Chapter 107

Carbohydrate Intake In Amateur Cyclists

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ABSTRACT
Cycling is a sport and Olympic modality that is widely practiced among individuals, especially among amateur people who seek physical and mental well-being, and an unbalanced diet and inadequate water intake can cause a drop in performance and fatigue in athletes or practitioners of the modality. . Carbohydrate ingestion during prolonged activities, over one hour, improves performance and delays fatigue in sports such as cycling, which involves intermittent high-intensity efforts. Thus, it is necessary to know the consumption of carbohydrates and water of amateur cycling practitioners, as well as to analyze the consumption of dietary supplements in this public, identifying if there is guidance from trained professionals. The present study demonstrated that the participating amateur cyclists know the importance of carbohydrates for improving performance, knowing the necessary amount of carbohydrates per day, however, they do not know how often carbohydrates should be consumed during the pedal. In addition, there are questions about hydration and the use of food supplements. This shows the importance of nutritionist guidance in improving the performance and health of cyclists.

Keywords: Cycling, Carbohydrates, Hydration.

1 INTRODUCTION

Sports nutrition aims to improve the performance and recovery of every athlete, whether in training or in competition (MARTÍNEZ, 2020). Cycling is a sport and Olympic sport that is increasingly being practiced among individuals, especially among amateurs who seek physical and mental well-being, and the unbalanced diet and inadequate hydric intake can cause a drop in performance and fatigue in athletes or practitioners of the sport (FACCIN *et al.*, 2018).

Since the last century, cycling has gained prominence as a competitive sport, physical activity, means of transportation and leisure, especially in Europe, the United States and reaching Brazil (PIRES, 2011). For Oliveira (2013), both road and mountain biking, whether competitive or recreational, have aerobic characteristics, with anaerobic peaks, being a volume of great duration, usually over 60 minutes, and may extend to several hours of exercise. Therefore, the proper handling of diet and food supplements has a positive influence on both the performance and the health of these athletes, since prolonged and intense efforts, typical of cycling, can increase the demand for energy.

In cycling, since there is a demand for both aerobic and anaerobic metabolism work, there is a great need for carbohydrates intake due to the use of glucose for the formation of adenosine triphosphate (ATP), besides mobilizing hepatic and muscle glycogen as a source of glucose (GONÇALVES *et al.*, 2017). For

Pignata and collaborators (2020), nutrition studies seek to examine the dietary intake of athletes, evaluate the adequacy between nutritional recommendations with dietary patterns, seeking to improve performance and accelerate the recovery process after the effort. It is important to highlight that the *deficit of* energy intake may cause an insufficient supply of nutrients related to metabolic functions, such as tissue repair, structural and immune responses.

In this sense, studies indicate that carbohydrate intake during prolonged activities, over one hour, improves performance and delays fatigue in sports such as cycling, and the replacement required to maintain blood glucose and delay fatigue is 30 to 60 grams per hour, and should avoid intake above 80g/hour (HERNANDEZ; NAHAS, 2009).

The importance of proper nutrition in cycling is already well known, there is improvement in the performance of the body through proper nutrition, with a balanced intake of all nutrients, whether carbohydrates, fats, proteins, minerals and vitamins (CAMARGO MADEIRA; NAVARRO, 2010).

However, studies show that most cyclists use dietary supplements without professional guidance, which is worrisome because it is known the importance of a balanced and individualized diet for athletes, requiring care before, during and after activities, due to the risk of dehydration, carbohydrate depletion, gastrointestinal problems, hypothermia and hyponatremia, a situation that can reduce endurance and threaten their health. (MAIA *et.al.*, 2022; PATROCINIO et.*al.*, 2017; COSTA *et.al.*, 2007).

In addition, it is known that during the pandemic the number of fans of amateur cycling increased, both because it is an exercise that maintains social distance and because it promotes connection with nature, especially when training outdoors. Therefore, considering that the adequate intake of carbohydrates and water is of utmost importance for performance and well-being, it is necessary to analyze its consumption in amateur cyclists, as well as the use of food supplements, identifying whether the prescription is made by trained professionals.

2 METHODOLOGY

This is a descriptive research, carried out with the purpose of investigating the behavior of cyclists. To this end, a standardized questionnaire was applied, with objective and self-administered questions. The target audience was composed of cyclists and data collection was done electronically. We invited 100 cyclists to voluntarily answer the questionnaire. All participants signed an informed consent form, releasing their answers to the study design. The study was approved by the ethics committee under number 60521422.0.0000.9367.

The questionnaire applied was an adapted questionnaire (appendix 1), composed of questions involving the time of sport practice, food intake and hydration before, during and after sport practice, as well as the use of supplements.

3 RESULT AND DISCUSSION

A total of 100 people participated in the study, being 8 women (8%) and 92 men (92%), with a mean age of 42 years. Santos and Silva (2021) also conducted a study that evaluated men with similar ages, ranging from 20 to 50 years. In the study by Pires (2011), the author refers that the age of *indoor* cycling practitioners would be between 26 and 45 years, with most of the practitioners being men. D'Elia (2009) states that this larger number of male practitioners is due to the fact that cycling is an individual sport and requires hours on the road, therefore, the greater adherence to the practice ends up being male, but reports a perspective of increase in the female gender in recent years. A study developed by Maia and collaborators (2022) identified an increase in the female public, and of the 19 cyclists evaluated, 52.6% were female, with an average age of 35 years.

Another point observed in the present study was the time of sports practice, and the volunteers had practiced cycling for an average of 9 years. In a study with *indoor* cycling (Pires, 2011), it was observed that 33% of practitioners had more than one year of experience. Participants in this study had, in most cases, more than a year of practice, demonstrating experience with the sport practice, considering that, according to D'Elia (2009), cycling practitioners with more than 12 months can already be considered experienced.

Regarding hydration, when asked, the participants referred that they are used to hydrate, 11% answered that this occurs sometimes and 89% answered positively to this question (Figure 1). A study developed by Cruz and collaborators (2009) showed that 80.69% of cyclists always hydrate during training and only a small number of athletes (1%) revealed that they do not have the habit of hydration, the same value was reported to those who almost never hydrate and others sometimes, corresponding to 1% of the cyclists investigated.

Marins (2011) reports that thirst is the primary symptom together with the feeling of loss of strength, generalized fatigue and cramps. All these symptoms are related to altered water homeostasis, in addition to a state of hypoglycemia or muscle glycogen level, since its depletion can be caused by inadequate energy intake during exercise, as well as by inadequate hydration.

Figure 1: Hydration habits of the cyclists studied.

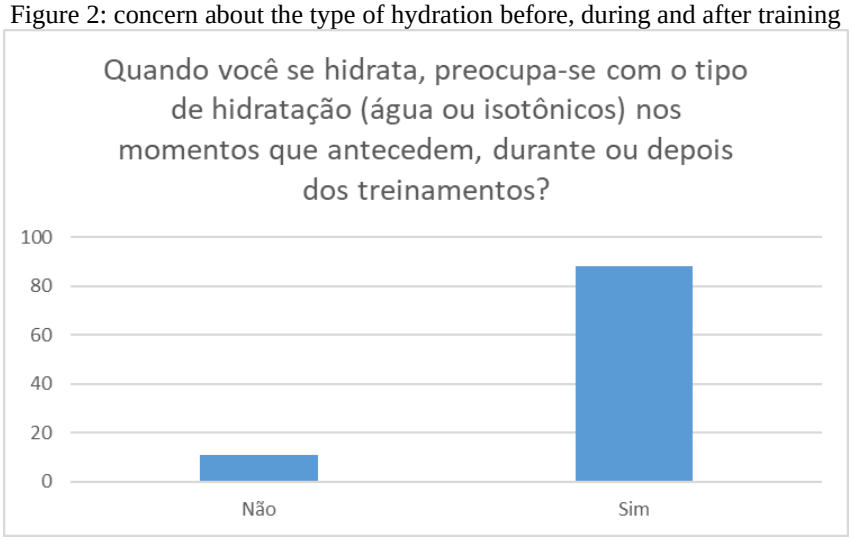
Source: from the authors.

Water, by keeping hydric stocks closer to normality, is more indicated before exercise or in efforts up to 1 hour. Carbohydrate drinks, on the other hand, during exercises that exceed 1 hour, help maintain glycemic control, besides favoring less mobilization of muscle glycogen and hepatic glycogen (CRUZ *et al.*, 2009).

When cyclists were asked if they had any idea about the importance of paying attention to the type of hydration (water or isotonic) before, during or after training, it was observed that 11% did not care about the type of hydration and 89% did care about it (Figure 2). In the study by Cruz *et al.* (2009) it was observed that 20% of the participants were not aware of the importance of hydration, especially for performance levels.

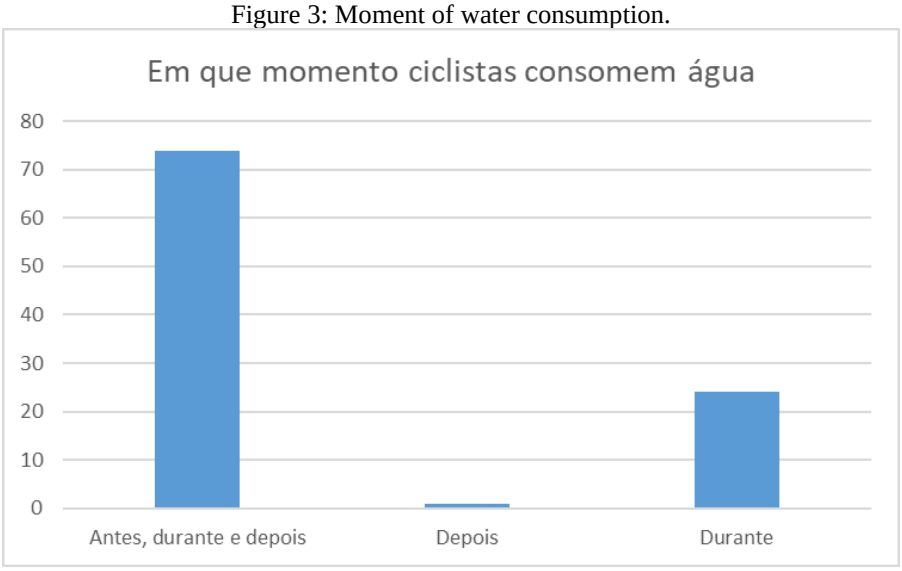
Maríns (2011) cites that adequate hydration before, during and after exercise is the main strategy to minimize the risk of thermoregulatory accidents associated with heat. Faccin and collaborators (2018) also highlights that for a good performance, the cyclist needs to be hydrated, and dehydration can bring negative consequences for the athlete, such as decreased muscle strength, increased risk of cramps, increased body temperature, and consequently, loss of performance.

Figure 2: concern about the type of hydration before, during and after training



Source: from the authors.

Figure 3: Moment of water consumption.



Source: from the authors.

Regarding the moment of hydration, it was observed that 1% of the participants consumed water only after the pedal stroke, 24% during the pedal stroke and 75% consumed water before, during and after the pedal stroke (Figure 3). The findings of the present study corroborate the findings of Cruz (2009) who points out that athletes clearly prefer hydration with water, and that consumption is done before, during and after the sport practice, highlighting that consumption is higher in *mountain bike* athletes than college athletes.

Although water does not provide energy and has no direct effect on energy needs, it is an essential element for the body to function. During exercise, it is recommended to perform a fluid intake already in the first 15 minutes and continue the intake every 15 or 20 minutes (MARINS, 2011; CRUZ *et al.*, 2009; D'ELIA 2009).

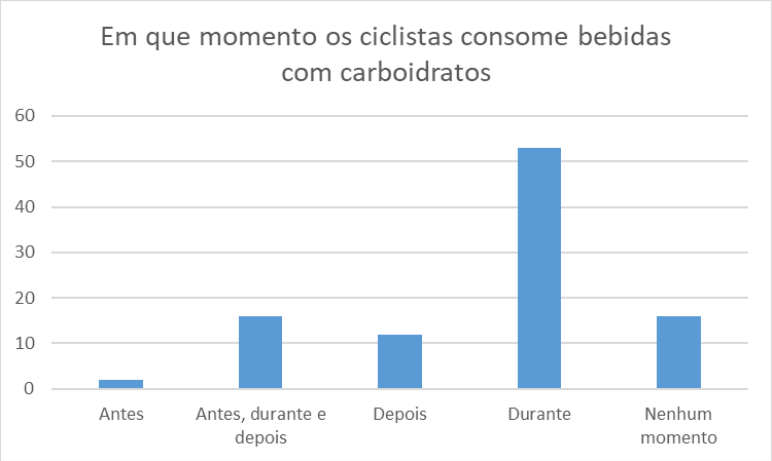
When asked at what time cyclists consumed carbohydrate drinks (Figure 4), 2% responded that they consumed before, 16% used before, during and after, 12% after, 54% during and 16% reported not consuming carbohydrate at any time (Figure 4).

Hernandez and Anhás (2009) suggest that the preparation with liquid or light consistency, with adequacy of the amount of carbohydrates in the meal before training, as during and after, should be sufficient in the amount of liquids to maintain hydration. It should also be low in fat and fiber to facilitate gastric emptying, besides being rich in carbohydrates to maintain glycemia and increase glycogen stores and moderate in the amount of protein.

Muhlen and Schauren (2018) also cites that in long-duration activities, hydration should be performed together with the use of energy and electrolyte repositories, because water alone does not adequately supply energy needs and fluid and electrolyte losses, which can cause dehydration and fatigue due to hydroelectrolyte losses, and it is important to ingest solutions with carbohydrates.

Cruz (2009) also reports that the carbohydrate drink during exercise has better blood glucose response, avoiding hypoglycemic states.

Figure 4: Time of consumption of carbohydrate beverages.

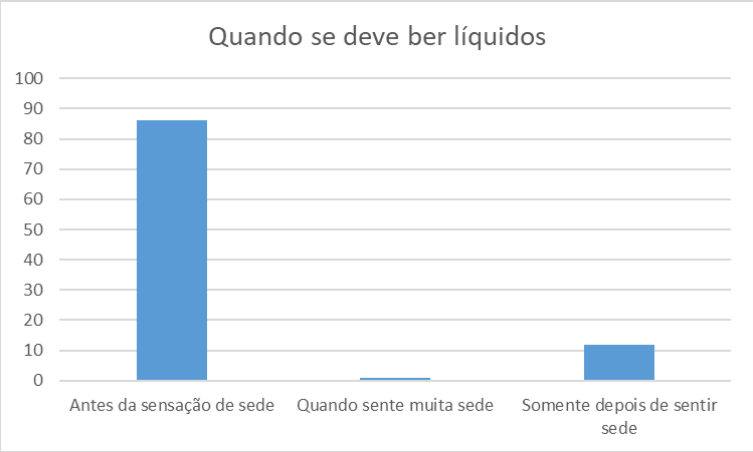


Source: from the authors.

Still in this sense, when participants were asked about when one should drink liquids (figure 5), 87% responded that before feeling thirsty, 1% when feeling very thirsty and 12% only after feeling thirsty. Gomes and collaborators (2014) cites that the sensation of thirst is only perceived when dehydration near or equivalent to 2% of body mass has already occurred. Therefore, the athlete should not rely only on the mechanism of the sensation of thirst to start ingesting liquids, since the symptoms after a state of intense dehydration such as headaches, feeling tired and dizziness are harmful.

Faccin and collaborators (2018) report in their studies that exercise performance is compromised if the individual is dehydrated to 3% of their body weight, and when the loss increases to 4 or 5% there can be a decrease in exertion capacity by about 30%.

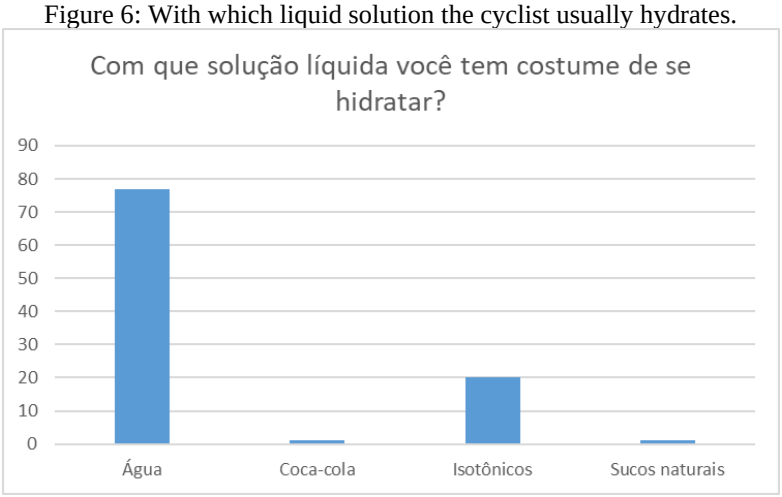
Figure 5: When to drink liquids.



Source: from the authors.

When asked what solution they used to hydrate themselves (figure 6), 78% responded that they hydrate themselves with water, 20% with isotonic drinks, 1% with natural juices, and 1% with soda. Data are very similar to the study by Cruz et al. (2009), which shows that about 97% of the participants use water as a means of hydration. However, in relation to isotonic drinks, the finding was about 84%.

Figure 6: With which liquid solution the cyclist usually hydrates.



Source: from the authors.

Regarding daily hydration, Maia and collaborators (2022) reported in their study the predominance of consumption of 1.5 to 2 liters per day, being this amount ingested by 63.2% of respondents. As for the hydric intake during training, it was found an average consumption of 1.27 with a variation of 1.05 liters more or less, water being the most prevalent type of hydration.

The ingestion of liquids, with carbohydrate or not, improves performance for the first hour of aerobic exercise at high intensity. Dehydration from exercise can occur not only due to sweating, but also due to insufficient intake (HERNANDEZ and NAHAS 2009).

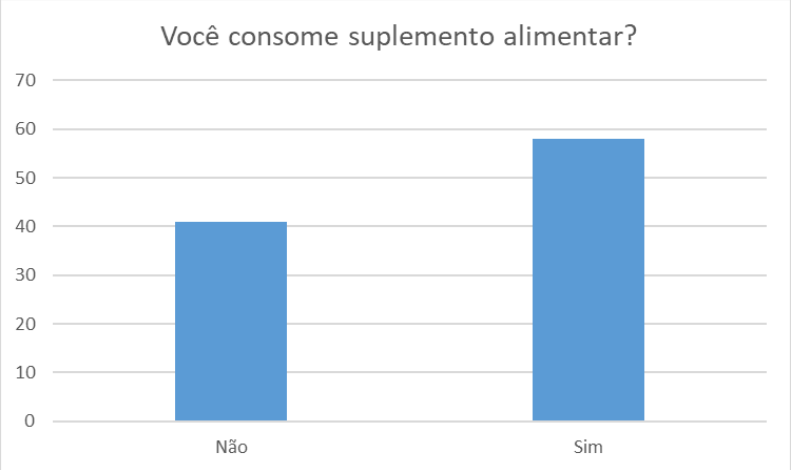
Maia and collaborators (2022) mention that to replace electrolytes, there is a preference for hydroelectrolyte beverages with sodium between 460 and 1150 mg/l and potassium up to 700 mg/l. Carbohydrate replacement should start after 1 hour of intense exercise, with the ideal consumption of 30 to 60 grams per hour (MAIA *et al.*, 2022).

Regarding the consumption of food supplements, 41% said they do not consume, while 59% answered yes (Figure 7). Data are very similar to Oliveira et al. (2014), in which, of the 43 cyclists interviewed, 63% consumed food supplements, and of these, 46% reported using them for the main purpose of recovery between workouts.

In the study by Cazal (2010) 146 cyclists were interviewed and approximately 88% used supplements in training and 97% in competitions. In the study by Camargo (2010), 93.3% of *mountain bike* cyclists were supplement consumers. The author also comments that the number of amateur athletes has been increasing in recent years and that the consumption of supplements is also growing, especially due to the increase in the supply of different brands on the market.

Supplements are designed to eliminate any possible deficiency in the diet. Some products ensure that the individual gets all the nutrients needed to stay healthy (PIRES, 2011). They were initially used to help professional athletes gain performance, but have been used as a way to optimize physical performance and delay fatigue in athletes and amateurs of any physical activity (OLIVEIRA, 2014).

Figure 7. Dietary supplement consumption among cyclists.



Source: from the authors.

In this context, Martinez (2020) cites that supplements have their benefits scientifically proven, whether in the form of bars, gels, vitamins and minerals, iron, calcium, creatine, bicarbonate, caffeine, glycerol, however, all must have a recommendation in a strategic and individualized manner.

In the present study, when investigated the moment that cyclists consume supplements (figure 8) it was found that 32% do not consume supplements, 31% use them during the pedal stroke, 16% and 10% consume supplements before and after, respectively, and 11% could not answer. In the study by Gonçalves and collaborators (2017), it was concluded that dextrose supplementation was efficient in increasing blood glucose, but had no influence on physical performance in *indoor* cycling classes.

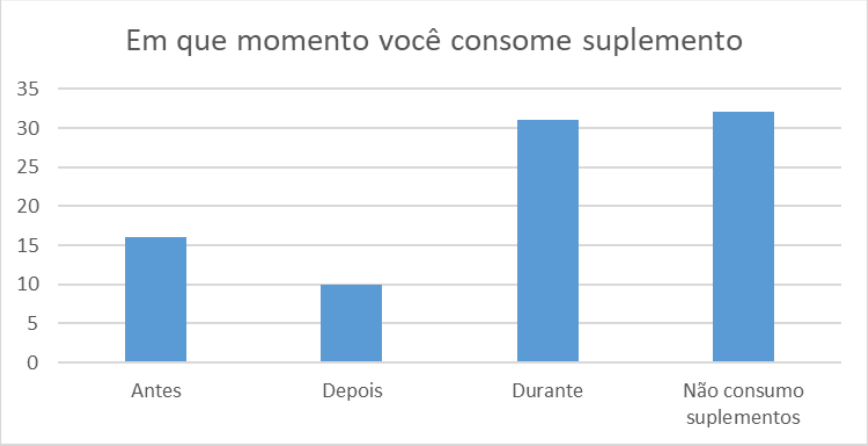
Pignata and collaborators (2020) cites that after exercise there is a recommendation of intake of high glycemic index carbohydrate, around 0.7 to 1.5g/kg of weight, within the period of four hours. In long races, athletes should consume between 7 and 8g/kg body weight, or 30 to 60 g of carbohydrate, for each hour of exercise, which avoids hypoglycemia, glycogen depletion, and fatigue. Often, for better utilization,

the carbohydrates consumed are part of the composition of sports drinks (HERNANDEZ and NAHAS 2009).

For Oliveira and collaborators (2014), the use of supplement with the intention of improving physical performance has been increasingly adopted by athletes around the world, due to the great importance in sports performance, and that used correctly and with monitoring, are important in health and physical performance of the athlete. Regarding cycling, it is important to highlight that it is a modality that presents high caloric expenditure and, therefore, supplementation is a strategy to meet the energy needs during training and throughout the day.

Hernandez and Nahas (2009) mention that the use of carbohydrate gel during exercise has been increasingly frequent and fulfills the role in the need for carbohydrates. However, its use must be accompanied by regular water intake, so that the association ensures the maintenance of the performance of a properly hydrated body. The necessary replacement of carbohydrates during exercise to maintain blood glucose levels and delay fatigue is 30 to 60g per hour, with a concentration of 4 to 8g/dl. Even with the combined use of several carbohydrates, their intake should not exceed 80 g per hour (HERNANDEZ and NAHAS 2009).

Figure 8: Moment when cyclists consume supplement.



Source: from the authors.

When asked about which supplements cyclists use (figure 9), the following results were obtained: Carbohydrate gel 20%, Whey Protein 16%, Creatine 15%, Vitamin complex 10%, Maltodextrin 8%, BCAA 7% and Thermogenics 2%. Three percent of the participants reported using other supplements and 19% reported using no supplements.

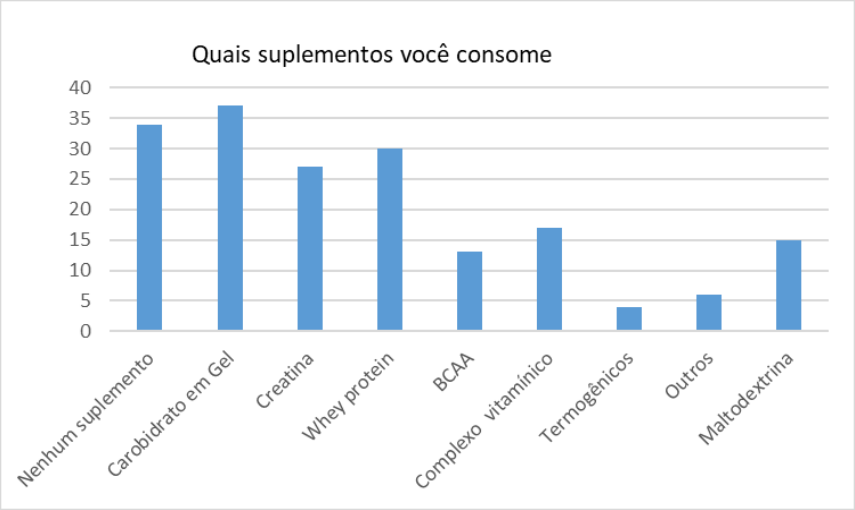
In the study by Costa et al. (2007), about consumption of food supplements by *mountain biker* athletes, it was found that 69% consumed carbohydrates, 52% amino acids, 45% vitamins and minerals, 10% creatine and 21% other types of supplements. Camargo and collaborators (2010) revealed that 78% of the respondents consumed supplements and 21% did not consume supplements, and most respondents used carbohydrate-based supplements.

Carbohydrate gel is widely accepted due to the ease of transport and consumption, since it can be carried on the shirt and can be consumed even while the cyclist rides at moderate to strong pace (D'ELIA, 2009).

In the study by Oliveira and collaborators (2014), amino acids and carbohydrates were the supplements most commonly used by the respondents, and a large part of the respondents were using supplements on their own initiative and in doses above what is recommended in the literature.

It is known that prolonged exercise decreases muscle glycogen levels, making there a great concern with adequate carbohydrate replacement, this being essential for the preservation of its ergogenic effect (FACCIN *et al.*, 2018).

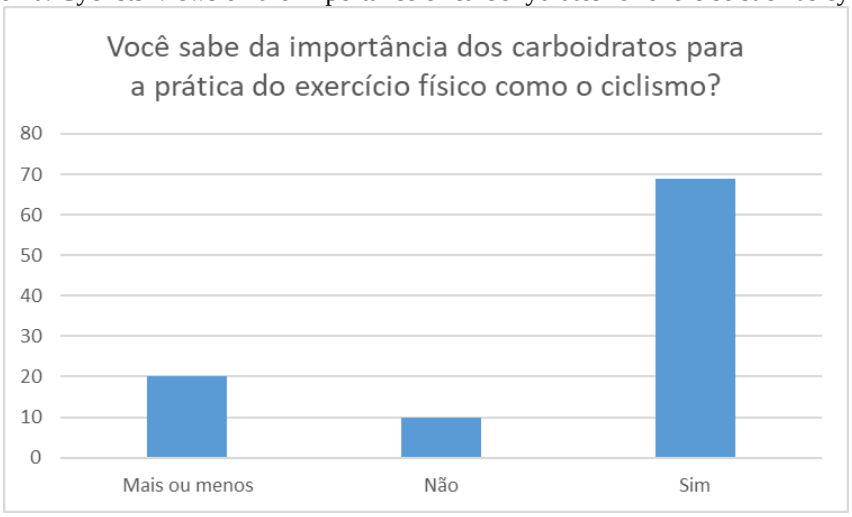
Figure 9: What supplements cyclists consume.



Source: from the authors.

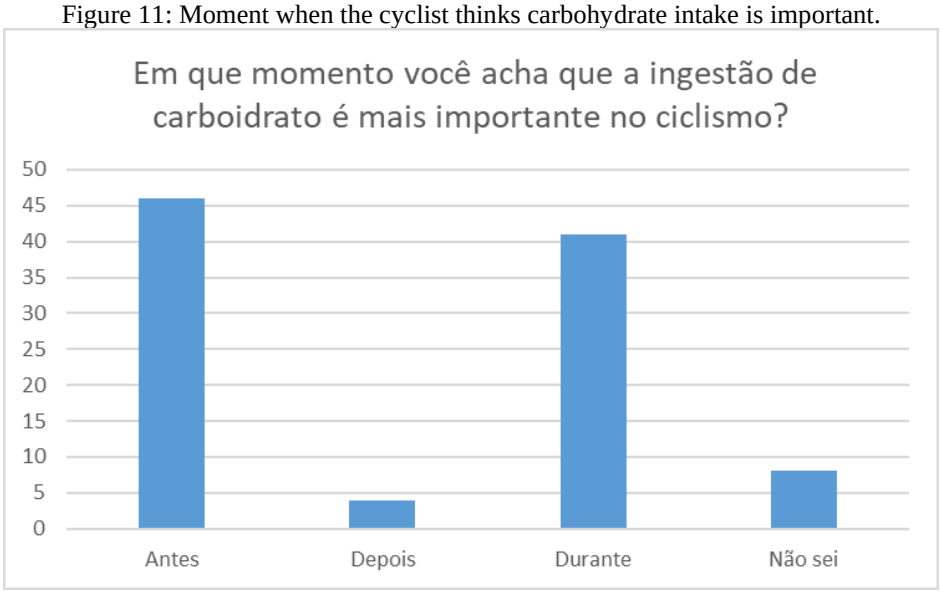
When cyclists were asked if they know the importance of carbohydrates for sports performance, 70% responded affirmatively, 10% did not, and 20% reported knowing more or less. According to their responses, cyclists are very aware of carbohydrate consumption, with almost 90% knowing more or less about its importance for sport performance.

Figure 10: Cyclists' views on the importance of carbohydrates for exercise such as cycling.



Source: from the authors.

Figure 11: Moment when the cyclist thinks carbohydrate intake is important.



Source: from the authors.

Of the interviewed cyclists, 47% considered that the ideal time to consume carbohydrates is before the pedal stroke, 41% during the pedal stroke, 4% after the pedal stroke and 8% could not answer (figure 11). In the study by Cazal (2010) 97.5% indicated the habit of consuming food as pre-training or pre-competition, being foods eaten as banana, white bread and whole wheat bread and giving priority to foods, in the pre-workout, that are of high digestibility, low in lipids and proteins, as well as rich in carbohydrates. The author also points out that meals with high glycemic index should be avoided, because hyperinsulinemia may occur, followed by hypoglycemia, with symptoms such as dizziness and nausea during exercise.

Silva and colleagues (2018) further report the importance of carbohydrate intake during exercise to delay fatigue and the early use of protein as energy production. This is because, during prolonged periods of physical training such as cycling (2 - 3 hours), athletes can oxidize a rate of approximately 1 to 1.1 g of carbohydrate per minute, equivalent to 60 g per hour, while endogenous carbohydrate stores are sufficient for only 3 hours of continuous, submaximal exercise (70 - 80%Vo2). Therefore, in training and races lasting

more than 60 minutes intensively, it is recommended to eat 30 - 60 g /h of carbohydrates (BONIFÁCIO, 2020).

Santos and Silva (2021) point out that the American College of Sports Medicine recommends the intake of 5 to 7g/kg/day of carbohydrates for exercises lasting 1 hour. For moderate intensity exercises lasting 1 to 3 hours a day, 6 to 10g/kg/day is recommended, and for workouts lasting more than 4 hours the carbohydrate recommendation is 8 to 12g/kg/day.

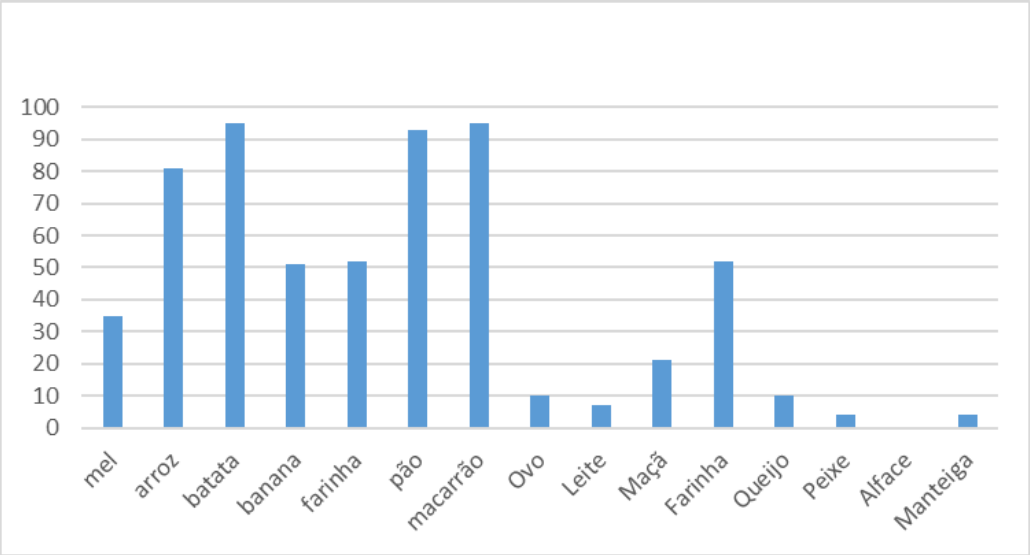
Cazal (2010) also reports that in addition to consuming an adequate pre-exercise meal, carbohydrate intake during exercise becomes essential because endogenous glycogen stores are limited and hepatic glucose production may only last for 1.5 to 2.5 hours of submaximal exercise.

Marchesato and Souza (2011) cite that the sources of carbohydrates, such as the preparations of the meals that precede cycling should respect basic principles such as individual gastrointestinal characteristics of athletes, fractionate the meals into three to five a day, consider the digestion time required for the pre-exercise meal, and evaluate the size of the meal and the composition in fiber quantity.

In our study, the participants reported using as a source of carbohydrates, respectively, the following foods: pasta (15%), potato (15%), bread (15%), rice (13%), flour (8%), banana (8%), honey (6%), beans (2%), apple (3%), egg (2%), cheese (2%), milk (1%), fish (0.6%), butter (0.6%) and lettuce (0%). In the study by Pires (2011), a large amount of misunderstandings in citing the sources of macronutrients in the diet was noted, however the main sources of carbohydrates were cited. These findings were similar to this study, in which more than 90% of respondents mentioned bread, pasta and potatoes as excellent sources of carbohydrates and 81% mentioned rice.

Cazal (2010) point out that banana and bread were the most remembered and consumed in his study. Oliveira (2013) cites several important carbohydrates for cycling according to the glycemic index and in the work is the pasta, banana, honey, bread, potato as found in the level of knowledge of respondents. It is worth remembering that foods, usually, are not ingested alone, but in meals with other nutrients, so it is important to consider the absorption time or the glycemic index of food (OLIVEIRA, 2013).

Figure 12. Carbohydrate source foods in the view of the investigated cyclists.



Source: from the authors.

Necessarily all people need a healthy diet, but this fact is much more highlighted in athletes and sportsmen who need specific methods to supply the needs generated by the body when in constant stress promoted by physical exercises, must have care with food before, during and after sports practices (MAIA *et. al.*, 2022).

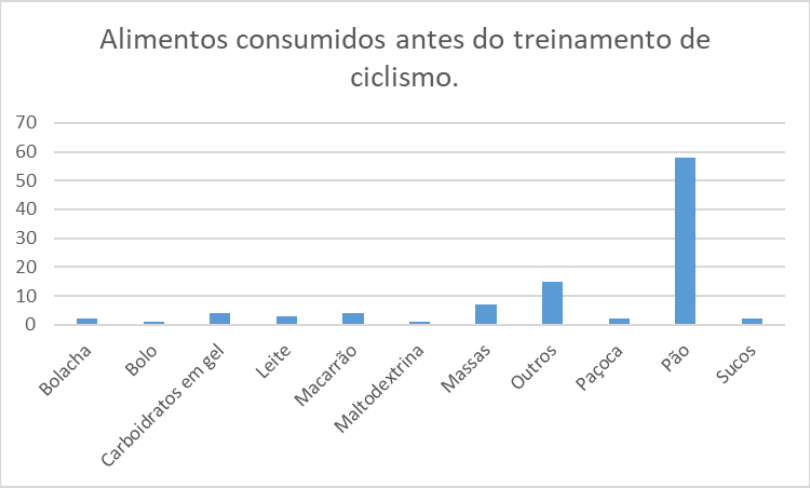
Regarding the consumption of food pre, intra and post training (figure 13, 14 and 15), it was observed in this study that before the pedal stroke, the foods most consumed by respondents were: bread (59%), pasta (7%), noodles (4%), carbohydrate gel (4%), milk (3%) juices (2%), paçoca (2%), cracker 2%, maltodextrin (1%), cake (1%) and other items (15%). During the bike ride, paçoca was the most consumed (27%), followed by carbohydrate gel (22%), rapadura (18%) others (11%), bread (7%), maltodextrin (5%), juices (5%), cookie (4%), cake (1%), there were no reports of consumption of milk, rice, beans, pasta and noodles.

After the pedal stroke, the indicated intake was rice with 15% of respondents, pasta with 11% and another 40% who ate unconventional products. D'Elia (2009) cites that the inadequate availability of muscle glycogen before exercises and its depletion during them can bring fatigue and breakdown of the intensity of effort.

In the study by Santos and Silva (2021) before the pedal the most consumed foods were black coffee (12%), banana (8%), coffee with milk, French bread and egg with (6%). During the pedal stroke, banana (3%), black coffee (2%), paçoca (2%). After training, rice consumption was 21%, beans 15%, grilled chicken 7%, noodles and tomatoes 6%. Cazal (2010) found in his study that 61.3% of participants consumed banana before training, oatmeal 11.7% and chocolate drink 10.0%. During exercise it was found that 55.3% consumed carbohydrate drinks, 53.7% isotonic drinks and 51.5% carbohydrate gels. Pignata and collaborators (2020) reports that during sports practice, there is also a need for simple carbohydrates, even when there is a good reserve initially. After exercise it is recommended the ingestion of high glycemic index carbohydrate, corresponding to values between 0.7 and 1.5 g/kg of body weight, within four hours.

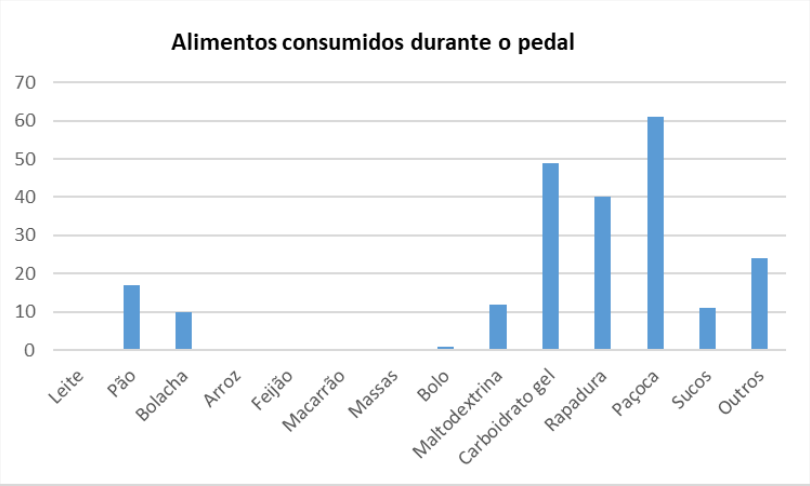
Still according to the studies by Santos and Silva (2021) there is a report that the recommendation of the American College of Sports Medicine (ACSM), recommends the intake of 7g/kg of carbohydrates for exercises lasting 1 hour / day, when the exercise is of moderate intensity lasting 1 - 3 hours a day it is recommended the intake of 6 - 10 g/kg of carbohydrates and in athletes who train for more than 4 hours / day the recommendation of carbohydrate intake can reach 8 to 12g/kg.

Figure 13: Food consumed before cycling by cyclists.



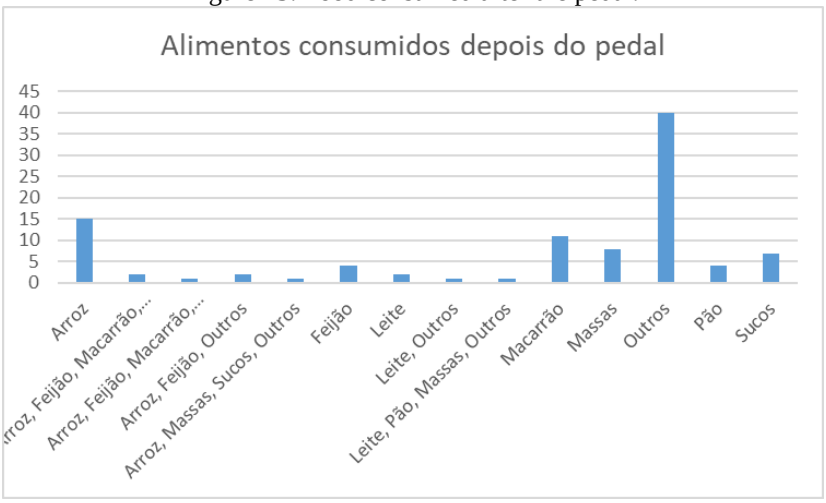
Source: from the authors.

Figure 14: Food consumed during the pedal stroke.



Source: from the authors.

Figure 15: Food consumed after the pedal.



Source: from the authors.

When asked to cyclists if they have ever been guided by a nutritionist, 43% of participants responded that they had already been guided by a nutritionist and 57% had not. In the research of Camargo and collaborators (2011) it was found that 28.7% had never had some kind of guidance from a nutrition professional. In the study by Pires (2011), dietary habits, supplementation and knowledge of *indoor* cycling practitioners in five gyms in different regions of Belo Horizonte - MG were investigated. The percentage of individuals who were monitored by a nutritionist differed in each of the regions, and the regions that presented the most errors in nutritional knowledge were those that had the least nutritional monitoring. In the study it was also noted that all individuals who were accompanied by a nutritionist changed their diet to *indoor* cycling.

In the present study, when asked who cyclists base their food choices on (figure 17), it was found that 26% rely on friends, 3% family, 1% pharmacist, 2% doctors, 2% books, 30% nutritionist, 14% physical education professionals, and 22% others.

In a study by Camargo et al. (2010) mountain bike riders reported that most of them use nutritional supplements not recommended by a professional but by friends, relatives, their own initiative and advertisements, and only 17.02% reported that they seek advice from a nutritionist.

In the work of Oliveira (2014), when cyclists were asked if they had started consuming food supplements, most indicated starting on their own initiative (36%), followed by recommendation from friends (28%), recommendations from the coach (25%), and with a doctor's prescription (11%).

In the study by Cazal (2010), which investigated the eating habits of 144 athletes who were inserted in a stage of iron bike, it was observed that the nutritionist contributed with 36.80% of the indication of supplements, friends and other athletes 27.78%, coach 19.44% and media 15.27%. One justification for the high number of individuals in follow-up with a nutritionist is the fact that they are professional athletes.

In the study with *mountain bike* athletes by Cruz *et al.* (2009), the means by which athletes received hydration orientation was investigated, and the nutritionist was responsible for 30.69% of the participation,

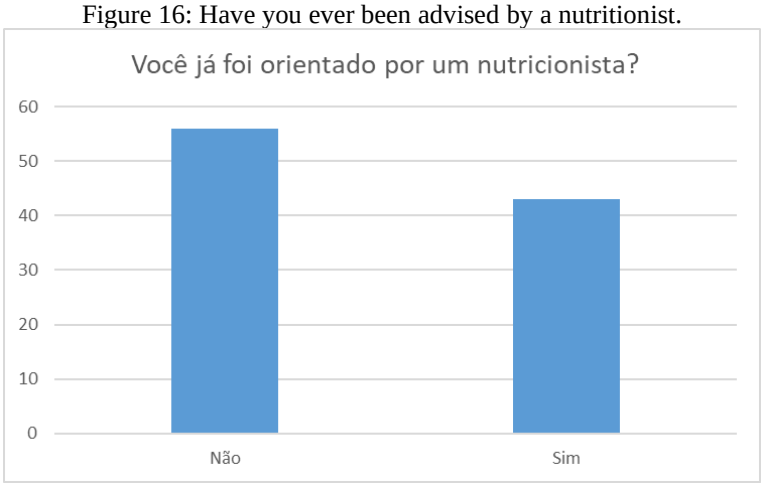
being magazines responsible for 34.16%, the coach responsible for 22.77%, friends responsible for 21.29%, and books responsible for 22.77%.

Santos e Silva (2021) cites that the results found in their studies found inadequate eating habits in cycling practitioners, reinforcing the need for nutritional monitoring by amateur athletes, to obtain an expected performance and to maintain quality of life.

According to Camargo *et al.* (2010), athletes who got some information that was not from an adequate professional misunderstood the knowledge about nutrition and supplementation, and most of them need guidance on the best strategy for supplementation in mountain biking. Gomes *et al.* (2014), suggests an educational process with the athletes, to improve the strategies for hydric replacement, in addition to hydration practices before, during, and after training sessions.

Camargo *et al.* (2010) cites that the federations responsible for cycling should have an information strategy to guide and educate cyclists about the importance and need for a good diet, supplementation, and hydration for a good performance and to avoid problems with health problems.

Figure 16: Have you ever been advised by a nutritionist.



Source: from the authors.

Figure 17: When the cyclist makes his food choices, who does he take guidance from.

Source: from the authors.

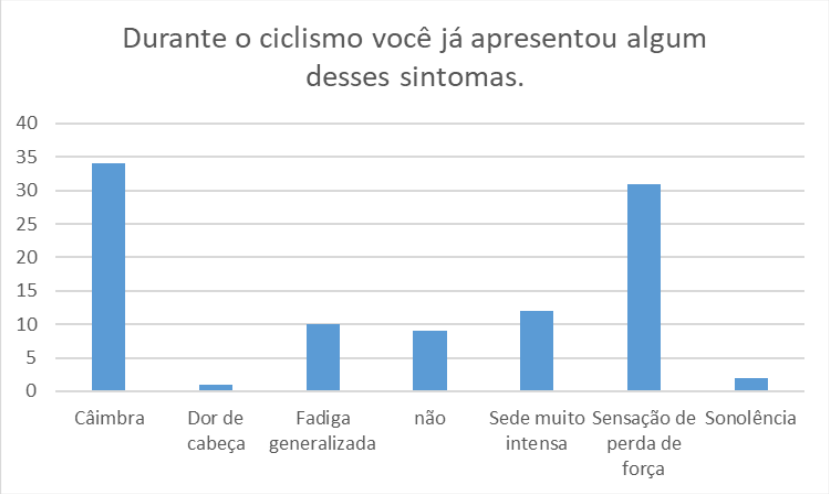
In relation to health, loss of performance, the cyclists were asked if they have ever felt any symptoms during training and cycling competitions, and the following data was obtained: 34% have had cramps, 31% a sensation of loss of strength, 12% very intense thirst, 10% generalized fatigue, 2% drowsiness 1% headache, and 10% no symptoms.

In the study by Cruz *et al.* (2009) on hydration habits in mountain bike athletes, there were reports that in 68.8% of the sample had suffered from loss of strength, 54% had cramps, 47.5% had thirst, 47.5% had fatigue, 33.1% had headache, 1.2% had drowsiness, and 2.9% had fainting and hallucinations. Marins (2011) cites that a dehydrated subject may have alterations in the ideal concentrations of electrolytes, especially sodium (Na+) and cramps, which in addition to impairing performance, is considered one of the symptoms of dehydration. Thus, 34% of the respondents had cramps that could be avoided with proper hydration during training or cycling competition. The 31% of the present study who experienced a loss of strength could have been avoided if a carbohydrate replacement strategy was adopted, as well as optimal hydration.

Gomes *et al.* (2014) report that the sensation of thirst is only perceived when a dehydration equivalent to a loss of approximately 2% of body mass, has already occurred. In the study by Marins (2011) on symptoms occurring with athletes in different modalities, cyclists had cramps in 43.8% of the respondents, mountain bike athletes 54.95% and triathletes 35.9%, values similar to this study. Regarding the loss of strength, 41% of cyclists had cramps and 68.8% of mountain bike athletes had a loss of strength, probably due to dehydration and lack of feeding strategy during the race. Regarding generalized fatigue, 36% and 47.52% of cyclists and mountain bike athletes, respectively, reported the occurrence.

Very intense thirst, which can be the cause of several symptoms, happened to 53% of cyclists and 47.5% of mountain bike athletes. These figures are very high compared to those found in the present study, in which only 12% had experienced very intense thirst. This data may indicate that cyclists are already much more aware and have their own resources to carry water and hydrate properly during training sessions and mountain bike competitions. All these symptoms may be related to altered water homeostasis, such as a state of hypoglycemia or muscle glycogen depletion caused by inadequate energy intake during cycling (Marins 2011).

Figure 18: During cycling, training, touring, or competition, did the athlete experience any of the symptoms related to diet and hydration.

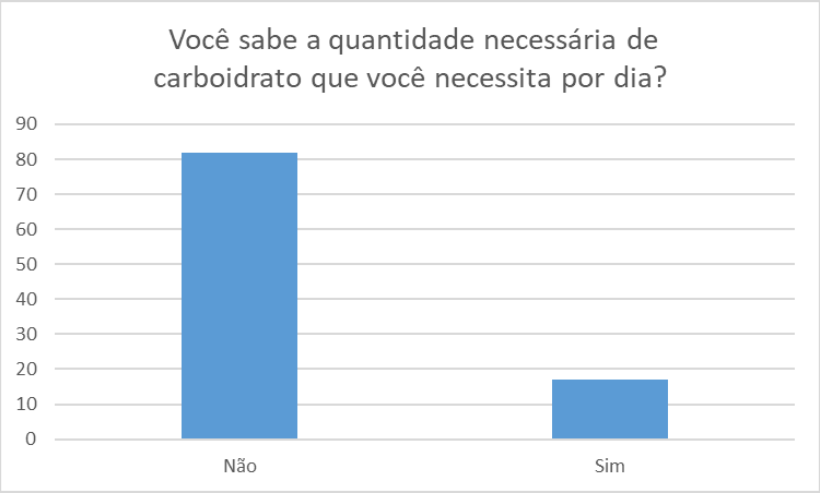


Source: from the authors.

Regarding the cyclist's energy demand, in order for it to be met, it should have a distribution with 60 to 65% of carbohydrates in relation to the total daily energy value. To promote muscle recovery, carbohydrate consumption should be between 5 and 8 g/kg body weight per day, and for long duration or intense workouts, for an adequate recovery of muscle glycogen as preservation, carbohydrate consumption can be recommended up to 10g/kg per day (OLIVEIRA, 2013).

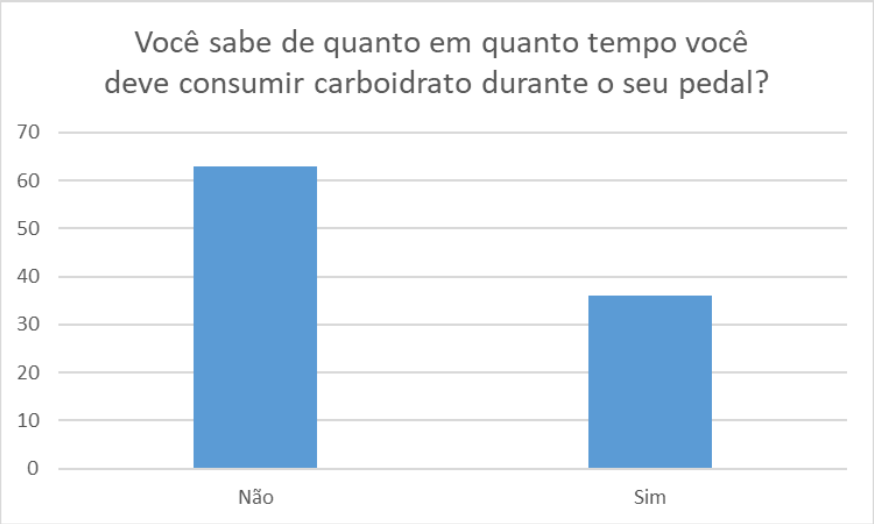
In the present research (figure 19) it was found that 83% do not know the necessary amount of carbohydrate per day and 17% know the necessary amount per day. *Mountain biking* requires a high demand of aerobic power, given by the high percentage of maximum heart rate, which predominates the participation of carbohydrates as an energy source. The lack of specific knowledge about the correct intake of this nutrient, may explain in part, the use of different substances such as amino acids as an energy substrate, nutrient that only occurs its participation as an energy source in long duration activities (COSTA et al 2007). Martinez (2020), recommends that the carbohydrate intake for cyclists, especially for mountain biking, is adequate according to the intensity. Being the recommendations for low intensity exercise between 3 to 5 g/kg of weight, moderate intensity exercise from 5 to 7 g/kg of weight, high intensity exercise from 7 to 12 g/kg of weight and extreme intensity exercise from 10 to 12g/ of body weight. Marchesato and Souza (2011) cite that for endurance races, cyclists should ingest between 7 and 8 g/kg body weight or 30 to 60 g of carbohydrates in order to avoid hypoglycemia, glycogen depletion, and fatigue.

Figure 19: Knowledge of the required amount of carbohydrate in the view of cyclists.



Source: from the authors.

Figure 20. Level of knowledge of how often to consume carbohydrates.



Source: from the authors.

During cycling training, the athlete must maintain adequate body stores of glycogen to perform the activities, given the need for glucose for skeletal muscle contraction to occur. The estimate of carbohydrates will depend on body weight, the hours of training in the day, and the intensity of effort of the activity (MARTINEZ 2020).

The study in question asked whether cyclists are aware of how long they should consume carbohydrates during cycling (figure 20) and it was found as a response that 64% do not know and 36% know about the amount of carbohydrate for cycling.

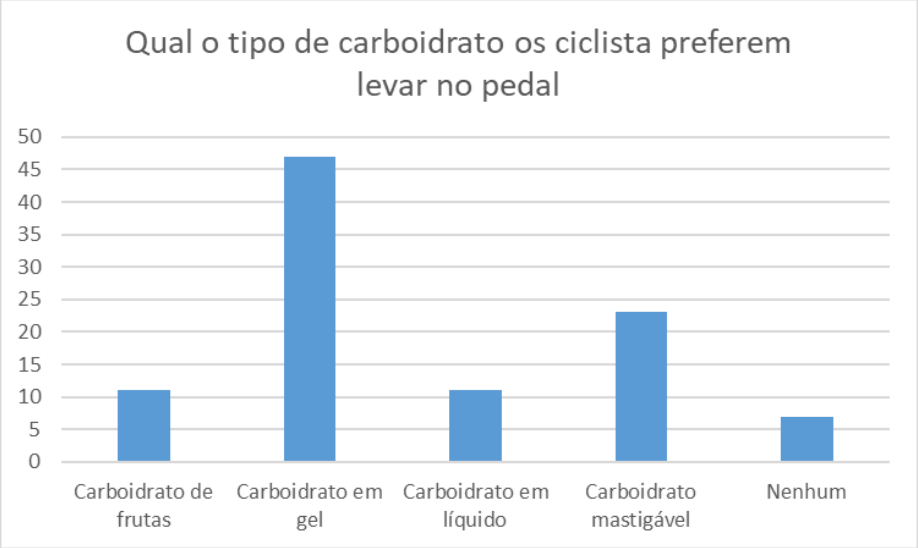
To maintain favorable blood glucose levels to keep up the pace in competitive effort, the cyclist should ingest 45 to 60 g of carbohydrates per hour (MARTINEZ 2020). This is because carbohydrate intake preserves blood glucose levels, sustaining the depletion of muscle glycogen stores and reducing fatigue in the face of physical exertion (MUHLEN and SCHAUREN 2018).

Maia et al. (2022) cites that adequate carbohydrate replacement should start after 1 hour of intense exercise, with an ideal intake of 30 to 60g per hour. Oliveira (2013) also agrees with the intake of 30 to 60g per hour and reports that the concentration of carbohydrate offered should be around 6% (6 g of

carbohydrate per 100ml of liquid), to improve the performance of endurance athletes, and the upper limit of concentration is 8%, since higher values are inadvisable because it decreases the gastric emptying speed and consequently the absorption of water and carbohydrate.

Intake of carbohydrates in interval form, every 15 to 20 minutes over two hours, has been shown to be more effective than consumed in a single amount after two hours of exercise (OLIVEIRA, 2013).

Figure 21: Which type of carbohydrate cyclists prefer to take on the pedal.



Source: from the authors.

The type of carbohydrate interferes both in the absorption and in the improvement of performance. When cyclists were asked what type of carbohydrate they prefer to take on the pedal (figure 21), 11% responded that they use carbohydrate from fruit, 48% carbohydrate gel, 11% liquid carbohydrate, 23% chewable carbohydrate and 7% no type of carbohydrate. D'Elia (2009) cites that during training, due to the intensity and duration of the activity, the moderate use of carbohydrate solutions (glucose, maltodextrin and fructose) can be used. This is a strategy for training days, since it is difficult to have intermediate meals on these days.

Therefore, in the study in question it was found a large amount of consumption of carbohydrate gel and chewable carbohydrate, due to the fact that they are good sources of carbohydrate, besides being easy for transportation and consumption during training. How the carbohydrate will be ingested, whether in a bar or gel, or even in a sports drink, seems to make no difference, as long as water is consumed as well (OLIVEIRA 2013).

In the study by Cazal (2010), about what Brazilian cyclists had nutritional practices, it was found that 33.3% consume energy bars, 55.3% carbohydrate drinks, 53.7% isotonic drinks, 51.5% carbohydrate gels, 10.6% protein bars, 2.2% banana, 3.7% fruit candy, 1.5% bread and 1.5% rapadura. The data differs a little from that found, probably due to the fact that the study of Cazal (2010) was conducted with athletes who participated in cycling race professionally, different from the athletes of the present study who were amateur athletes. But even so, the consumption of carbohydrate in gel form was very close to the data, perhaps due to the affordable price, ease of transport and easy consumption.

Sareban and colleagues (2016) evaluated *triathlon* participants *by* asking about the intake of carbohydrate in gel form and liquid carbohydrate and observed that of the nine athletes, seven reported gastrointestinal discomfort, with no participant reporting gastrointestinal discomfort with the consumption of the liquid carbohydrate. Performance was not affected by the intake of liquid carbohydrate compared to the gel form. The choice of carbohydrate will depend on the cyclist's preference. It is worth remembering that the way the carbohydrate will be offered as well as the amount of carbohydrate to be offered should be tested during training and never during periods of long training or competition, in order to avoid any gastrointestinal discomfort or problems with adaptation (OLIVEIRA 2013).

4 CONCLUSION

This study showed that amateur athletes are aware of the importance of carbohydrates to improve performance, and most consider the intake before training the ideal time for consumption, besides having knowledge about the ideal sources of carbohydrates. The big concern is in whom cyclists take into account when making their food choices, because most participants do not follow up with a nutritionist, giving importance to guidelines they receive from people who are not specialized in the subject.

Furthermore, it can be concluded that most participants do not know the ideal amount of carbohydrates to be consumed, nor do they know how often carbohydrates should be consumed during pedaling, and the nutritionist's guidance could make the difference in the performance and health of these individuals.

Therefore, it is necessary to provide guidance on the importance of nutritional monitoring for the practice of physical activity in general and more specifically for amateur cycling, which is a practice that has increased a lot in recent years.

REFERENCES

BONIFÁCIO, Luiza Pereira di. Direcionamento Nutricional para o Triathlon: da ciência à prática. São Paulo, SP: Literare Books International, 2020.

CAMARGO, M.M.; MADEIRA, R.A.; NAVARRO, F.. Consumo de Suplementos por Usuário Mountain Bikers Amadores. Revista Brasileira de Nutrição Esportiva, São Paulo. v. 4, n.20, p. 115-120, março/abril, 2010.

CAZAL, Mariana de Melo. Práticas Alimentares, Efeitos do Índice Glicemico e da Hidratação no Desempenho de Ciclistas. Dissertação de mestrado. Viçosa – MG – Brasil, 2010.

COSTA, V. P.; *et. al.* Aspectos Fisiológicos e de Treinamento de Mountain Bikers Brasileiros. Revista de Educação Física, n.136, março, 2007.

CRUZ , M.A.E., *et al.* Nível de Conhecimento e Hábitos de Hidratação dos Atletas de Mountain Bike. Fitness & performance Journal, mar-abr, 2009.

D'ELIA, José Rubens. Ciclismo: Treinamento, Fisiologia e Biomecânica. São Paulo: Phorte, 2009.

FACCIN, A.P.M. *et. al.* Avaliação do Consumo Dietético, Desidratação e Grau de Fadiga em um Grupo de Ciclistas Amadores. Revista Brasileira de Nutrição Esportiva, São Paulo, v. 12, n.73, p. 636-646. set/out, 2018.

GOMES, Luís Paulo Souza; *et. al.* Estado de Hidratação em Ciclistas Após Três Formas Distintas de Reposição Hídrica. Revista Brasileira Ciência & Movimento, 2014.

GONÇALVES, Álisson Carvalho; et al. Efeito da Ingestão de Carboidrato Sobre o Desempenho Físico Durante Treino de Ciclismo Indoor. Revista Brasileira de Nutrição Esportiva, São Paulo, v.11, n. 62, p.185-191, mar./abril. 2017.

HERNANDEZ, A.J.; NAHAS, R.M. Modificações dietéticas, reposição hídrica, suplementos alimentares e drogas: Comprovação de ação ergogênica e potenciais riscos para a saúde. Revista Brasileira de Medicina do Esporte, v.15, n.3, 2009.

JEUKENDRUP, Asker. A Step Towards Personalized Sports Nutrition: Carbohydrate Intake During Exercise. Sports Med., v.44, n.1, p.25– 33, 2014.

MAIA, R.C.V.S.; *et.al*. Perfil Nutricional de Ciclistas Atendidos no Projeto de Extensão "Nutrição Esportiva e Saúde (NUTRES)'' da UFMS. Revista Brasileira de Nutrição Esportiva. São Paulo, v. 16, n.97. p. 73-85, mar/abril, 2022.

MARCHESATO, F.S.; SOUZA, E.B. Recomendações de Macronutrientes para Ciclistas: Uma revisão bibliográfica. Caderno UniFoa, Edição especial do curso de Nutrição, novembro, 2011.

MARINS, João Carolos Bouzas. Hidratação na atividade física e no esporte: Equilíbrio Hidromineral. Editora Fontoura, 1ed. Várzea Paulista, SP, 2011

MARTÍNEZ, Sheila Iturriaga. Plan Nutricional para un Ciclista em la Disciplina Mountain Bike. Nutricion clínica y dietética hospitalaria, v.40, n.3, p.180- 184, 2020.

MORO, T.; *et. al*. Time-Restricted Eating Effects on Performance, Immune Function, and Body Composition in Elite Cyclist: a Randomized Controlled Trial. Journal of the international Society of sport Nutrition, 2020.

MUHLEN, L.V.; SCHAURE, B.C.. Consumo Alimentar e Hábitos de Hidratação de Participantes Amadores de uma Prova de Ciclismo de Longa Duração. Revista Brasileira de Nutrição Esportiva, São Paulo, v.12, n.76, suplementar 2, jan/dez 2018.

OLIVEIRA, D.C., *et. al.* Suplementação e Automedicação no Ciclismo Amador. VIII seminário de Pesquisas e TCC da FVG, 2014.

OLIVEIRA, Josie de Souza. Recomendações Nutricionais e o Desempenho no Ciclismo. In Bases para o Desempenho no Ciclismo. Da Avaliação à Estratégia de Prova. Tony Meireles Santos (organizador). Editora CRV. Curitiba, PR. 2013

PATROCÍNIO, D.L.. *et.al.*. Uso Referido de Suplementos Alimentares por Corredores de Montanha. Revista Brasileira de Nutrição Esportiva, São Paulo, v.11, n.58, 2017.

PIGNATA, B.H., *et.al.* Nutrição Esportiva em Atletas de Triathlon Sob o Consumo Alimentar e Gasto Energético. Revista Brasileira de Nutrição Esportiva, São Paulo, v.14, n.88, p. 427-436, set/out, 2020.

PIRES, Amanda Nunes. Avaliação do uso de Suplemento Esportivo e Conhecimento em Nutrição por Praticantes de Ciclismo Indoor em Academia de Cinco Regiões da Cidade de Belo Horizonte MG. Revista Brasileira de Nutrição Esportiva. São Paulo, v.5, n27, p. 251-256. maio/junho 2011.

SANTOS, G.S., SILVA, A.M. Hidratação e Alimentação no Pré, Durante e Após a Prática de Ciclismo por um Grupo de Desportistas do Município de Taubaté-SP. Journal Health Scienci inst, 2021.

SAREBAN, M., *et. al*. Carbohydrate Intake in Form of Gel is Associated With Increased Gastrointestinal Distress But not With Performance Differences compared With Liquid Carbohydrate Ingestion During Simulated Long-Distance Triathlon. Internaticonal jornal of sports nutrition and exercise metabolismo. 2016.

SILVA, J.F. *et.al*. Perfil do Estado de Hidratação e Dietético em Atletas de Ciclismo. 70 º reunião anual da SBPC, UFAL, Maceio – Al. 2018.

SITIKO, S. *et. al.* Effects Of a Low-Carbohydrate diet on Performance and Body composition in Trained Cyclist. Nutr Hosp. 2019.

ANNEX 1

Questionnaire Applied To Athletes To Verify The Level Of Knowledge About Carbohydrate Consumption

Age: ( )years

Sex: ( )Male ( )Female

How many years have you been cycling:

You are in the habit of hydrating yourself:

( ) Never

( ) Almost never

( ) Sometimes

( ) Always

When you hydrate, do you worry about the type of hydration (water or isotonic) in the moments before, during or after training?

( )Yes

( )No

At what point do you consume water?

( )Before ; ( )During ; ( )After ; ( )No time; ( )Before, during and after.

At what point do you consume drinks with carbohydrates?

( )Before ; ( )During ; ( )After ; ( )No time; ( )Before, during and after.

When should one drink liquids?

( ) Before the sensation of thirst

( ) Only after feeling thirsty

( ) When you feel very thirsty

What liquid solution do you use to hydrate yourself?

( ) Water ( ) Isotonic ( ) Soft Drinks ( ) Natural Juices ( )Coca-Cola ( )Beer ( )Coffee ( ) Others

Do you consume food supplements?

( )Yes

( )No

At what point do you take supplements?

( )Before ( )During ( )After ( ) I do not consume supplements

What supplements do you consume?

( ) Maltodextrin ( ) Carbohydrate gel ( )Whey Protein ( ) Creatine

( ) Thermogenics ( ) BCAA ( ) Vitamin complex ( ) Others

( ) No supplements

Do you know the importance of carbohydrates for exercise such as cycling?

( )Yes ( )No ( )More or Less

At what point do you think carbohydrate intake is most important in cycling?

( )Before ( )During ( )After ( ) I don't know

Tick the carbohydrate sources

( ) honey ( ) rice ( )beans ( )potato ( )lettuce ( )egg ( )fish ( )apple

( ) Banana ( ) Butter ( ) Flour ( )Milk ( ) Bread ( ) Macaroni ( ) Cheese

Tick the food you consume before the pedal stroke?

( )Biscuit ( )Rice ( )Beans ( )Pasta ( )Cake

( )Maltodextrin ( )Carbohydrate Gel ( )Rapadura ( )Paçoca ( )Juices ( )Others

Tick the food you eat during the pedal stroke

( )Biscuit ( )Rice ( )Beans ( )Pasta ( )Cake

( )Maltodextrin ( )Carbohydrate Gel ( )Rapadura ( )Paçoca ( )Juices ( )Others

Mark the food you eat after the pedal stroke

( )Biscuit ( )Rice ( )Beans ( )Pasta ( )Cake

( )Maltodextrin ( )Carbohydrate Gel ( )Rapadura ( )Paçoca ( )Juices ( )Others

Have you ever been guided by a nutritionist?

( ) Yes ( ) No

When it comes to food, who do you base it on?

( )Friends ( )Family ( )Nutritionist ( )Physical Education Teacher ( )Physician ( )Pharmacist ( )Physiotherapist ( ) Books ( )Magazines ( )Parents ( )Others

While cycling (touring, training, or competing), have you experienced any of these symptoms?
( ) Very intense thirst ( )Cramps ( ) Paleness ( )Deep Eyes ( ) Drowsiness ( ) Sensation of loss of strength ( ) Headache ( ) Fainting ( ) Generalized fatigue ( ) Interruption of planned activity ( ) Momentary loss of consciousness.

Do you know how much carbohydrate you need per day?
( )Yes ( )No

Do you know how often you should consume carbohydrate during your cycling?
( )Yes ( )No

What type of carbohydrate do you prefer to take with you on the bike?
( ) Carbohydrate gel
( ) Carbohydrate in liquid
( ) Chewable carbohydrate
( ) Carbohydrate from fruit
( ) None