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Nutritional Status and Adequacy of Dietary Intake of an Elite 1000m Flat Water Kayak Paddler

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Background: Sports performance, besides the mental and emotional features of the athlete, is the outcome from the correct combination of training load, rest/ recovery and nutrition. Nutritional deficits or excesses can be deleterious for sports performance, particularly in sports that rely on high power output as 1000m kayak paddler. Objective: To describe the nutritional intake habits of a highly performing kayaker, and its adequacy for training, as only few studies have focused on this type of sports. Methods: An elite male kayaker specialized in 1000m flat-water races, World Champion, European Champion and Silver medallist in the London Olympic Games (35 years) reported his food intake for 7 consecutive days during a specific preparation period. Results: Daily average energy intake was 3174 ± 306 kcal; the intake of carbohydrates was 47.8 ± 9.3% (4.4 ± 1.2 g.kg^{-1}*. body weight. day*$^{-1}$*), protein 20.8 ± 4.3% (1.9 ± 0.3 g.kg*$^{-1}$*body weight. day) and fat intake was 31.4 ± 5.2% (1.3 ± 0.2 g. kg*$^{-1}$ *body weight day. d*$^{-1}$*). Fiber average consumption was 23.6 ± 9.2 g/day and cholesterol 638 ± 218 g/day. While water-soluble vitamins were within the recommended levels, fat-soluble vitamins and beta-carotene were below athletes' recommendations. All macro minerals intake was within the Dietary References Intake (DRI) for general population values as well as the trace elements with exception of iodine and molybdenum. Also, an unbalanced ratio between omega-6/omega-3 fatty acids was observed. Conclusion: This kayaker had a caloric intake adequate to the training requirement of the analyzed week. However, a reduction in fat intake and an increment in carbohydrate should be promoted in order to achieve dietary recommendations for athletes. The low intake of fat-soluble vitamins and beta-carotene found may justify the use supplementation.*

Keywords: *kayaking, nutrition, macronutrients, vitamins, minerals*

Background

The balance between energy intake and expenditure is a primary concern for athletes. Ensuring adequate nutrition around training sessions is critical for recovery and performance (Beck et al. 2015). Energy requirements are individual, but are often high due to maintain a high level of lean muscle mass and the meet the needs of a high volume and frequency of training particularly in sports with a high-power demand like 1000m kayak paddling. For almost all sports, training and

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competition at the highest level is incompatible with energy deficits. Chronic energy deficits in active subjects reduces the size of fast-twitch fibers (Henriksson 1992), which are important for flat-water elite canoeists. Athletes may experience chronic fatigue when carbohydrate intake is insufficient to match energy demands of heavy training (Costill et al. 1988) and kayak paddling gets the majority of fuel from carbohydrate given its intensities above 75% VO2max (Stellingwerff 2011). Several studies point to nutritional deficits and/or nutritional imbalances, mainly reduced CHO intake, in different sports as young male soccer players (Rodrigues Santos and Vasconcelos 2009), male futsal players from different competitive levels (Silva et al. 2012), male (Rodrigues dos Santos et al. 2011) and female (Rodrigues dos Santos et al. 2013) middle-distance runners, however nutritional information in kayak paddling is limited raising the need for more research.

Elite flatwater kayak paddlers commonly train at least twice a day, 6 days/ week during pre-competitive period. Training varies between on-water (i.e., in the boat) and out-water (gym, run, bicycle, swimming) sessions focusing on both aerobic and anaerobic capacity, as well as strength and power development. This type of training is very demanding and any nutritional or energy deficit can compromise both the performance and the athlete's health status (Lee and Lim 2019). Moreover, several athletes of Sprint Canoe/Kayak have to fund training or competition expenses as they're not professionals and balance by themselves the high-energy needs being prepared with appropriate training snacks around training and work schedules (sports dietitians Australia) requiring knowledge about carbohydrate and protein intake that they lack (Doering et al. 2016). The athlete depends not only on weight control and proper body composition, but also on meeting the needs of vitamins and minerals and even on the way the meals are distributed on the day to improve your sports performance and achieve results allowing his entry as professional in national and international sports teams.

With this case-study, we intended to describe and compare the adequacy of the nutritional intake of an elite male 1000m flatwater kayaker, a power-based sport, in the sense of detecting eventual nutritional conditions that may lead to compromised recovery between training efforts or athlete's performance adding knowledge to current literature.

Methods

The athlete is a 35-year-old elite male kayak paddler, with over 15 years of sport experience at the highest international level. He is a former World champion, European champion and silver medallist in the Olympic Games of London. He was committed to get position for the Olympic Games in Japan. Training characteristics during the nutritional collection week are presented in Table 1.

Table 1. *Training Distribution over the 7 Day Micro Cycle of a Specific Preparation Period*

Day	**Morning**	**Afternoon**
Monday	Water. 15 km. 6 x 250m (115/120 spm), rest 5'. Stretching (Str)	Gym (Strength). 6 exercises x 6 RM x 6 sets + Abdominals/Lumbars. Str
Tuesday	Water. 15 km. 2 x 1000m / rest 8' (250m at 85 spm, 500m at 90 spm, 250m at 95 spm) + 2 x 750 m / rest 8' (250m at 115 spm, 250 at 110 spm, 250m at 115 spm). Str	Water. 10 km. Easy pace. 65 spm. Str
Wednesday	Water. 15 km. 8 x 45" (110 spm) 1'15" rest. Recovery 6'. 8 x 30" (115 spm), 1'30" rest. Str	Gym (Strength). 6 x 20 reps/rest 40", 55% Maximum Load + Abs/Lumb. 30' running. Str
Thursday	Water. 10 km. 6 x 10"/rest 1'50". Maximum pace. Start stopped. Str.	Rest
Friday	Water. 15 km. 2 x 1000m / rest 8' (250m at 85 spm, 500m at 90 spm, 250m at 95 spm) + 2 x 750 m / rest 8' (250m at 115/120 spm, 250 at 110/115 spm, 250m at 115/120 spm). Str	Gym (Strength). 6 exercises x 6 RM x 5 sets + Abdominals/Lumbars. Str
Saturday	Water. 15 km. 7 x 50" at 105 spm/1'10" rest. Recovery 6' + 7 x 35" at 110 spm / 1'25" rest. Str.	Water. 8 km. Easy pace (65 spm) + Str.
Sunday	Water. 10 km. Easy pace. (65 spm) + Str.	Rest

*Not*e: a specific warming-up preceded every workout. spm = strokes per minute; RM = repetitions maximum; Str=Stretching

Body weight was assessed with a SECA 899 (SECA, Hamburg Germany) digital scale every morning in fasting at the same time (7 a.m.) and before the first training session of the day, wearing minimal underclothing.

The participant was informed about the benefits and risks of participating in the current study prior to signing an informed consent form, which was approved by the ethic board of the local university. Experimental procedures were in accordance with the Helsinki Declaration and ethical principles for medical research involving human subjects (Harriss et al. 2019).

Nutritional Data Collection

The athlete reported all food and supplements ingested for 7 consecutive days through a food record divided as follows: breakfast, morning snack, lunch, afternoon snack and dinner. A dossier with informative photographs with the standard quantities of the main foods was delivered and the athlete informed of the correct way to fill in the forms according to the quantities consumed. Mean daily food intake was converted to nutrients using ESHA's Food Processor Nutrition Analysis software (Bazzano et al. 2002). For the consumption of macronutrients, we took as reference the work of Stellingwerff et al. (2011), specific for the power type athletes like ours and American College of Sports Medicine proposals (American College of Sports Medicine 2009; for micronutrients we followed Whiting and Barash (2006) and Murray and Horswill (1998) proposals.

Results

The athletes' biometric features include height of 185 cm, body mass of 87 kg (without significant changes during the 7-day micro cycle) and a BMI of 25.42 kg/ m^2. Mean energy and macronutrients intake are presented in Table 2. Data shows the kayaker has an adequate energy intake with an average of 3174 (± 306) kcal daily. However, there is a low carbohydrate intake (4.4 ± 1.2) $g.kg^{-1}.day^{-1}$, a high intake of cholesterol and reduced ingestion of dietary fibres.

Table 2. *Mean Values (±SD) for Energy and Macronutrients Intake*

Variables	**Mean ± SD**	**Minimum**	**Maximum**	**recommendations**
Energy intake (kcal)	3174 ± 306	2722	3631	
Energy intake ($kcal.kg^{-1}.day^{-1}$)	36.0 ± 3.4	31.2	40.8	50 kcal. kg^{-1}.day-^{1} (a)
Protein ($g.day^{-1}$)	163.4 ± 29.0	121.0	211.0	
Protein (%)	20.8 ± 4.3	15.0	25.4	
Protein ($g.kg^{-1}.day^{-1}$)	1.9 ± 0.3	1.39	2.43	~1.5-1.7 $g.kg^{-1}.day^{-1}$ (b)
Carbohydrate ($g.day^{-1}$)	383.4 ± 103.3	260.0	576.0	
Carbohydrate (%)	47.8 ± 9.3	38.2	63.5	
Carbohydrate ($g.kg^{-1}.day^{-1}$)	4.4 ± 1.2	2.99	6.62	~6-10 $g.kg^{-1}.day^{-1}$(b)
Fats (%)	31.4 ± 5.2	21.6	36.4	
Fats ($g.kg^{-1}.day^{-1}$)	1.3 ± 0.2	1.0	1.53	~ 1-1.5 $g.kg^{-1}.day^{-1}$(b)
Saturated fats (%)	11.5 ± 2.3	6.4	13.4	
Monounsaturated fats (%)	11.9 ± 1.8	8.6	13.9	
Polyunsaturated fats (%)	4.8 ± 1.5	3.0	7.4	
Cholesterol (mg)	638 ± 218	420	1066	
Dietary fibre (g)	23.6 ± 9.2	12.4	40.6	20-35 g/day (c)
Complex CHO (%)	15. 7 ± 3.6	11.0	20.7	
Sugars (%)	20.2 ± 9.2	9.7	36.4	
Caffeine (mg)	5.8 ± 5.9	0	13.4	
Alcohol (g)	0	0	0	
Insoluble fibers (g)	14.1 ± 7.8	2.71	28.0	
Soluble fibers (g)	4.0 ± 1.9	0.95	6.94	
Water (ml)	1790 ± 544	1245	2665	

a) according to National Research Council (1989); b) according to Stellingwerff et al. (2011); c) according to Marlett et al. (2002).

According to Table 3 the athlete shows an adequate intake of hydro-soluble vitamins and a reduced intake of fat-soluble vitamins also a high intake of trans fatty acids and an unhealthy ratio omega6/omega3 fatty acids (8:1).

Table 4 shows that macrominerals and trace minerals intakes are all within, or exceed, the international recommendations for athletes, with exception of iodine and molybdenum.

Table 3. *Mean Values (±SD) for Vitamins and Fatty Acids Intake*

Fatty acids	Mean ± SD	Minimum	Maximum	DRI*
Omega-3 fatty acids (g)	1.4 ± 0.3	1.09	2.0	6 g
Omega-6 fatty acids (g)	11.6 ± 2.9	8.26	16.1	9 g
Trans fatty acids (g)	4.5 ± 4.4	0	9.77	
Oleic acid (g)	33.6 ± 5.6	27.5	42.9	
Arachidonic acid (g)	0.3 ± 0.2	0.09	0.57	
Vitamins	**Mean ± SD**	**Recommendations for athletes (Murray and Horswill 1998)**		
Thiamine (mg)	3.4 ± 0.9	1.5 mg		
Riboflavin (mg)	2.7 ± 0.4	1.7-1.8 mg		
Niacin (mg)	35.7 ± 8.4	19-20 mg		
Vitamin B6 (mg)	3.2 ± 0.8	2 mg		
Vitamin B12 (µg)	7.0 ± 1.2	2 µg		
Folate (µg)	351.1 ± 138.9	200 µg		
Pantothenic acid (mg)	7.5 ± 1.3	4-7 mg		
Vitamin A (µg)	388 ± 135	1000 µg		
Vitamin A Carotene (µg)	165 ± 110	6000 µg		
Vitamin C (mg)	302 ± 224	60 mg		
Vitamin D (µg)	3.1 ± 0.9	10 µg		
Vitamin E (mg ET)	7.9 ± 2.3	10 mg		
Vitamin K (µg)	36.4 ± 27.3	70-140 µg		

*Dietary reference intakes (Erasmus 1993).

Table 4. *Mean Values (±SD) for Macrominerals and Trace Minerals intake*

Macrominerals	Mean ± SD	DRI*
Calcium (mg)	848.1 ± 1	800-1200 mg
Magnesium (mg)	431.4 ± 76.8	350 mg
Phosphorus (mg)	1772 ± 140	800-1200 mg
Potassium (mg)	4523 ± 1309	1875-5625 mg
Sodium (mg)	3089 ± 1142	1100-3300 mg
Chloride (mg)	856 ± 606	2300 mg
Trace Minerals		
Copper (g)	1.8 ± 0.5	0.9 g
Iron (mg)	21.1 ± 4.4	8 mg
Manganese (mg)	3.2 ± 1.0	2.3 mg
Selenium (µg)	179.3 ± 22.7	55 µg
Zinc (mg)	19.9 ± 5-7	11 mg
Boron (mg)	3.4 ± 1.7	NA
Iodine (µg)	66.5 ± 8.1	150 µg
Molybdenum (µg)	12.6 ± 9.9	45 µg

*Dietary reference intakes. American College of Sports Medicine (2009).

Discussion

The nutritional needs for elite athletes must be considered individually and adjusted to the requirements of training and competition. Kayakers rely on high power output for success and only very few studies have focused on the complexity of power sports nutritional demands. The aim of our study was to describe the pre-competition nutritional intake of an elite male 1000m flat-water kayak paddler and its adequacy to guidelines. The average value of the daily energy supply for our kayaker was 36.0 ± 3.4 Kcal/kg of body weight/day. Our athlete's average energy intake is in line with previous work on Portuguese male elite canoeists showing an intake around 3261 ± 454Kcal in the same pre-competitive period (Morgado and Sousa 2016). However, Burke et al. (2001) found average male energy requirement of 55 Kcal/Kg of body weight/day. While this discrepancy could not be of relevance it might also translate the common concerns that this type of athletes have with their body weight as increased body fatness may raise the drag force and reduce efficacy of paddling (Michael et al. 2009).

Elite kayakers usually practice twice a day with each workout session lasting between 1.5 and 2 hours. This type of training is very demanding at several levels, with the binomial recovery/nutrition being of fundamental importance. Energy, carbohydrate and protein needs must be met during this exhaustive training to maintain body weight, resynthesize muscle glycogen, and provide sufficient protein to build and repair muscle tissue. During our data collection, the athlete's body weight remained stable with slight daily variations not exceeding 100g which can be suggestive of the adequacy of caloric intake to caloric expenditure. While energy intake appears to match caloric expenditure, the relative contribution of the various macronutrients in our participant does not seem to be the most adequate, considering the Stellingwerff et al. (2011) recommendations. The values of CHO ingestion, either as a percentage of total energy intake or when relative to body weight, are very low in relation to the recommendations (6-10g CHO kg bw. day) for power athletes (Stellingwerff et al. 2011) in pre-competition period. When training is intensified, low CHO intake reduces muscle glycogen concentration, increases muscular fatigue (Costill et al. 1988) and may compromise immune function reducing the ability to cope with exhaustive load (Maughan and Poole 1981). We can hypothesize that at least in some workouts this kayaker might have a suboptimal level of glycogen stores with probable deleterious effect on training intensity and mood for hard training given the high training volume requiring carbohydrate-rich foods to provide the energy provision. Nevertheless, potential beneficial effects on performance were still found in extremely low carbohydrate diets (3-15% carbohydrate) (Coggan and Coyle, 1991, Maughan and Poole 1981) during specific training sessions but more research is needed according to Burke et al. (2011).

Given the high protein intake, it can contribute not only to tissue repair but also to glycogen synthesis through gluconeogenesis. For 50 g of glucose produced, 34-40 g come from glycogenesis, 8-14 g from protein deamination and 2-3 g from glycerol (Fromentin et al. 2013). Protein intake in the range of 1.3-1.8 $g.kg^{-1}.day^{-1}$ maximize muscle protein synthesis in athletes (Phillips and Van Loon 2011). The average values of protein ingested in this study seem adequate not only for muscle repair and accretion as well as for energetic purposes. According to Stellingwerff et al. (2011) besides the amount of protein intake it seems also important to consider the timing and type in relation to exercise sessions. Fat intake is within dietary references for athletes (Rodriguez et al. 2009) particularly for this preparation phase where fats are an important source of energy. However, the problem is that the high fat intake seems to be made at the expense of CHO.

Regarding the type of fats, there is an average high intake of saturated fats (SFs) and a reduced intake of polyunsaturated fats (PUFs). Our athletes' intake of monounsaturated fats (MUFs) is adequate and reflects the Mediterranean dietary pattern (Davis et al. 2015).

Despite, epidemiological studies suggest that reducing dietary SFs reduces the risk of cardiovascular events and myocardial infarction (Hooper et al. 2015), in our view, these approaches lose consistency in the high-performance sports field. The focus should be on the effects of the imbalance between intake of SFs in relation to intake of PUFs. Reduced intake of PUFs namely the two essential fatty acids (EFAs), alpha-linolenic acid (ω3) and linoleic acid (ω6) can negatively affect the production of prostaglandins, which support the regulation of blood viscosity, inflammatory processes, blood cholesterol and fat levels, and water balance (Oesterling et al. 1972). It is well known that exhaustive exercise is a remarkable producer of inflammation outbreaks. Since the body does not synthesize EFAs, they must be provided by the food. The Western diets, namely Mediterranean diet, provide a high amount of ω6 fatty acids. This nutritional condition favors the formation of eicosanoids that arise from the oxidation of arachidonic acid and related PUFs by cyclooxygenase, lipoxygenase and cytochrome P450 enzymes and via non-enzymatic free radical mechanisms (Dennis and Norris 2015). Eicosanoids are related to the pro-inflammatory response. Non-steroid anti-inflammatory drugs, prostanoids and dietetic fish oil ω3 fatty acid supplementation control the action of eicosanoids (Norris and Dennis 2012). Therefore, the high intake of ω6 fatty acids to the detriment of ω3 can accentuate the inflammatory processes naturally induced by exercise and delay recovery between efforts. Although there is no consensus among nutritionists, a daily intake of 9 g of ω6 and 6 g of ω3, and therefore a ratio of 1.5-1.0, is recommended (Erasmus 1993). In this study, the average intake of ω6 exceeds the recommendations while those of ω3 is far below the recommendations. The ratio ω6:ω3, 8:1, can hinder the buffering of inflammatory processes. Other studies found a similar scenario (Rodrigues dos Santos et al. 2010, 2013). In order to rebalance this particular aspect of the diet, the athlete should increase the consumption of cold-water fish such as salmon, mackerel and sardines however, there is no evidence of the relationship between the consumption of ω3 rich foods and sports performance. Huffman et al. (2004) showed that supplementation with ω3 fatty acids did not improve endurance performance during a maximal bout of exercise. A more balanced diet is desirable since nutrition does not make a champion but can prevent it from being. Our athlete has a high average consumption of trans fatty acids. These fatty acids, processed or natural occurring, are related to several diseases (Souza et al. 2015). In an athlete with a very high level of training, the clinical perspective does not apply, however, the intake of foods rich in trans fatty acids should be reduced as much as possible and not exceed 2 g/100g fat per day (Leth et al. 2006). Cholesterol is mainly synthesized from dietary saturated fats and there is no scientific evidence to validate the hypothesis that dietary cholesterol increases blood cholesterol (Soliman 2018). Our kayaker has a high uptake of dietary cholesterol directed related to the high uptake of SFs. At first glance, this athlete's lipid outlook could be worrying - high intake of SFs, dietary cholesterol, and total fat. However, blood tests done regularly by this kayaker point to blood values of triglycerides and cholesterol within normal laboratory values (data not shown). Exhaustive daily training is the best way to neutralize the possible deleterious effects of a high fat diet (Suk and Shin 2015). The recommendations for the consumption of dietary fibers is 20 to 35 g per day (Escudero and Gonzalez 2006), that is, twice the consumption of our athlete. For the good functioning of the digestive system, it is advisable to reduce the simple sugars, processed foods and increase the foods rich in fiber. Moreover, our athlete does not drink any alcohol. This is a healthy behavior because chronic alcohol consumption is related to unfavorable changes in the immune system, the clotting process and brain integrity (El-Sayed et al. 2005). Caffeine intake, between 0 and 13.4 mg, is not significant because a single cup of espresso takes about 60 ml of coffee, and contains about 126 mg of caffeine.

According to the highly referenced work of Erp-Baart et al. (1989), when energy intake ranges between 2388 and 4776 kcal/day vitamin and mineral intake is most probably sufficient. Our data only partially confirm this statement. Although caloric intake is within the referred values, the intake of water-soluble vitamins exceeds while the intake of fat-soluble vitamins is below the recommendations for athletes (Murray and Horswill 1998). Nevertheless, the low fat-soluble vitamin intake does not seem to be problematic for this athlete. Photochemical processes from the cholesterol can synthesize vitamin D. Adequate amounts of vitamin E are necessary to prevent peroxidation of tissue PUFs and Vitamin E deficiency, extremely rare in humans, is unlikely caused by dietetic limitations (Kemnic and Coleman 2021). The intake of vitamin E in our athlete despite below the recommendations, is in line with the low intake of polyunsaturated fatty acids as low PUFs intake reduce the needs of vitamin E (Raederstorff et al. 2015). An intake of 0.6 mg alpha-tocopherol equivalents per gram linoleic acid is generally seen as adequate for human adults (Valk and Hornstra 2000). Our data of 7.9±2.3 mg of vitamin E for 10.5±3.0g of linoleic acid, gives a surplus of antioxidant protection. Vitamin K1 (phylloquinone) derives from green leafy vegetables while vitamin K2 (menaquinone) is synthesized in the gut from the bacteria. Even in a situation of low dietary intake, synthesis in the ileum from the bacteria seems sufficient to respond to the body's demands (Conly and Stein 1992). However, to normalize the intake of phylloquinone, the athlete should be advised to eat more green leafy vegetables such as parsley, spinach, broccoli and kale. These foods also benefit bone metabolism and the coagulation system (Sim et al. 2020). The low values of vitamin A and beta-carotene intake observed in this athlete should be adjusted to optimize immune response to exercise, maintenance of epithelial cells integrity and protection against oxidative free radicals (Bar-El Dadon and Reifen 2017). Reactive oxygen species (ROS) and reactive nitrogen species (RNS) produce both deleterious and beneficial effects. Overproduction of ROS (arising either from mitochondrial electron-transport chain or from excessive stimulation of NADPH) results in oxidative stress (Valko et al. 2007). During training, kayakers dramatically increase their oxygen consumption and this probably raises free radicals' production, which are known to have a plethora of deleterious effects (Radak et al. 2013). Some diseases, like cancer or cardiovascular diseases are associated with increased ROS production (Halliwell 2012). These highly reactive molecular species are capable to damage some important macromolecules as DNA, proteins, carbohydrates, and lipids (Valko et al. 2007). The first line of defense against oxidative stress is enzymatic – superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase/glutathione reductase (GPX) (Ighodaro and Akinloye 2018). We can consider exogenous antioxidants (tocopherol, ascorbate, ß-carotenes, flavonoids) provided by the diet as the second line of defense against oxidative stress. It is common practice in sport to ingest high amounts of anti-oxidant substances to combat oxidative stress induced by prolonged and/or intense exercise (Valko et al. 2007). The effects of these practices are dubious. For instance, many polyphenols, such as the flavonoids, have remarkable antioxidant activity *in vitro* but there are few, if any, compelling data that polyphenols exert antioxidant effects *in vivo* (Halliwell et al. 2005). Some authors highlight the beneficial effects of ROS. ROS have become increasingly recognized to mediate some adaptive responses in skeletal muscle induced by exercise. Therefore, exercise-associated increases in ROS are likely to involve redox-sensitive signaling effects rather than oxidative damage (Webb et al. 2017). Regardless of the benefits or harms of ROS, an athlete should enrich his diet with fruits, grains and vegetables that in addition to fight antioxidants have other benefits for the individual's health (Halliwell 2012).

All macrominerals, with the exception of chloride, are within or exceed the DRI. The low mean chloride intake in our athlete has no clinical significance because, in healthy individuals, NaCl homeostasis is fine-tuned in renal collecting ducts where Cl urinary excretion is balanced with dietary salt intake (Rajagopal and Wallace 2015). These low values of Cl are in line with the ones found in other studies in elite athletes (Siqueira and Rodrigues dos Santos 2004, Rodrigues dos Santos et al. 2010).

With the exception of iodine and molybdenum, all trace minerals are within the recommendations. Selenium, manganese, cooper and zinc, the principal minerals linked to antioxidant defense respect the recommendations (Alkadi 2020). To avoid persistent iodine deficits the athlete must increase the consumption of fish. Low average values of molybdenum can affect the formation of the enzyme xanthine oxidase, which is fundamental to transform xanthine into uric acid (Rajagopalan 1988). To correct this nutritional deficit the athlete should increase the consumption of milk, vegetables and whole grains. These foods are excellent sources for almost all macro- and macrominerals.

Conclusion

This case study reports the regular nutritional intake in a specific preparation week of an elite kayaker. Despite the mean energy input is below some recommendations it is in line with previous work in a similar population. While protein intake matches the recommended needs for muscle repair and accretion in power type athletes, the low carbohydrate intake might raise some concerns for the best energy conditions during high intensity workouts. So, it is suggested to reduce the percentage of energy from fat and increase the supply derived from CHO. Despite the high intake of fats, some fat-soluble vitamins – A, D, E, and K do not meet the recommendations for athletes. Although intake of beta-carotene is low, the adequate ingestion of micro minerals, connected with the antioxidant defense, points to the potentiation of endogenous mechanisms to fight oxidative stress.

Based on our data, an increase in the supply of CHO and some vitamins and minerals seems justified for this athlete, either through supplementation or through enrichment of the diet with specific foods that cover the deficits found, in order to achieve recommended quantities for power athletes.

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