

Dietary practices of Brazilian mountain bikers before and during training and competition

Mariana de Melo Casal¹, Rita de Cássia Gonçalves Alfenas¹, Maria do Carmo Gouveia Peluzio¹,
Vânia Mayumi Nakajima², Stella Lucia Volpe³, Paulo Roberto dos Santos Amorim¹, João Carlos Bouzas Marins¹

¹Federal University of Viçosa Brazil.

²Federal University of Minas Gerais.

³Drexel University, Philadelphia, Pennsylvania, USA.

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Summary

Background: The quality of the consumed diet is important for the improvement in performance during training and the achievement of positive results on competitions. The objective of study was to investigate the breakfast practices, and nutritional strategies used before and during training and competition of cyclists participating in the biggest mountain biking competition of Brazil.

Methods: The participants (n = 146) were asked to complete a questionnaire during the distribution of kits on the day before the competition. The questionnaire included 13 questions about the participants' characteristics, pre-training and pre-competition usual breakfast and meal consumption, and systemic or gastrointestinal symptoms during exercise. All statistical analyses were conducted using SigmaStat 3.1 software.

Results: 97.54% of participants consumed breakfast pre-training, while all participants consumed a pre-competition breakfast. After the analyses, banana and bread were the most consumed foods for pre-training and competition breakfast. Forty-two percent and 58 % of the participants consumed some supplement during the morning of the training and competition, respectively. Most participants indicated the consumption of some form of supplement during training (88.35%) and competition (97.25%). About 30% and 54% used three or more types of energy replenishment strategies during the training and the competition, respectively. 86% of the participants reported some form of adverse symptom during the training or race.

Conclusions: Our study demonstrated that most of the mountain bikers interviewed consumed breakfast before exercise, although most of the foods chosen for breakfast were not appropriate for a pre-exercise meal. Moreover, these cyclists had a high ingestion of supplements before and during exercise, often being used as substitutes for food. The information obtained about these supplements was provided by unreliable sources in 43% of athletes. It is also suggested that these athletes should be better informed about risks and benefits of supplements use.

Key words:

Sports. Nutrition surveys.
Carbohydrates.
Food supplements.
Food intake. Exercise.

Prácticas dietéticas de los ciclistas de montaña brasileños antes y durante el entrenamiento y la competición

Resumen

Introducción: La calidad de la dieta es importante para la mejora del rendimiento tanto a la hora de entrenar como para obtener el logro de resultados positivos en competiciones.

El objetivo del estudio fue investigar las prácticas dietéticas en el desayuno, y las estrategias nutritivas usadas antes y durante el entrenamiento y la competición en ciclistas de montaña que participan en la mayor prueba de ese tipo en Brasil.

Metodología: Los participantes (n = 146) fueron reclutados para completar una encuesta durante la recogida de materiales de identificación de los equipos en el día previo a la competición. La encuesta incluyó 13 preguntas sobre sus conductas nutricionales, pre-entrenamiento y pre-competición sobre el desayuno usual y consumo de la comida, síntomas sistémicos o gastrointestinales durante el ejercicio. Para el análisis estadístico se utilizó el programa SigmaStat 3.1.

Resultados: Un 97,54% del total aseguraron tomar el desayuno antes del entrenamiento, y todos los participantes desayunaron antes de la competición. Después de los análisis, el plátano y pan estaban en la mayoría de las comidas pre-entrenamiento y competición. 42% y 58% de los participantes consumieron algún suplemento por la mañana antes del entrenamiento y competición, respectivamente. La mayoría de los participantes indicó el consumo de algún tipo de suplemento durante el entrenamiento (88,35%) y competición (97,25%). Aproximadamente, 30 y 54% usaron tres o más tipos de estrategias para reponer energía durante el entrenamiento y la competición, respectivamente. Un total de 86% de los participantes informaron haber tenido algún síntoma adverso durante el entrenamiento o competición.

Conclusiones: Se demostró que la mayoría de los ciclistas realizan algún desayuno antes del ejercicio, aunque la mayoría de los alimentos escogidos no eran apropiados para una comida pre-ejercicio. Los ciclistas tenían una ingestión alta de suplementos antes y durante el ejercicio, usándose a menudo como sustitutivo de la comida. La información obtenida sobre estos suplementos fue proporcionada por las fuentes no fiables en 43% de los deportistas. También se sugiere que estos atletas se informen bien sobre los riesgos y beneficios del consumo de suplementos.

Palabras clave:

Deportes.
Encuestas nutricionales.
Carbohidratos.
Suplementos dietéticos.
Ingesta de alimentos. Ejercicio.

Correspondencia: João Carlos Bouzas Marins

E-mail: jcbouzas@ufv.br

Introduction

The type of foods included in physically active individuals' and athletes' diet is important for health¹. The quality of the consumed diet is also important for the achievement of an adequate body weight and composition, for the improvement in performance during training and the achievement of positive results on competitions¹⁻³.

The pre-exercise meal should provide sufficient energy for exercise. Because many athletes train and compete in the morning, the pre-exercise meal is often breakfast^{4,5}. Among all meals, breakfast is considered the most important meal of the day, because it occurs after 8 to 12 hours after fasting, leading to an important reduction in glycogen storage⁶. Therefore, the pre-exercise meal must be highly digestibility, rich in carbohydrate, and lower in fat and protein. Moreover, foods with high sugar content should be avoided. The consumption of high glycemic index meals, can induce hyperinsulinemia, followed by hypoglycemia; resulting dizziness and nausea during exercise⁷. Before exercise, the athlete should ingest carbohydrate food sources that are able to maintain euglycemia, reduce muscle glycogen utilization and avoiding insulin peaks⁸. Therefore, the consumption of low glycemic index foods is recommended, due to its slow digestion and absorption, leading to a gradual release of energy to the tissues and delaying the occurrence of fatigue⁹.

In long-duration exercises, such as cycling training and competition, carbohydrate intake during the exercise becomes essential, because the endogenous reserves of glycogen are limited and hepatic glucose production can sustain euglycemia only for about 1.5 to 2.5 hours with sub-maximum exercise¹⁰.

Although a number of researchers have examined the effect of carbohydrate ingestion before and during exercise on endurance performance, the available literature on dietary practices, including information on the use of dietary supplements and sports foods, before and during training and competition in mountain bikers is limited.

Considering the importance of the pre-exercise meal, especially if this is the first meal of day, and also the relevance of carbohydrate ingestion before and during long duration exercises, the objective of the present study was to investigate the breakfast dietary practices, and nutritional strategies used before and during training and competition of cyclists participating in the biggest mountain biking competition of Latin America.

Materials and Methods

The Iron Biker is a two-day annual ultra- endurance cycle race held in Ouro Preto - Minas Gerais, Brazil. It is considered one of the most important races of the Brazilian Confederation of Cyclism. Among the 439 mountain bikers who registered for the 2009 Iron Biker, 150 (34.17%) expressed interest in participating in this dietary survey study. The study was evaluated and approved by the Ethics Committee of Human Research of Viçosa Federal University.

Recruitment of mountain bikers for the study occurred during the distribution of kits on the day before the race. After a verbal explanation of the nature and objectives of the study, the cyclists who volunteered

were individually interviewed, though their identities were never given. After an explanation of how the study would be conducted, those who did not want to participate in the research study were released.

The questionnaire was developed specifically for our study, and was also based on previous, questionnaires developed by Havemann and Goedecke¹⁰ and Cruz *et al.*⁴. The questionnaire included 13 questions about the participant's characteristics (gender, age, demographics and training data), pre-training and pre-competition usual breakfast and meal consumption, overall dietary intake, and the occurrence of systemic (e.g., headaches, dizziness, cramps) or gastrointestinal (e.g., nausea, vomiting) symptoms during training and competition. Vitamin and mineral supplements were excluded from the analysis. All participants were also asked about the reasons of their nutritional choices.

One week before the application of the questionnaire, the three researchers were provided with the appropriate forms to correctly complete the questionnaire. The researchers were required to register any food, beverage, or supplement consumed by the participants, describing the types of all the products consumed (e.g., full cream milk, white bread).

This questionnaire was pilot-tested twice to ensure clarity, to close open-ended questions, to check the time taken for questionnaire completion by interviewer and to eliminate any question difficult to understand. The pilot study involved the participation of 30 mountain bikers who raced in the national competition (Brazilian Cycling Championship) in Belo Horizonte - Minas Gerais, and 26 cyclists of who participated in a local competition (Cross-Country) in Viçosa - Minas Gerais. The mountain bikers who participated in the pilot study were not included in the sample of this study. Data analyses were performed by a registered dietitian.

Statistical Analyses

Values are presented as mean \pm standard deviation (mean \pm SD) and median (for those that failed in the normality test). All statistical analyses were conducted using SigmaStat 3.1 software (SPSS Inc, Chicago, IL, EUA). Descriptive statistics were used to calculate mean and SD for age, training time per week, median for years of sport practice, and the usual time the last meal is consumed prior to exercise. The Mann-Whitney test was used to compare time of last meal intake prior to training and competition. Frequency analysis was calculated for each question, discarding unanswered questions. The predetermined level of significance for the study was $p \leq 0.01$.

Results

Participants Characteristics

Among the 150 mountain bikers who answered the questionnaire, one participant did not complete the questionnaire and three participants were excluded because they were in their first competition. Therefore, 146 participants completed the study. The majority (93.15%) were men, between 13 to 63 years of age (mean = 36.28 ± 10.06 years), 38.35% were from Minas Gerais and living in 19 different cities in the state. On average, the mountain bikers trained $4.3 (\pm 1.5)$ times/week with a duration of $2.5 (\pm 1.0)$ hours/day, and a median of 7.0 years of sport practice. All individuals were Brazilian.

Pre-exercise Breakfast

Tables 1 and 2 provide specific information about the most frequently consumed foods, beverages, and supplements for pre-exercise breakfast. Among the participants who train in the morning (n = 122), 97.54% ingested pre-training breakfast, while all participants consumed a pre-competition breakfast. A total of 28 different types of solid foods and 8 beverages were consumed for breakfast. Banana, white bread and whole meal bread were the most consumed foods for training and competition breakfast. Coffee was the most popular beverage for training and competition breakfast, followed by fruit juice and whole milk (Table 1).

Forty-two percent and 58% of the participants ingested supplement with breakfast on the morning of the training and competition,

Table 1. Consumption of Food and Beverage in the Breakfast Before Training (n = 119) and Competition (n = 146).

Food or beverage	Training		Competition	
	%	n	%	n
Foods				
Apple	26.89	32	25.34	37
Avocado	1.68	2	1.37	2
Banana	61.34	73	57.53	84
Biscuits	3.36	4	3.42	5
Cake	1.19	1	6.85	10
Cornflakes	3.36	4	3.42	5
Curd	4.20	5	4.79	7
Egg	5.88	7	8.22	12
Granola	13.44	16	13.01	19
Grape	1.68	2	2.74	4
Ham	10.08	12	10.96	16
Honey	11.76	14	11.64	17
Jelly	6.72	8	6.16	9
Margarine or Butter	12.60	15	12.33	18
Melon	5.88	7	7.53	11
Nuts	1.19	1	0.68	1
Oats	11.76	14	10.27	15
Orange	1.68	2	2.05	3
Papaya	26.05	31	25.34	37
Pasta	2.52	3	8.22	12
Potatoes	1.68	2	4.10	6
Other Fruits	2.52	3	4.79	7
Soya beans	2.52	3	2.74	4
Sugar	4.20	5	2.74	4
Toast	2.52	3	2.05	3
Watermelon	4.20	5	6.85	10
White Bread	50.42	60	52.74	77
Wholemeal Bread	36.13	43	37.67	55
Beverages				
Coffee	40.34	48	43.84	64
Fruit Juice	35.29	42	41.78	61
Non-fat Yoghurt	4.20	5	2.74	4
Skim Milk	23.53	28	20.55	30
Soft Drinks	0	0	1.37	2
Soy Milk	4.20	5	2.74	4
Yoghurt	6.72	8	8.90	13
Whole Milk	27.73	33	26.02	38

The percentage was over 100%, because there was more than one answer for each question.

respectively. The types of supplements used were mainly carbohydrate beverages, branched-chain amino acids (BCAA), and isotonic sports drinks. After excluding participants who did not report intake of a supplement, 92% and 84.52% consumed a carbohydrate supplement during breakfast before training and competition, respectively.

Pre-exercise Meal

Some mountain bikers, who train in the morning, consumed another meal after breakfast just before training (5%). The meal before training mainly included supplements (carbohydrate and BCAA supplements) and bananas. On the competition day, 19% of cyclists consumed another meal after breakfast. This meal was similar to training days, and the participants ingested mainly supplements (carbohydrate bars, carbohydrate gels and isotonic sports drinks) and bananas (Table 3).

The time of the last meal consumed prior to competition (60 minutes) was significantly higher compared with the consumption of the last meal prior to training (45 minutes) (p < 0,001). The reasons for selecting specific foods for breakfast and the pre-exercise meal are listed in Table 4. The main reason for selecting specific foods was preference (30.14 %).

Dietary and Supplement Intake During Exercise

Most participants (88.35%) indicated the consumption of some form of supplement during training, with 73.97% consuming only supplements and 14.38% consuming supplements and food. Three participants relied on food alone and 9.58% did not consume anything.

Table 2. Supplements Used in the Breakfast Before Training (n = 50) and Competition (n = 84).

Supplements	Training		Competition	
	%	n	%	n
Carbohydrate supplements				
Isotonic sports drink	32	16	36.90	31
Carbohydrate beverages*	42	21	50	42
Carbohydrate gels	18	9	27.38	23
Carbohydrate bars	18	9	25	21
Protein supplements				
Protein bars	6	3	7.14	6
BCAA	32	16	47.62	40
Whey Protein	10	5	11.90	10
Creatine	2	1	0	0
Glutamine	0	0	1.19	1
Albumin	0	0	1.19	1
Other supplements				
Endurox®	4	2	2.38	2
Glicodray®	2	1	2.38	2
Glycerol	2	1	1.19	1
Caffeine	0	0	1.19	1
Accelarator®	2	1	1.19	1
CLA	2	1	1.19	1
NO	4	2	1.19	1

*Maltodextrin or dextrose diluted in water BCAA: Branched-Chain Amino Acids; CLA: Conjugated Linoleic Acid; NO: Nitric Oxide.

The percentage was over 100%, because there was more than one answer for each question.

Table 3. Supplements, Beverages and Food Consumed in the Second Meal Before Training (n = 6) and Race (n = 28).

Supplements, Beverages or Food	Training		Race	
	%	n	%	n
Supplements				
Isotonic sports drink	16.66	1	39.29	11
Carbohydrate beverages*	50	3	32.14	9
Carbohydrate gels	0	0	39.29	11
Carbohydrate bars	0	0	42.56	12
BCAA	50	3	28.57	8
Creatine	0	0	7.14	2
Beverages				
Fruit Juice	33.33	2	10.71	3
Milk	16.66	1	3.57	1
Food				
Bananas	50	3	35.71	10
Apple	33.33	2	21.43	6
Pear	33.33	2	0	0
Cereal	16.66	1	3.57	1
Bread	0	0	7.14	2

*Maltodextrin or dextrose diluted in water

BCAA: Branched-Chain Amino Acids

The percentage was over 100%, because there was more than one answer for each question.

Table 4. Reasons for Food Choice in Pre-exercise Breakfast and Meal By Brazilian Mountain Bikers (n = 146).

Reason	%	n
Preference	30.14	44
Energy Supply	28.77	42
Dieticians' indication	17.80	26
Practicality	15.07	22
Healthy foods	12.33	18
Food habit	8.21	12
Avoid gastrointestinal symptoms	7.53	11

The percentage was over 100%, because there was more than one answer for each question.

The main supplements used during training were carbohydrate beverages (50%), isotonic sports drinks (48.63%) and carbohydrate gels (46.57%) (Table 5).

During competition, most participants (97.25%) indicated the use of some supplement during the race; 84.24% used only supplements and 13.01% used supplements and food. Two participants relied on food alone and 1.36% did consume anything. The main supplements used during training were carbohydrate gels (81.5%), isotonic sports drinks (62.33%) and carbohydrate beverages (54.79%) (Table 5).

Among the participants who used supplements, all used carbohydrate supplements during training and competition. While 25.34% and 7.53% of the participants used one type of energy replenishment strategies during training and competition respectively, 34.93% and

Table 5. Supplements, Beverages and Food Consumed During Training and Competition By Mountain Bikers (n = 146).

Supplements, Beverages or Food	Training		Race	
	%	n	%	n
CHO supplements				
Isotonic sports drink	48.63	71	62.33	91
Carbohydrate beverages*	50	73	54.79	80
Carbohydrate gels	46.57	68	81.50	119
Carbohydrate bars	30.13	44	45.89	67
Protein supplements				
Protein bars	9.59	14	14.38	21
BCAA	7.53	11	10.96	16
Whey Protein	0	0	1.37	2
Other supplements				
Endurox®	0.68	1	2.05	3
Glicodray®	1.37	2	1.37	2
Glycerol	0.68	1	0.68	1
Caffeine	0.68	1	0.68	1
Accelerator®	0.68	1	1.37	2
Beverages				
Soft Drinks	4.79	7	5.48	8
Fruit Juice	2.74	4	1.37	2
Coffee	0.68	1	0.68	1
Milk	0.68	1	0.68	1
Food				
Fruit Sweets	3.42	5	2.74	4
Sugary sweets	1.37	2	1.37	2
Bananas	2.05	3	2.05	3
Apple	2.05	3	1.37	2
Nuts	1.37	2	2.05	3
Potato	0	0	0.68	1
Bread	1.37	2	1.37	2
Potato	0	0	0.68	1

*Maltodextrin or dextrose diluted in water.

CHO: Carbohydrate; BCAA: Branched-Chain Amino Acids.

The percentage was over 100%, because there was more than one answer for each question.

35.61% used two types of energy replenishment strategies, 19.18% and 35.61% used three types of energy replenishment strategies, and 10.27% and 18.49% used four or more types of energy replenishment strategies. The selected replenishment strategy used by the study participants were carbohydrate supplements or carbohydrate-rich foods (e.g., bananas).

Among the mountain bikers interviewed, 98.63% used supplements before and/or during training and competition. Primary sources of supplement information are specified in Table 6.

Reported Symptoms During Exercise

Eighty-six percent of the participants (n = 126) reported some form of adverse symptom during training or competition. The main symptoms were muscle cramps (67.46%), strength loss (48.41%) and hand numbness (36.50%) (Table 7).

Table 6. Sources of Information About Supplements Used Before and During Training and Competition (n = 144).

Source	%	n
Dieticians	36.80	53
Friends/fellow athletes	27.78	40
Coach/trainer	19.44	28
Media (magazines, newspapers, Internet)	15.27	22
No information	8.33	12
Doctors	7.64	11
Textbooks	4.86	7
Sales representative/promoter	1.39	2
Family members	0.69	1

The percentage was over 100%, because there was more than one answer for each question.

Table 7. Reported Symptoms During Exercise By Brazilian Mountain Bikers.

Symptoms	%	n
Muscle cramps	67.46	85
Strength Loss	48.41	61
Hands numbness	36.50	46
Intense thirst	31.74	40
Generalized fatigue	28.57	36
Head ache	15.07	19
Concentration difficulties	14.28	18
Heartburn	14.28	18
Gas or bloating	8.73	11
Visual alterations	4.76	6
Drowsiness	4.76	6
Pallor	3.97	5
Other	4.76	6

The percentage was over 100%, because there was more than one answer for each question.

Discussion

Many studies have been conducted to assess the effect of pre-exercise meals and nutritional strategies used during exercise on performance, as well as metabolic and physiological parameters^{9,11-14}; however, the evaluation of athletes' dietary practices before and during the exercise is necessary to provide effective dietetic strategies for overall health and improved athletic performance.

The importance of breakfast as the first meal of the day has been well established. Breakfast provides readily available energy to be used in the morning and during daily activity¹⁵. It becomes more important when it is the pre-exercise meal, because, it is responsible to restore muscle and hepatic glycogen before exercise, avoiding hypoglycemia and dehydration¹⁶. Breakfast skipping can alter the metabolism and cause low nutrient availability to the brain, damaging cognitive functions¹⁷. The maintenance of an adequate nutritional state is especially important in mountain bikers, because they usually have long training times and complex technical situations, requiring an optimal motor control

response. In this study, it was demonstrated that only three individuals did not consume breakfast before training, and none of them omitted breakfast before competition. This was a positive outcome, because after sleeping, if the mountain bikers did not consume any meal prior to competition, the combination of lack of food would result in a hypoglycemic state, as well as reductions in cognitive and physical performance. In contrast, Brasil *et al.*⁵ evaluated the food habits of 500 individuals who were physically active in the morning, 17.8% performed physical activity in fasted state.

White bread and whole meal bread were the most mentioned foods consumed by mountain bikers as pre-training and pre-competition breakfast items. These foods can be an important carbohydrate source if consumed in adequate quantity. It has been well-established that pre-exercise carbohydrates consumption can improve exercise performance¹⁸⁻²⁰. Nevertheless, these high glycemic index (HGI) foods. According to some authors, HGI foods should not be consumed before physical activity, mainly in the last hour previous to the exercise, because they may cause hyperglycemia, followed by increases in insulin, resulting in rebound hypoglycemia^{21,22}.

On the other hand, banana, a low glycemic index (LGI) food, was the most mentioned food consumed by the mountain bikers as a pre-training and pre-competition breakfast food. The consumption of a LGI meal, having a low-fat and moderate protein content, would be ideal prior to exercise. A LGI meal is slowly digested and absorbed, providing glucose slowly and constantly to the muscles during exercise, resulting in a slight rise in insulin and avoiding rebound hypoglycemia⁵.

The most consumed type of drink during pre-training breakfast was coffee. In two other studies^{5,23}, coffee was the preferred drink during breakfast for runners and physically active individuals. Caffeine consumption has been considered a possible ergogenic aid, mainly in high-intensity exercise, categorized by intermittent activity within a period of prolonged duration, including cycling²⁴. The possible mechanisms responsible for its ergogenic effect are: it acts as adenosine receptors antagonism; it favors fatty acids mobilization, increasing fat oxidation and preserving glycogen; it causes an increase in adrenaline and cortisol levels; and it may have antioxidant effects^{3,25,26}. There are many studies that have shown the beneficial effect of caffeine ingestion in a variety of exercise performance²⁷⁻²⁹. Nevertheless, the International Society of Sports Nutrition suggested that caffeine exerts a greater ergogenic effect when consumed in an anhydrous state compared to coffee²⁴. Since the results of the studies are controversial, it is necessary to monitor each individual response to observe if caffeine will have ergogenic effect.

The consumption of food supplements for breakfast was widely reported by the mountain bikers. The search for dietary practices that can improve sport performance has increased the interest in food supplement use instead of dietary practices adjusted to each sport performance objective^{30,31}. According to García-Rovés *et al.*¹⁶, athletes need to consume foods, not just for nutrients, but to reach training and competition nutritional requirements. They also stated that, a diet based on specific nutrients instead of satisfying all nutritional requirements could negatively affect performance, and more importantly, could alter the athletes' health. Meyer *et al.*³² and Maughan *et al.*⁶ emphasize that a balanced diet is recommended to meet energy requirements and provide nutrients needed for optimal training and competition.

Athletes' food choices are influenced by physiologic, nutritional, psychological and behavior factors. We observed that most mountain bikers chose their foods before exercise according to their preference. To obtain the proper amount of energy was the second factor that most influenced the participants' food choices. This result reflects these mountain bike competitors' profile. This competition gathered competitive and amateur mountain bikers, and this may be the reason for the different choices. We hypothesize that those cyclists who chose based on preference did not have the main objective of winning a competition and they did not have the knowledge of the importance of the meal as an energy source for the next exercise. Conversely, the cyclists who made their choices based on food as an energy source, were probably the more competitive athletes, and indicated the knowledge of the necessity of energy for training and competition. The point is not to avoid the foods that are of their preference, but to choose foods they prefer that would also provide adequate energy and nutrients, leading to better performance and minimize adverse symptoms (e.g., gastrointestinal upset). García-Rovés *et al.*¹⁶ verified that the foods that most contributed as energy sources for the competitive cyclists were the ones reported to be their favorite foods.

The results obtained in our study are corroborated by Robins and Hetherington¹⁷ who evaluated the dietary patterns of non-elite triathletes. They reported that, for less competitive triathletes, food choice was not an important part of the training and competition. According to these authors, the nutritional knowledge seems to be related to the competitive level. They also observed that the more experienced and well-trained athletes acquired the knowledge of the importance of their energy needs based on past experience, i.e. by the method "trial and error".

Nevertheless, in our study, almost 18% made their food choice following a registered dietitian's guidance. These athletes recognized that nutrition established by the expert would be most suitable to help them achieve the best performance. However, the fact that most respondents did not mention the registered dietitian, and considering that this is a professional able to provide appropriate guidance with individualized dietary plans for each athlete, indicates the need for intervention in this population group so that they recognize the importance of professional registered dietitian. Besides the lack of professional recognition, other factors impede the search for nutritional guidance, such as financial difficulties and lack of access to a registered dietitian who specializes in sports nutrition.

Regarding the consumption time of the last meal before training (45 minutes) and competition (60 minutes), it seems to be sufficient for digestion of food consumed by most mountain bikers evaluated. This fact can be confirmed in the question relating to symptoms experienced during exercise, in which symptoms that may be related to poor digestion, such as heart burn, gas formation and bloating, were reported by a few respondents (23.01%). Robins and Hetherington¹⁷ evaluated non-elite triathletes in a qualitative study, and they also found that the digestion time of food consumed before exercise was enough to keep them physically comfortable during their activity.

In prolonged exercise, such as cycling training and competition, besides the pre-exercise meal, the carbohydrate consumption during

exercise is essential to avoid hypoglycemia. The study participants consumed an energy replacement during exercise in different ways, but mainly through the consumption of supplements, especially sports drinks (Table 4). Marins *et al.*³³ evaluated the hydration habits of marathoners, triathletes and cyclists; the cyclists had a high percentage (55.9%) of sports drink consumption during exercise. Havemann and Goedecke¹⁰ evaluated the nutritional practices of cyclists before and during an ultra-endurance event, and found that 89% of participants used supplements and foods during the race, and the sports drinks were the most used supplement. Athletes evaluated by Bescós *et al.*²⁶, Clark *et al.*³⁴ and Nazni *et al.*³⁵ also preferably consumed sports drinks during exercise.

Sports drinks are good supplements for several reasons: 1) they provide a quick source of energy through glucose, 2) they hydrate the body, and 3) they increase water absorption in the small intestine and compensate for the loss of electrolytes in sweat^{15,36,37}. Therefore, isotonic sports drinks are recommended, whose composition varies between 4% to 8% of carbohydrate and it has electrolyte concentrations similar to blood plasma^{1,3}. In our study, 32% and 36.9% consumed an isotonic sports drink during training and competition, respectively. However, most respondents (42% in training and 50% in competition) made their own sports drink, diluting dextrose or maltodextrin and salt in water. While this practice is cheaper and widely used in sports, if the athlete is not aware of the quantities of carbohydrate and salt needed to produce an isotonic sports drink, this drink becomes a detrimental factor to his/her performance. If the drink has a carbohydrate concentration below the recommended level, it would possibly not reach the energy requirements demanded by the exercise; or on the contrary, if the concentration is above the recommended (hypertonic drink), it may cause the secretion of body water into the intestinal lumen, promoting abdominal discomfort and possibly diarrhea, in both situations, performance could be impaired.

Besides sports drinks (isotonic and carbohydrate beverages), approximately 30% and 54% of mountain bikers used three or more types of energy replenishment strategies during training and competition, respectively. Although we did not analyze the amount of carbohydrate ingested during exercise, it is possible that those participants who used more than three energy replenishment strategies, for example, isotonic sports drinks, carbohydrate gels and carbohydrate bars, consumed a quantity of carbohydrates above the recommended levels, causing feelings of fullness, acid reflux, vomiting, and impaired performance. It should be emphasized that the carbohydrate consumption of these mountain bikers during competition may be higher than the ingestion during training sessions (Table 4). This assumption is based on the difference in the number of energy replenishment strategies used by the respondents during training and competition. Worme *et al.*³⁸ reported that dietary changes were common during competition. Indeed, Nazni *et al.*³⁵ demonstrated that 68% of athletes evaluated adopted a change in the dietary pattern at the time of competition. However, it is important to emphasize that the nutritional behavior during competition should be the same as training days, and any new nutritional strategy should be tested during training.

The use of dietary supplements before (at breakfast and/or the second meal) and during exercise was a common practice for the athletes

in our study (98.63%). This practice often may be dictated by wrong or inadequate information³⁸. It might be inevitable that mountain bikers, like other athletes, have some nutritional misconceptions because of their great interest in knowing more about diets to improve performance, and they acquire information through non-scientific sources, such as in sports magazines or advice from their peers¹⁷. In our study, 43% of respondents obtained information from friends, magazines, newspapers and the Internet. Tian *et al.*³⁹ reported that magazines, newspapers and the Internet were the main sources of information for supplement use by university athletes.

Although 49.3% of mountain bikers reported reliable sources for the use of supplements, such as a registered dietitian, physician and credible books. When combined, however, athletes received supplement information from coaches, friends, other athletes, family members and the media, more frequently than credible scientific sources. A similar result was obtained recently by Dascombe *et al.*⁴⁰, who evaluated elite athletes. In previous studies, the athletes were obtaining information for supplement use from family members⁴¹⁻⁴³, coaches⁴⁴⁻⁴⁹ and friends/other athletes⁵⁰. Usually, relatives, coaches and peers have no formal nutritional knowledge; thereby the reliability of the information presented by them to the athletes cannot be reliable⁵⁰.

In relation to the symptoms occurring during exercise, the majority (67.46%) of the respondents had already felt cramps. Helge *et al.*⁵¹ demonstrated that cramps were associated with high production of sweat and dehydration. According to Marins *et al.*³³, the onset of cramps is related to problems in mineral balance and water loss. The American College of Sports Medicine¹ complements concurs that muscle cramps are associated with dehydration, electrolyte deficits and muscle fatigue. In the study of Havemann and Goedecke¹⁰, they also found that cramps were one of the main symptoms experienced by participants during an ultra-endurance event. In our study, most participants who reported cramps during competition consumed less than 500 mL/ hour of liquid.

The second most frequent symptom reported by mountain bikers during exercise was the sensation of strength loss. In another study of mountain bikers, 68.81% of them reported feeling sensation of strength loss during exercise⁴. The strength loss may be due to several factors, mainly related to decreased muscle glycogen stores, changes in fluid homeostasis with dehydration that exceeds 2%, a state of hypoglycemia, or the combination of these factors.

One limitation of the current study was the convenience sample of mountain bikers, which limits the generalizability of the observed findings. It would also have been interesting to perform a body composition participants; however the dynamics of the study did not allow for this analysis. Another limitation was the analysis of only qualitative aspects of cyclists' nutritional practices before and during training and competition. Thus, it is suggested the future research uses quantitative dietary habits to enable better evaluation of the glycemic index of the pre-exercise meal, especially among those individuals who consume breakfast as the pre-exercise meal. The amount of carbohydrate consumed pre- and during exercise should also be evaluated in a quantitative manner. The correlation of these parameters will allow for a more in-depth analyses of athletes' consumption compared to current recommendations.

Conclusion

Our study demonstrated that most of the mountain bikers interviewed consumed breakfast before exercise. Moreover, these cyclists had a high ingestion of supplements before and during exercise, often being used as substitutes for food. The information obtained about these supplements was provided by unreliable sources.

These results lead to a better understanding of mountain bikers' nutritional practices, so physicians and registered dietitians can provide better nutritional support for this group of athletes. It is also suggested that these athletes should be better informed about risks and benefits of supplements use.

Competing interests

The authors declare that they have no competing interests.

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