Nutritional assessment of Brazilian Muay Thai practitioners

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Abstract

Background and Study Aim: Muay Thai is a martial art of Thai origin which involves a boxing style. Since this sport implies high energy expenditure with great participation of aerobic and anaerobic glycolytic metabolisms, there is consequent risk of dehydration. For a high physical performance, the hydration status must be kept and the qualitative and quantitative intake of macro and micronutrients must be adequate. The aim of this study was to evaluate Muay Thai practitioners as to their dehydration degree and dietary intake.

Material/Methods: The sample included 30 male practitioners who signed an informed consent approved by local Ethics Committee. For the nutritional assessment, data on weight, height and skinfolds were collected and used in the calculation of BMI and fat percentage. To evaluate the risk of dehydration, sweat rate and body water loss percentage were calculated; questionnaires concerned water intake and hydration habits were applied. The nutritional assessment included a three-day dietary record.

Results: The participants presented eutrophic pattern and adequacy relative to body composition. Although sweat rate was significant, dehydration did not occur due to the water intake guided by thirst. Protein and micronutrient intake was not adequate as regards macronutrient dietary intake.

Conclusions: Nutritional guidance is necessary either to avoid water stress and maintain the body composition or to keep an adequate macro and micronutrient intake.

Key words: nutritional recommendations • martial arts • dehydration • sport practitioners

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Background

The Muay Thai, also known as Thai Boxing is a martial art originated in Thailand. It involves a boxing style in which points are scored through contact with all body parts (except groin and head) by punch, elbow, knee and kick, which may result in knockouts and traumas [1–3]. This martial art developed for defence against invasions and is currently a ring sport. The International Federation of Muaythai Amateur (IFMA) [4] has over 110 members around the world including five continental federations subjected to one single consolidated set of rules [5]. Physiologically Muay Thai is an sporadic activity of high physical and energy demands presenting short phases of maximal or supramaximal-intensity exercises interspersed with short recoveries, which implies high energy expenditure (9.39±1.38 METs or 10.75±1.58 kcal·min^{-1}) with great involvement of aerobic and anaerobic glycolytic metabolisms [5].

Besides the high energy demand Muay Thai is characterized by weight classes, similarly to several other martial arts (Karate, Judo, Boxing, Wrestling, Taekwondo etc.) in which the athletes generally compete in weight classes that are 5% to 10% lighter than their usual weight [6]. The most often studied sport discipline as regards

Nutrition policy – are established on the physiological needs of each nutrient and used for planning food supplies for population groups and dietary guidelines and prescriptions.

Martial arts – activities in which participants learn self-defence, mainly through the use of combat hand-to-body.

Food consumption – information about food intake by an individual or a group.

Dehydration – condition resulting from excessive loss of water by the living organism.

Nutrition – science of food, nutrients and other substances present in foods, their action, interaction and balance in relation to health and disease.

the use of weight reduction strategies, which are often aggressive and dangerous are Olympic Wrestling and even deserved the American College of Sports Medicine (ACSM) Position Stand [7]. Although Muay Thai has no parallel, there are some common points like inadequate food practice such as fasting and absence or skipping of meals, use of laxatives and other practices which may negatively interfere in the short and long-term nutritional status, as well as in the performance [8]. According to American Dietetic Association (ADA) [9] athletes need individualized and planned nutritional guidance to equally satisfy their energy demands, which can be from 2,000 (gymnasts) to 6,000 kcal (bodybuilders). Special attention should be given to weight sports by adopting frequent mini-meals (or snacks) of easy consumption and rich in carbohydrates to resist the energy demand and the exhaustive trainings, as well as to maintain and/or reach an appropriate weight before the beginning of the competition season, avoiding thus dietary practices that are harmful to both health and performance [10]. Therefore, it is the nutritionist's role to carry out a nutritional assessment, guiding and following safe nutritional strategies [9]. In addition in weight sports, strategies for rapid weight loss are also adopted from hours to one week pre-competition, and the several methods for weight reduction primarily engage active (strenuous exercises) or passive dehydration (dry and steam sauna) associated or not with diuretic and restrictive water intake practices among other pathological methods [6,8]. Dehydration has strong impact on plasma osmolality, and hyperosmolality together with decreased blood volume affect thermoregulation by increasing the central temperature and the carbohydrate oxidation, among others [11]. Thus, preventive measures should be adopted to minimize the dehydration deleterious effects, which may decrease the activity practicing time and in specific situations interrupt the activity causing organic compromising such as increased heart rate, decreased gastric emptying and risk of disorders associated with hyperthermia [12].

The present study aimed to analyse Muay Thai practitioners by calculating their sweat rate (SR) and water loss percentage, evaluating their hydration habits, and quantifying their macro and micronutrient intake correlating these data to their performance in the sport.

Material and Methods

This study was carried out at 3 gyms (*dojo*) in São Paulo City, Brazil, and the studied sample included 30 male *Muay Thai* practitioners who were older than 18 years and had been training for more than 12 months. After clarification about the procedures and aims of the work, the individuals signed an informed consent as approved by the Research Ethics Committee of a University Centre (COEP 047/05).

For anthropometric and sweat rate assessment 10 Muay Thai fighters were evaluated. The following anthropometric measurements were made: pre and post-training weight using a Plenna Lumina scale of 150 kg maximal capacity and 100 g accuracy, and height using a Seca Bodymeter® 208 portable stadiometer of 2 m maximal capacity and 1 cm accuracy. Then, Body Mass Index (BMI) = weight (kg)/height (m^2) was calculated and the nutritional status was classified according to World Health Organization (WHO) [13]. To assess body composition based on fat percentage (%F), a Sunny® clinical plicometer was used at the right hemibody to measure four skinfolds: bicipital (BS); tricipital (TS); subscapular (SeS) and suprailiac (SiS), in addition the equation proposed by Durnin & Womersley [14] was employed and%F was classified according to Lohman [15].

To assess the dehydration impact the methods indicated by ACSM [11] were adopted, including calculation of sweat rate (mL·min) and water loss percentage relative to initial weight [16]. *Ad libitum* water intake was allowed and the total volume was determined using a measuring cup for accuracy.

To evaluate dietary intake 20 practitioners were chosen to perform a three-day dietary record which included one weekend day, one training day and one non-training day [17] for the calculations of calories, besides macro and micronutrients, the software DietWin Professional 2.0, version 2008 (Brubins®) was used.

Data are presented as measures of central tendency (mean) and variability – standard deviation (SD). To verify statistical difference between initial and final weights, paired t-test was applied, at probability of $p<0.05$.

Results

The obtained data for the sample of Muay Thai practitioners were on average: 23.8 ± 5.3 years, 70.9±9.7 kg, 177.1±4.9 cm, 22.59±2.88 $kg \cdot m^{-2}$ (BMI), which classified them as eutrophic [13] and body fat 15.4±4.3%, which is within the mean for men [15] (Table 1).

There was a significant loss ($p<0.05$) of the initial weight relative to the final weight (70.9±9.7 *vs.* 69.8±9.2 kg), resulting in a mean sweat rate of 12.6±8.8 $mL \cdot min^{-1}$. However, the water loss percentage relative to the initial weight was on average 1.5±0.9% (Table 1).

Data on macro and micronutrient intake are shown in Table 2.

Table 1. Data on anthropometry and hydration status of Muay Thai practitioners. Brazil, 2009.

	BMI ($kg \cdot m^{-2}$)	Fat percentage	Initial weight (kg)	Final weight (kg)	Sweat rate ($ml \cdot min^{-1}$)	Water intake (mL)	% weight loss
Mean	22.59	15.4	70.9	69.8*	12.6	719.0	1.5
Standard deviation	2.88	4.3	9.7	9.2	8.8	335.3	0.9
Minimal	18.36	10.5	57.8	57.2	3.0	100.0	0.3
Maximal	26.23	24.3	85.0	83.5	30.0	1050.0	3.0

*$p<0.05$

Table 2. Macro and micronutrient intake by Muay Thai practitioners. Brazil, 2009.

	Mean	Standard deviation	Minimal	Maximal
Energy (kcal)	3202.50	730.65	2196.27	4869.71
Carbohydrates (% total energy intake)	52.05	6.65	38.65	69.96
Proteins (% total energy intake)	19.70	5.12	12.46	34.92
Lipids (% total energy intake)	27.67	5.15	12.95	35.85
Fiber (g)	23.46	14.19	11.29	77.82
Vitamin A (µg)	662.99	449.93	180.01	2009.67
Vitamin E (mg)	12.89	5.70	4.95	26.14
Vitamin C (mg)	171.81	174.15	9.50	736.54
Calcium (mg)	969.60	405.14	344.55	2021.21
Iron (mg)	16.42	4.88	7.46	28.54

Discussion

Although the sample recruiting was directed to both genders, only male practitioners participated. Such predominance in fight and combat sports is probably due to the high muscle strength demand along with the characteristic competitive feature of this gender [18]. According to the anthropometric analysis the sample was eutrophic, based on the BMI. The body composition was consistent with the adequate standards for the general population, based on fat percentage and similar to that found in a study with Shotokan Karate practitioners (%F = 14.8±4.6) [19]. However, these data were highly different when compared to Brazilian athletes of other martial arts such as Karate Shotokan (%F = 10.5±3.0) [17], Kung Fu (8.6±5.3%) [20], Jiu Jitsu (9.83±4.17) [21] and Taekwondo (8.2±3.2%) [22], probably reflecting the athletes' training degree and experience in the sport.

Sweat rate was higher than that of Karate athletes (4.9±1.7 mL·min), however weight percentage was similar to that found for these Karate practitioners (1.4±0.3%) [17], indicating slight dehydration [12]. Water loss between 1 and 2% has been reported to increase body temperature up to 0.4°C for each subsequent 1%, along with a progressively negative impact on the performance [11]. In this study, the participants ingested water *ad libitum* (719.0±335.3 mL), indicating that the thirst mechanism was sufficient to prevent involuntary dehydration, as already proved by works in this field, which frequently criticize fluid replacement using pre-established volumes [11].

The three-day dietary record indicated that the mean energy intake by Muay Thai practitioners was 3,202.50±730.65 $kcal \cdot day^{-1}$ in accordance with the Recommended Dietary Allowance (RDA) [23], in which the mean energy needs for slightly to moderately active men from 19 to 50 years old are 2,900 $kcal \cdot day^{-1}$. On the other hand studies with high-level Brazilian athletes of combat sports have recorded for Shotokan Karate an intake of 2,886.7±1,034.7 $kcal \cdot day^{-1}$ [24], for Taekwondo 2,939.7±576.6 $kcal \cdot day^{-1}$ [22] and for Kung Fu 3,243.24±645.8 $kcal \cdot day^{-1}$ [20].

Prolonged and/or high-intensity exercise reduces the muscle glycogen concentration, leading to constant concern about its replacement [10]. Carbohydrates are essential to maintain prolonged and intense efforts and the depletion of muscle/liver glycogen reserves is associated with central and peripheral fatigue. Thus the intake of carbohydrates of different glycaemic indexes

before, during and after the exercise constitutes a suitable nutritional strategy to keep and enhance the performance [25]. The American College of Sports Medicine [10] recommends a diet supplying from 50 to 60% of the total energy intake (TEI) of carbohydrates. In the present study, the sample had adequate carbohydrate intake (52.05±6.65% TEI), close to that of Brazilian Taekwondo athletes, 58.9±8.2% [22].

The protein needs of athletes are related to the repair of exercise-induced micro-lesions in their muscle fibres used as secondary and additional energy source to favour lean tissue mass gain [26,27]. According to ACSM [10], the recommended protein intake is between 12 and 15% TEI. Thus in the studied group, the mean protein intake was higher than the protein need 19.70±5.12% TEI. This was also verified for Taekwondo 17.5±4.6% TEI [22]. An intake above the need by combat and sport athletes can favour strength and health. However, since there is not systematic data on the upper intake level (UL), it cannot be determined for the general healthy population, implying that it is prudent to avoid protein amounts above those recommended for the studied group [28]. ACSM [10] also recommends lipid intake from 25 to 30% TEI, which is within that obtained in the present study, 27.67±5.15%, also observed for Taekwondo athletes 23.7±4.2 TEI [22] and Karate athletes 26.8±5.8% TEI [29].

Mean fibre intake 23.46±14.19 g was similar to that presented in a study on the Brazilian population by Matos & Martins [30] around 23.77±12.98 g·day^{-1} and SBAN [31] recommends an intake of 20 g·day^{-1}. Mean fibre intake has already been reported to be 18.6±5.4 g for Taekwondo athletes [22] and only 9.0±2.9 g for Japanese Karate athletes [29].

Micronutrients are not energy sources, although they are important in the metabolic process, especially in the regulation of energy production reactions, besides the synthesis and degradation of compounds [32]. The results of micronutrient analysis indicated that, although the mean of values is adequate, there was great variability in the consumption (minimal *vs.* maximal intake).

Vitamins A and E are liposoluble, can be stored in the adipose tissue at considerable amounts and do not directly participate in the energetic metabolism but are indirectly involved in it by reducing muscle damage and increasing the recovery after exercise due to their antioxidant actions [32]. Mean vitamin A intake was 662.99±449.93 μg·day^{-1}, which is within the minimal value recommended by EAR 625 μg·day^{-1} [33] and comparable to that of Taekwondo athletes 609.5±312.7 μg·day^{-1} [22]. In addition 60% of the analysed individuals did not reach the minimal value and marginal intake values (<70% RDA) have been reported in literature for Greco-Roman Wrestling athletes, ballet dancers and gymnasts. Vitamin A deficiency may damage vision, genetic expression, growth, immune function and others [32]. On the other hand, vitamin E intake was 12.89±5.70 mg·day^{-1}, which is below the 15 mg·day^{-1} recommended by RDA [23] but adequate according to EAR 12 mg·day^{-1} [33], corroborating the data obtained by Lukaski [32] who evidenced that vitamin E intake is adequate for most athletes according to RDA, but higher among physically active than among sedentary individuals. Its function in these individuals is to reduce the oxidative stress especially in type-I fibres, more needed than those of type II. Its deficiency may increase the susceptibility of these fibres to free radicals and lead to early exhaustion during exercise [34].

Ascorbic acid, a hydrosoluble vitamin is probably involved in the synthesis of the collagen related to cell integrity in fibrous tissues (connective tissue, cartilage, bone matrix, skin and tendons), acting thus in the healing of wounds, fractures and bruises. Thus immunological and antioxidant activity is being extremely important to athletes and physically active individuals [34,35]. The mean intake of ascorbic acid 171.81±174.15 mg·day^{-1} was above that recommended by RDA (90 mg·day^{-1}) and EAR (75 mg·day^{-1}), although there are records of 56.5±54.5 mg for Shotokan Karate [24] and 240±147.3 mg for Taekwondo athletes [22], which are within the range documented for male athletes (95 to 520 mg·day^{-1}). Besides suboptimal intakes (<70% RDA) have been recorded for Greco-Roman Wrestling athletes (23%) and soccer players (20%) [32]. In the present study 35% of the sample had values lower than the minimal recommended by EAR [33].

Differently from vitamins, there are abundant studies related to the interactions between mineral nutritional status and physical activity [36]. Calcium is an important mineral in the muscle contraction mechanism, being stored in the sarcoplasmic reticulum and released when muscle fibres are stimulated. It also participates in enzyme activation and in cell membrane permeability regulation, both important to the energetic metabolism and the bone health [36]. The mean calcium intake of 969.6±405.14 mg·day^{-1} was below the value recommended by AI (adequate intake) 1000 mg·day^{-1} but above the minimal value recommended by EAR 800 mg·day^{-1} [33] not reached by 30% Muay Thai practitioners.

Iron, a trace element essential to oxygen supply to tissues and its consequent use is a functional component of proteins such as haemoglobin, myoglobin, cytochromes and other iron-dependent proteins. Furthermore, it is

critical for energy production during exercises [35,37]. The mean iron intake by Muay Thai practitioners was 16.42±4.88 mg·day^{-1}, which is above that recommended by RDA 8 mg·day^{-1} and EAR 6 mg·day^{-1} [33] and can be related to the hyperprotein diet pattern as evidenced for high-level athletes of Taekwondo, presenting intake of 24.5±10.1 [22] and Shotokan Karate 20.6±7.9 [24]. For athletes intake deficiencies are more related to the female than to the male gender and for the latter they are more frequent among runners and skiers [34].

Conclusions

Muay Thai practitioners had body composition consistent with eutrophic status, which may result in a more athletic body composition due to the practiced sport, including a reduction in body fat percentage. Despite the strenuous activity, according to water loss percentage, these practitioners are not at risk of dehydration, probably due to their rehydration mediated by thirst during exercise, since their sweat rate is higher than that of other martial art athletes. Although energy, carbohydrate and lipid intake is adequate, a suitable protein, vitamin and mineral intake is important in order to reduce the intake variability and make adequate the daily need of Muay Thai practitioners. Thus, nutritional guidance and follow up is not justified by water stress or inadequate body composition but by the nutritional balance. The present results confirm the importance of using nutritional strategies before, during and after physical activity, especially for the practice of martial arts, in which nutrition may be decisive for a high performance.

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