eggs and dairy | Meat and fish |
| Lacto vegetarian | Dairy | Meat, fish and eggs |
| Ovo vegetarian | Eggs | Meat, fish and dairy |
| Flexitarian (semi-vegetarian) | Sporadic consumption of meat (usually poultry and fish) | Habitual consumption and/or large amounts of meat |
| Vegan | Vegetables, fruits, legumes, seeds | Any food of animal origin |

*Source: Own.*

Vegan diets have been associated to a 40% reduction in the risk of coronary heart disease, a 29% reduction in strokes, and a 50% decrease of metabolic syndrome and type 2 diabetes (Rizzo et al., 2011). The potential mechanisms that underlies these effects have been associated with an increase in fibre intake, antioxidants and plant-based proteins, and a reduction of saturated and total fats intake, dietary cholesterol and a lower caloric intake (Kahleova, Levin and Barnard, 2017).

Therefore, this type of diet has numerous health-related advantages as it is considered a healthy alternative to omnivorous diets, promoting longevity, and other benefits that are related to ethical issues, namely the significant reduction of harm to animals and the environmental benefit that is a direct result from the reduction of farm animals and thus the environmental damage caused by their gas emissions.

It is an appropriate diet for all individuals and ages, due to the high consumption of certain types of dietary fats and fibres and can also be used by athletes to optimize carbohydrate intake and manage weight (Woodbrige, Konstantaki and Horgan, 2020). These authors also emphasize that this is a high nutritional quality diet when compared to non-Vegan diets. In fact, regarding the health of the entire population a meatless diet would be desirable, and the consumption reduction of animal foods could contribute to ensure food security in the future and to combat climate change (Weikert et al., 2020). However, and like any other type of diet, the Vegan diet also has some nutritional limitations, such as the restriction in the intake and absorption of haem iron (found in abundance in animal products such as red meat), which reduces the ability to synthesize haemoglobin, thus limiting the supply of oxygen to the muscles, impairing performance and leading to iron deficiency anaemia, which can have serious health consequences (Woodbridge, Konstantaki and Horgan, 2020). Moreover, it may be poor in the consumption of key micronutrients such as vitamin B12, vitamin B2 (riboflavin), vitamin D, proteins (essential amino acids), long-chain n-3 fatty acids, as well as calcium, iodine, zinc and selenium. In contrast, it is hoped that a Vegan diet can guarantee a supply of vitamin C, vitamin E, thiamine and folate, magnesium and potassium minerals, as well as dietary fibres and secondary plant compounds. Lower intake of saturated fatty acids and cholesterol is also considered beneficial (Weikert et al., 2020).

Omega-3 fatty acids and Iodine deficiencies (Obersby et al., 2013; Gilsing et al., 2010) are generally due to poor diet planning According to Jakše and Jakše (2018) the use of protein-based food supplements is a popular choice, but theoretically unnecessary for athletes who follow a well-planned vegan, omnivorous or mixed diet, especially when paying attention to adequate energy intake. and the frequency and amount of intake of plant foods with higher protein content. Woodbridge et al. (2020) also report that if the vegan diet is not well planned, athletes run the risk of not reaching the recommended nutrient intake and consequently having health and performance impairments.

Most vegans are aware that their diet is associated with the risk of vitamin B12 deficiency and this is by far the most consumed supplement (Weikert et al., 2020). Melina, Craig and Levin (2016) report that vitamin B12 can be consumed through conventional foods, twice a day, or through dietary supplementation in amounts of 500 to 1000 mg several times a week.

The need for vitamin D supplementation is the same in vegans and omnivores, differs according to geographic location. It is recommended that all adults (regardless of diet) with little or no sun exposure and especially in the winter months take vitamin D supplementation (Woodbridge, Konstantaki and Barnard, 2017; Jakše and Jakše, 2018). It is still important mention that nutrition general, evaluated fur feeding index healthy alternative, it is typically best in diets vegetarians and vegans than in diets omnivores (Melina, Craig and Levin, 2016). Therefore, it is believed that a well-planned plant-based diets can overcome the limitations

presented above and provide significant improvements in general physical and emotional health, well-being and quality of life.

With the growing interest in the potential health benefits associated with the Vegan diet, this topic has also become interesting for researchers studying the effect of different vegetarian diets on athletes and their performance (Jakše and Jakše, 2018). It is evident that health and athletic performance are intertwined, since a sick athlete cannot achieve the desired performance and results. In the same way, a healthy diet can prolong the longevity of the sportsperson's career.

A balanced diet, and the absence or restriction of substance intake in foods harmful to health, are crucial, not only for the health of athletes, but also for their recovery after training and their performance. It provides support during physical preparation and helps to prevent injuries (Jakše and Jakše, 2018). However, the question remains: is the Vegan diet ultimately suitable for athletes and will it affect their performance?

Fuhrman and Ferreri (2010) state that a well-designed Vegan diet can constitute a nutritionally adequate diet that provides energy, maximizes performance, offers resistance to diseases, allows a simple control of body weight, while enjoying regular meals to complete satiety and offers efficient recovery after repeated daily efforts. This differentiated food consumption provides a higher carbohydrates intake, and phytochemicals' antioxidant in comparison with the Omnivorous diet, which includes foods of animal origin and vegetable. Consequently, it can supply glucose/glycogen in greater amounts to skeletal muscle, neutralize oxidative stress caused by exercise, mainly helping aerobic capacity (Melina, Craig and Levin, 2016; Ferreira et al., 2016; Hawley and Leckey, 2015; Pingitore et al., 2015; Rogerson, 2017; Sureda et al., 2008). On the other hand, it provides less energy intake and less supply of proteins and amino acids, which can be harmful for the maintenance of lean body mass and can interfere with the production of muscle strength and power (Morton et al., 2018).

The Vegan diet has been increasing among athletes, especially in the endurance and ultra-resistance modalities, such as marathons, ultra-marathons and triathlon, between others. The testimony of successful athletes worldwide, such as tennis players Novak Djokovic and Venus Williams and the racing driver Lewis Hamilton, have been fostering interest and promoting the adoption of this food parameter as a way to optimize sports performance (Rogerson, 2017). However, despite all the information available about this type of diet, some coaches and professionals are still concerned about the possibility that their athletes may not receive the adequate nutrition necessary for individual training and performance (Larson-Meyer, 2018). The diminutive research documenting Vegan diet effects on general fitness (maximum strength, cardiorespiratory endurance, muscle endurance) and body composition may explain coaches' and athletes' reservations (Dahlinghaus, Berberet and Rehfeld, 2018). In fact, most scientific evidence about a well-planned Vegan diet influence on athletes' health and performance has only been carried out in the last 10 to 20 years (Jakše and Jakše, 2018). Careful evaluation of this type of diet is justified on the basis of its growing popularity. Therefore, it is difficult to give objective information to people and athletes that will help them make an informed decision.

It is of great importance to investigate the nutritional status of athletes who use diets exclusively based on plants and establish a relation with their performance, that is, does Vegan food cause any damage, or advantage for the athletes' performance, when compared to the omnivorous diet? In this sense and based on the growing demand interest and adherence to the Vegan diet, this review aims to make a state of the art and design future research studies. Despite the increasing expansion of the vegan diet around the world and its benefits being well documented, very little has been studied about its influence on the performance of athletes. Will athletes who adopt this type of well-planned diet, in addition to health improvements, be able

 

to enhance their performance, or, on the other hand, this being a more restricted diet than the omnivorous one, could it compromise the athletes' performance? In this review study, we intend to gather scientific information that will allow us to answer these questions, help to clarify doubts of athletes/coaches, and create a starting point for future studies.

***Vegan diet and performance***

There is a consensus that food is the basis for health, so diet is highly relevant to an athlete's health status (Wirnitzer, 2020). Moreover, nutrition must provide the body with all vital nutrients, preserve the capacity to perform physical and mental tasks, reduce the risk of chronic diseases and promote health. A well-built diet should also provide enough energy to achieve energy balance (Rogerson, 2017).

The association between nutrition and performance have been pursued since the first Olympic games in 776 BC in Ancient Greece and, so far, coaches and athletes continue to seek food that is benefits for sports performance (Vilardi, Ribeiro and Soares, 2001). As a result, in recent decades, Vegan diets, which consist of excluding any food of animal origin from the diet, have shown exponential growth worldwide. Vegan diets are healthy and nutritionally appropriate and suitable for all stages of life, including pregnancy, lactation, childhood, adolescence, adulthood and also for athletes (Melina, Craig and Levin, 2016). The World Health Organization (WHO) recommends exclusive breastfeeding for the first 6 months of a baby's life (Ministry of Health, 2009). When introducing solid foods, it is possible and appropriate to adopt any type of vegetarian diet. Complementary foods should be rich in energy, protein, iron and zinc, which can be found in hummus, tofu, well-cooked vegetables and avocado puree. Children and adolescents who follow any vegetarian diet are at lower risk of overweight and obesity than those who follow a non-vegetarian diet (Melina, Craig and Levin, 2016). The same authors add that consuming balanced vegetarian diets early in life can help establish healthy lifestyle habits. The nutrients that may require greater attention for young people who follow this type of diet are iron, zinc, vitamin B12 and for some, calcium and vitamin D, and if necessary, these can be supplemented. The protein requirements of vegan children may be slightly higher than those of non-vegan children, due to differences in protein digestibility and amino acid composition. One to two year olds should consume more 30 to 35% protein than their non-vegan peers, two to six year olds should consume more 30%, and those over the age of six should consume more 15 to 20% protein than non-vegans (Melina, Craig and Levin, 2016). The Vegan diet is beneficial for health throughout life (Melina, Craig and Levin, 2016; Jakše and Jakše, 2018), and its benefits can be maximized by ensuring energy balance and nutritional adequacy, through a varied consumption of vegetables, legumes, fruits, whole grains, nuts and seeds (Melina, Craig and Levin, 2016). After the age of 50, the ability to absorb vitamin B12 decreases, so all individuals from this age, regardless of the type of diet adopted, need vitamin B12 supplements (Melina, Craig and Levin, 2016). From the above, it appears that it is possible and feasible to follow a vegan diet from the age of six months and maintain it throughout life.

The Italian society of human nutrition adds that Vegan diets are compatible with performance (Agnoli et al., 2017). But is the Vegan diet only compatible with the athletes' performance or could it be responsible for improving their sports performance?

The Vegan diet is becoming increasingly popular in the general population and in the sports world. Many athletes have come to declare their commitment to Veganism and attribute this success to their diet. For example, Patrick Baboumian is considered the strongest Vegan in the world, winning in 2011 the German competition and in 2012 the European title of Powerlifting, also surpassing Guinness records in strength disciplines. This athlete admits that he achieved his best sports results thanks to a Vegan diet (Maziarz et al., 2020). Scott Gordon Jurek, an ultramarathon athlete since 1997 and Vegan since 1999, has numerous

achievements and medals. Fiona Oakes is a British athlete who holds four marathon world records and claims to be Vegan since she was 6 years old (Maziarz et al., 2020). These are just a few examples of the many world-renowned athletes who are Vegan. However, are these data sufficient to affirm that this diet has a positive effect on sports results?

In what concerns to health matters there is no longer any doubt that a well-planned Vegan diet is more health-promoting and less damaging than conventional diets (Wirnitzer, 2020). The same author adds that the growing body of scientific data provides a significantly broader basis in favour of Vegan diets, showing that their beneficial effects far outweigh their potential harmful ones.

The fact is that, in addition to their role in cardiovascular health, plant-based diets have other physiological effects that can offer performance advantages. These include leaner body mass, increased glycogen storage, improved tissue oxygenation, reduced oxidative stress and reduced inflammation (Barnard et al., 2019). Provides a reduction in body fat due to low fat and high fibre content. This reduction in body fat is associated with an increase in submaximal and maximal aerobic capacity (Barnard et al., 2019).

The decrease in body fat reduces the atherosclerotic risk (accumulation of fatty plaques, calcium and other substances in the arteries), which can also be directly beneficial for athletic performance. This reduction in body fat is essentially due to the low fat and high fibre content of these diets, traits that decrease the energy density of meals, with a corresponding reduction in energy consumption (Barnard et al., 2019).

The Vegan diet increases glycogen storage as it is rich in carbohydrates (CH) and CH are the main source of energy during moderate and high intensity aerobic exercise and endurance is increased by a CH rich intake (Barnard et al., 2019).

Many athletes, however, have eating patterns that are deficient in CH, putting them at risk due to a fast depletion of muscle and liver glycogen, resulting in early fatigue (Barnard et al., 2019). According to Nieman (1999) the basis of the diet for endurance athletes is CH, in order to optimize the hepatic and muscular glycogen reserves and, in this sense, a vegetable-based diet will contribute to the high consumption of CH, which will be essential for prolonged exercise.

A key factor in delivering oxygen to muscles and other tissues is blood viscosity. In general, reducing blood viscosity will improve blood flow and, consequently, improve athletic performance (Barnard et al., 2019). Aerobic training increases blood volume and, as the plasma volume increase to a greater extent than the mass of red cells, it reduces blood viscosity. However, plasma viscosity is also influenced by food choices. As plants are typically low in saturated fats and cholesterol, Vegan diets reduce plasma lipid concentrations, leading to reduced viscosity (Barnard et al., 2019).

Physical exercise leads to an increase in the production of free radicals. These free radicals and reactive oxygen species are constantly produced by mitochondria and other intracellular organelles, and increase during exercise, as well as during cellular responses to damaged tissue (Mota et al., 2019). When the production of free radicals and reactive oxygen species exceeds the body's ability to scavenge them by endogenous and exogenous antioxidants, macromolecules oxidatively damage occurs and accumulates resulting in loss of function (Valko et al., 2007). The imbalance between prooxidants, antioxidants and repair capacity result in oxidative stress (Sies, 1985). Oxidative stress related to physical exercise can also lead to muscle fatigue and, consequently, reduced athletic performance and recovery. Compared to Omnivores,

 

people who follow a Vegan diet have an increased consumption of antioxidants, which has been shown to be effective in reducing oxidative stress associated with exercise (Lewis, Ruby and Bush-Joseph, 2012).

Food choices can also help to reduce inflammation in the body. Although regular exercise reduces chronic inflammation associated with obesity, metabolic syndrome and type 2 diabetes, acute bouts of intense exercise can trigger an inflammatory response and contribute to delayed muscle soreness (Barnard et al., 2019). According to these authors, a plant-based diet seems to be a good strategy to reduce inflammation.

Together, these factors reinforce the advantageous of Vegan diet for athletes, since they can positively affect their performance during training and competitions and probably constitute a good prerequisite for maximum performance (Barnard et al., 2019). However, if not well planned, the adoption of a Vegan diet can also lead to deficiencies in some nutrients, such as vitamin B12, vitamin D, iron, iodine, calcium, zinc, and omega-3 fatty acids long chain (Rogerson, 2017). Can these deficiencies affect the health of athletes and, consequently, will they be decisive for their performance? It is important to note that nutritional deficiencies (for example, iron, iodine, vitamin D and vitamin B12) generally occur in all dietary patterns, and are not an exclusive issue of Vegan diets (Wirnitzer, 2020). In fact, Vegan diets are not nutritionally more deficient than any other type of diet. So, it is important to plan appropriately Vegan diets in order to fulfil the lack of some nutrients, so as not to weaken athletes' health.

The vitamin B12 issue, for example, is the only chemical compound that are often consumed but that cannot be found in plants. Its deficiencies result in reduced resistance and tolerance to exercise; thus, its supplementation is essential for athletes (Wirnitzer, 2020). Vitamin D deficiency can increase the risk of cardiovascular disease, diabetes and even autoimmune diseases and cancer. Most plant-based foods do not contain vitamin D, with the exception of mushrooms. Since the basic source of vitamin D is its cutaneous synthesis, which occurs under the influence of UVB rays, its supplementation in athletes and non-athletes will also be important, especially in the autumn and winter months (Wirnitzer, 2020).

What is important to keep in mind is that any athlete, regardless the diet adopted, who wishes to optimize health and sports performance, must follow a properly planned, supplemented, varied and balanced diet (Goios et al., 2020). Therefore, what these authors reinforce is that the issue of critical nutrients can be overcome by carefully planning diet and complementing it with the appropriate supplementation when necessary.

Although all this information is extensively available, athletes, family members, coaches, sports scientists and doctors specialized in sports medicine, remain very reticent about the potential positive effects that result from Vegan diets, as they still doubt its beneficial effects on performance. Wirnitzer (2020) argues that there is no scientific logic against the adoption of a Vegan diet for sport and that the reluctance expressed by many is due to the lack of knowledge and cultural prejudices. Moreover, due to the benefits provided by Vegan diets, such a regime is important to be considered to achieve the best personal health results, not only for non-active people, but also for athletes. In addition, Vegan diets have been found to effectively support parameters that affect performance (for example, induced immunosuppression exercise and oxidative stress, due to higher skeletal muscle oxygen demands), nutritional requirements, recovery and resistance to disease in athletes.

Since a well-planned and diligently well-implemented Vegan diet has been shown to be compatible with athletic performance and success, such diets are healthy options for maximizing performance, endurance, recovery and regeneration, and immunity for athletes involved in strength and resistance training (Wirnitzer,

2020). In addition, a well-planned, varied and adequately supplemented Vegan diet, rich in nutrient density, appears to successfully and effectively support parameters that influence athletic performance (Rodriguez, DiMarco and Langley, 2009), nutritional requirements, recovery, and disease resistance in athletes (Fuhrman and Ferreri, 2010).

In summary, Vegan diet seems to have a positive influence on athletes' performance, though it still is a subject of some controversy. As the magnitude of athletes' performance gains with Vegan diet remains to be determined (Wirnitzer, 2020) it is pertinent to question if Omnivorous diets are more advantageous for performance than Vegan diets?

***Vegan diet versus omnivorous diet***

As already mentioned, Veganism is becoming more and more visible and also more accepted in sports sciences and in the health and fitness industry (Rogerson, 2017). Most scientific evidence strongly associates a well-planned Vegan diet with health, successful control of body weight, as a preventive measure, and, in some cases, with the end and reverse of the most common chronic diseases, such as cardiovascular diseases, type 2 diabetes, certain cancers and some other diseases (Jakše and Jakše, 2018). Thus, it is understood that many individuals adopt these diets as a way to promote their health and, in the case of athletes, in addition to health promotion, which is fundamental to optimizing their performance (Jakše and Jakše, 2018). Despite the existence of some controversy, what seems to gather consensus is that this diet is a viable option to adequately support athletic performance, while contributing to overall physical and environmental health (Lynch, Johnston and Wharton, 2018). Considering that Omnivorous diets also provide some nutrients unavailable in the Vegan diet, will the former be more advantageous than the latter, which restricts all foods of animal origin?

## RESULTS AND DISCUSSION

Table 2 presents a summary of original studies related to the topic. Of these studies, only one measured the effects of adopting a Vegan diet on the overall performance of physical fitness and body composition in an active population, using Omnivorous as a control group (Dahlinghaus, Berberet and Rehfeld, 2018), in the remaining three groups were used: the Vegan group, the Ovolactovegetarian group and the group of Omnivores (Nebl ate al., 2019; Souza, 2019).

Table 2. Summary of articles where sports performance was analysed depending on the type of diet adopted.

| Article | Sample | Goal | Instruments and Procedures | Results and Conclusions |
|---|---|---|---|---|
| Dahlinghaus et al. (2018) | N= 12 university students (divided into 2 groups, an experimental group and a control group) | To study the effects of adopting a vegan diet on physical fitness and body composition in active individuals | - The *myfitnesspal software* was used to track the diet of the participants, during 3 days before the test and during the test application.<br>- Both groups underwent initial assessment of performance and body composition (height, weight, blood pressure, fat percentage, 1RM squat, 1RM bench pressures, push up test to failure (PUT) and VO2 max test).<br>- The experimental group followed a vegan diet for 3 weeks and the control group maintained their normal diet. Both groups maintained their usual training program.<br>- The post-test consisted of repeating the same assessments as the pre-test. | - The experimental group significantly reduced weight, average consumption of calories, protein and fat.<br>- There were no changes in the Fitness scores of the experimental group.<br>- It was concluded that a short-term vegan diet decreased body weight, with no impact on sports performance. |

 

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|---|---|---|---|---|
| Nebl et al. (2019) | N= 76 recreational runners (24 Vegan; 26 OLV; 26 Omnivorous) | Comparing maximal exercise capacity in Vegan, OLV and Omnivorous recreational runners | - Cycle ergometer test was performed;<br>- During the test, capillary blood samples were collected several times to measure lactate and glucose concentrations;<br>- To determine the nutrient intake, a 24-hour dietary collection was performed. | - No significant differences were found between the groups;<br>- A similar maximum potency was observed.<br>- Some differences in nutrient intake between the groups were revealed: Vegans consumed significantly higher amounts of carbohydrates, fibre, magnesium, iron and vitamin E. Consumption of dietary fat and vitamin B12 was significantly lower in Vegans compared to the other two groups.<br>- It was concluded that there are no advantages or disadvantages between these diets in terms of exercise capacity. |
| *Souza (2019)* | *N= 42 physically active individuals (9 vegans, 19 OLV and 14 omnivores)* | *Compare physical performanc e between Vegans, OLV and Omnivores; to compare exercise-induced muscle damage recovery between vegans and omnivores.* | *- For the first objective, the individuals of the three groups performed a maximal aerobic speed test, a 10 RM handgrip strength test, deadlift strength and countermovement jump (CMJ) and completed a food questionnaire about the last 24h.*<br>*- For the second objective, vegans and omnivores completed a set of exercise-induced muscle damage (EIMD) tests and filled out a food questionnaire over the last 24h.*<br>*- They were evaluated before, immediately after and after 24, 48 and 72 hours.* | *- No significant differences were found between the three groups in strength, CMJ and maximal aerobic speed tests.*<br>*- It was concluded that these diets are similar in terms of physical performance.*<br>*- After 72 hours vegans showed a 4% reduction and omnivores a 6% increase in CMJ. Greater delayed onset muscle soreness was observed in vegans 24 and 72 hours after the tests were applied.*<br>*- Vegans had lower amino acid intakes than omnivores.*<br>*- It was concluded that vegans may show impairments in muscle recovery after EIMD when compared to omnivores.* |

*Source: Own.*

In the study developed by Dahlinghaus, Berberet and Rehfeld (2018), 12 physically active students were randomly assigned into the experimental group (Vegans) or the control group (Omnivores). Each group was instructed to adopt their usual diet three days before the pre-test. At baseline, both groups underwent into a fitness (blood pressure, one repetition maximum of back squat, and bench press, push up test to failure, and 1.5 mile run test) and body composition (height, weight and body fat percentage) assessment. Afterward, the experimental group was instructed to follow a Vegan diet over three weeks, while the control group

maintained their habitual diet. Over the three weeks, both groups maintained their normal exercise program three times a week. After three weeks, both groups were submitted to the post-test (same as the pre-test). Results evidenced significant reduction in body wight in the experimental group associated with a decrease in average caloric intake, protein and fat, while the control group showed no significant differences. Considering fitness parameters, this study suggests that a short-term Vegan diet has no impact on fitness scores, nor on improving or impairing individuals' performance. However, a clear limitation to this study exists in that the sample was too small to provide any kind of extrapolation of the results. Additionally, once weight reduction in the Vegan group decreased significantly, it could be hypothesized that fitness parameters that depend on relative strength (strength/weight), such as jumps and sprints, could afford more benefits than the selected fitness variables.

Similar results were obtained by Nebl et al. (2019) in which 24 Vegans, 26 Ovolactovegetarians and 26 Omnivorous recreational runners were submitted to an incremental exercise test on a cycle ergometer until voluntary exhaustion, in order to determine their maximum exercise capacity. No significant differences between groups were observed which reinforce the idea that the Vegan diet may be a viable alternative.

In order to compare physical performance between physically active individuals adhering to the Vegan, Ovolactovegetarian and Omnivore diet and the recovery of exercise-induced muscle damage between Vegans and Omnivores, Souza (2019) conducted two studies. In the first study, 42 individuals of the three groups performed a $VO_2$max test; 10 maximum repetitions of handgrip strength, deadlift and vertical jump test with counter-movement, and answered the 24-hour food recall. There were no differences between the three groups in the strength, $VO_2$max and nutrient intake. The authors concluded that the Vegan, Ovolactovegetarian and Omnivore diets are similar with regard to physical performance.

In the second study, Souza (2019) submitted 14 Vegans and Omnivores into an exercise-induced muscle damage protocol. Subjects were assessed before, immediately after, 24, 48 and 72h with vertical jump tests with countermovement, range of motion, blood creatine kinase concentration and lactate dehydrogenase, delayed muscle soreness, thigh circumference and responded to the 24-hour food recall. Vegans evidenced higher difficulty in muscle recovery after the exercise-induced muscle damage comparatively with the Omnivores, that was explained by the lower protein intake by the Vegans ones.

Nevertheless, there is not enough scientific evidence to suggest that the Vegan diet is superior or inferior to the Omnivorous diet in terms of performance and sports performance. In fact, most of the studies analysed involve recreational practitioners and non-athletes, used small samples, and had reduced time of intervention.

## CONCLUSIONS

Adherence to a Vegan diet is often the result of ethical, environmental, religious and health reasons.

The Vegan diet does seem to be beneficial for many aspects of health which could be the result of an increase in fibre intake, antioxidants, vitamin C, vitamin E, thiamine, folate, magnesium and potassium minerals, plant-based proteins and a reduction of saturated and total fats intake, dietary cholesterol and a lower caloric intake. Most scientific evidence strongly associates a well-planned Vegan diet with successful control of body weight, a preventive measure and, in some cases, with the end and reverse of the most common chronic non-communicable diseases, such as cardiovascular disease, type 2 diabetes, certain cancers and some other diseases.

 

The Vegan diet also has some nutritional limitations, such as the restriction in the intake and absorption of haem iron, vitamin B12, vitamin B2 (riboflavin), vitamin D, proteins (essential amino acids), long-chain n-3 fatty acids, as well as calcium, iodine, zinc and selenium.

A Vegan diet needs to be well-planned to overcome its nutrients limitations, and, when this occurs, sports performance doesn't seem to be affected, even when compared with other types of diet. Some concerns arise when muscle damage induced by exercise is examined. The lower protein intake by Vegan practitioners could increase the recovery time after exercise.

Given the scarce literature comparing Vegan athletes with Omnivorous athletes depending on their performance, especially at the elite level, further investigations are necessary. It is also important that athletes are encouraged to adopt a healthy diet, that they identify with personally and that they can do so without feeling embarrassed due to baseless, conservative or prejudiced theories.

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## DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author.

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