Diagnosis of the nutritional status of the Weight Lifting Permanent Olympic Team athletes of the Brazilian Olympic Committee (COB)

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ABSTRACT

This study aimed to diagnose the nutritional status of the Weight Lifting Permanent Olympic Team Athletes of the Brazilian Olympic Committee (COB). The sample was composed of 24 athletes, aged 16-23 yr, 12 males (19.7 ± 2.4 yr) and 12 females (19.2 ± 1.8 yr). The following procedure was applied to diagnose the nutritional status: analysis of the adequability of energy and macronutrient intake – carbohydrates (CHO), lipids (LIP) and proteins (PRO) –, through the methods 24-hr diet records and the Food Consumption Frequency Questionnaire, besides anthropometrical profile characterization. The results obtained from the dietary evaluation showed that the energy distribution among the macronutrients was adequate, 54 ± 6.8% (CHO); 28,5 ± 5.9% (LIP); and 14.5 ± 3.4% (PRO) for the male team, and 56.3 ± 4.7% (CHO); 28.6 ± 4.6% (LIP); and 13.7 ± 2.4% (PRO) for the female team. However, regarding total energy intake, 83% of the athletes presented energy intake below the recommended values, considering the high level of physical activity, resulting in daily caloric deficiency. Body fat percentage of the male athletes (3.6 ± 0.7%) indicated that all of them were below the reference standard, while 58% of the female athletes had excess fat (17.9 ± 5.8%). It was concluded that although the athletes showed an adequate caloric distribution of macronutrients, it was still not sufficient to meet the energy requirements of their modality, thus these athletes should seek nutritional orientation.

Keywords: Sports nutrition. Athletes. Weight lifting. Body composition.

INTRODUCTION

Eating habits may outline the athlete's performance. Several factors should be considered in order to plan a suitable nutritional planning, among them the energetic suitability of the diet, the macronutrients distribution and the supply of adequate quantities of vitamins and minerals. Moreover, the athlete's diet should be established according to individual needs, frequency and training intensity and duration[1].

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High level weight lifting athletes dedicate between four to six daily hours to training, promoting calculated energetic waste of 6 *METs*[2] (resting metabolic rate), where 1 MET equals 3,5 ml(kg.min)$^{-1}$. The athletes should count on qualified professional aid such as coaches, physicians, physical therapists, psychologists and nutritionists in order to support the entire training load required during daily and weekly sessions.

It is known that the high increase of the physical exertion derived from daily exercise and dietetic inadequacy expose the physical activity practitioners to organic problems. Anemia, bone mineral loss and eating disturbs cases related to athletes of both sexes have been registered, as well as amenorrhea, as the main dysfunctions that occur with athletes[3-6].

Generally, eating disturbs are not uniform among athletes, what actually occurs is an expected behavior of deficiencies according to the modality evaluated, especially fights[7], Olympic gymnastics[8] and marathon[9]. Aiming to identify such nutritional deficiencies, one of the proposed strategies is the verification of the energetic consumption and its distribution, besides the macronutrients amount consumed, especially calcium and iron.

The aim of this work was to diagnose the nutritional status of the athletes of the Weight Lifting Olympic Team, verifying energetic suitability and macronutrients distribution and quantification.

METHODOLOGY

24 athletes participated in the study; 12 males and 12 females, at daily training at the Federal University of Viçosa, in Viçosa, MG. All athletes were members of the Brazilian Confederation of Weight Lifting (CBLP), affiliated with the International Federation of Weight Lifting (*International Weightlifting Federation* – IWF). The sample characteristics are presented in table 1.

All the ethical procedures required by the 196/96 resolution of the Health National Committee were adopted in order to conduct this research, being approved by the Ethics Committee of the University. The athletes signed a consent form to volunteer to the study.

The nutritional status of the athletes was diagnosed through qualitative and quantitative evaluation of the ingested food, 24-hour diet records and the Food Consumption Frequency Questionnaire.

The dietetic data obtained with the 24-hour records and the food consumption frequency questionnaires were changed into energy and nutrients indices through the DIET PRO Software, version 4.0 (www.dietpro.com.br), using the collected average indices with the two types of dietetic inquiry.

The intake suitability of macronutrients was calculated based on the Reference Dietetic Intake (RDI)[10], that recommend caloric intake between 45 and 65%, derived from carbohydrates; 10 and 35%, from proteins; and 20 and 35%, from lipids.

The Basal Metabolic Rate (BMR) of the athletes was calculated according to the proposed formulas by FAO/WHO/UNU (1985)[11]. The energetic intake suitability was calculated by the total energetic need (TEN), that is the product of the BMR by the PAI (TEN = BMR x PAI), where BMR = basal metabolism rate and PAI = physical activity index (coefficient)[12].

According to the indices proposed by James and Schofield (1990)[13], for the physical activity index (PAI) by sex and desired activity, the physical activity index for weight lifting athletes, which is considered a heavy activity, is 2,10 for men and 1,82 for women.

The anthropometrical profile characterization, which aims to establish the body composition, was performed using measurements of the body weight, height and seven skinfolds of all the athletes. These measurements were always taken prior to the training, in the afternoon. The body weight was obtained through a scale brand name SOEHNLE® (Spain), with sensibility of 100 g and capacity of 150 kg. Stadiometers brand name ASIMED® (Spain), which presents scale in millimeters were used in order to obtain the height measurements. A plicometer brand name CESCORF® (Brasil), with sensibility in millimeters, was used in order to evaluate the skinfolds in men (triceps, subscapular, suprailiac, chest, abdominal, medium underarm and thigh) and in women (abdominal, suprailiac, triciptal and thigh) (table 1). Each skinfold was three times measured in a circuit way, being considered as final index the average among the three registers. The anthropometrical data collection was conducted in the Human Performance Laboratory (LAPEH) of the Physical Education Department (DES), of the Federal University of Viçosa, by a specialized trainee in the biometry field.

The anthropometrical evaluation data were used in prediction equations specific for athletes, in order to determine the body density (BD) and the body fat percentage (% GC). The body density calculation (BD), used the skinfolds equation (SF), by Jackson and Pollock (1978)[14], that uses the sum of seven skinfolds (Σ7 SF) to estimate the body composition of male athletes. The equation by Jackson *et al.* (1980)[15], which uses the sum of four skinfolds (Σ4 DOC), was used for women athletes.

The specific formulas for men[16] {% BF = [(4,95/BD) – 4,50] x 100} and women {% BF = [(5,01/BD) – 4,57] x 100} were used to convert the body density (BD) in body fat percentage (% BF).

The statistical analyses and the remaining calculations were performed with the aid of the SAS program (*Statistical Analysis System*, SAS *Institute Inc.,* Cary, NC, USA – version 8.0, 1999), under license for the Federal University of Viçosa, 2005. The statistical analyses were essentially descriptive. It was tried to summarize the data of nutritional suitability of the athletes through the comparison with the reference indices. The indices named suitability percentage (% TEN) were calculated by % TEN = (Reference- Index)/reference x 100%[12].

RESULTS

The average weight, height and fat percentage anthropometrical indices of the athletes are presented in table 1.

TABLE 1
Anthropometrical data (weight and height) of athletes from the Permanent Weight Lifting Olympic Team

N	Sex	Age (years)	Weight (Kg)	Height (cm)	% Fat
12	M	19,75 ± 2,42	68,27 ± 8,89	171,83 ± 8,37	3,6 ± 0,79
12	F	19,25 ± 1,86	65,74 ± 12,34	164,49 ± 6,06	17,99 ± 5,81

Descriptive analysis, data presented in average ± Standard deviation; M = Male; F = Female.

The data presented in the previous table 1 show that the evaluated athletes, both male and female, are young. The low fat percentage obtained in men is an initial remark.

Energetic suitability

The average indices of energy dietetic intake (EDI), the basal metabolic index (BMI), the total energetic need (TEN) and the percentage of suitability to the total energetic need (%TEN) are found in table 2.

TABLE 2
EDI, BMR, TEN indices and energetic suitability of the athletes from the Permanent Weight Lifting Olympic Team

N	Sex	Energy	BMR	TEN	% TEN
12	M	2.985,30 ± 667,54	1.744,83 ± 151,39	3.664,49 ± 317,27	81,22 ± 15,93
12	F	2.022,91 ± 698,79	1.478,62 ± 178,25	2.691,11 ± 324,43	76,54 ± 29,1

Descriptive analysis, data presented in average ± Standard deviation; (EDI) = energy dietetic intake; BMR = basal metabolic rate; (TEN) total energetic need; %TEN = suitability percentage to the total energetic need; M = Male; F = Female.

Table 2 shows that both groups of evaluated athletes present energetic consumption lower than what is considered ideal to support the training load usually imposed to weight lifting athletes.

The food distribution among the macronutrients is presented in table 3.

TABLE 3
Percentage dietetic distribution among carbohydrates, proteins and lipids of the athletes from the Permanent Weight Lifting Olympic Team

N	Sex	Carbohydrates	Lipids	Proteins
12	M	54,09 ± 6,85%	28,57 ± 5,99%	14,53 ± 3,4%
12	F	56,38 ± 4,71%	28,63 ± 4,69%	13,72 ± 2,48%

Descriptive analysis, data presented in average ± Standard deviation; M = Male; F = Female.

As previously presented in table 3, regardless the evaluated group, there are no significant differences in the percentage distribution among the energetic macronutrients. The carbohydrates consumption is higher in women than in men. Concerning lipids and proteins, the results show minimum differences between the male and female athletes.

DISCUSSION

According to table 2, the average indices of daily energetic consumption are inadequate both for men and women. Out of the total of athletes, 20 (83%) had energetic intake lower than the recommended and only 4 (17%) had it above the standard-index. During high intensity training, suitable amount of energy for the body weight maintenance should be ingested with the purpose to maximize the training effects and be healthy. Low intake of energy may result in muscular mass loss, menstrual dysfunction, increase of fatigue risk and consequently compromising of athletic performance[2].

It is important to highlight that despite the calculation of the estimate of the total energetic need (TEN) showing to be inadequate, the Brazilian male athletes still presented caloric waste threshold lower than the desirable to elite weight lifting athletes (between 3.000 and 10.000 kcal/day) (Stone and Kirksey, 2003)[17]. These indices show that the training volume of the Brazilian male team can still be doubled. Within this context, new dietetic planning is crucial, since should these athletes not be adapted to the demands, they will not be able to have profitable performance, and even produce nutritional deficits and health damage.

Chen *et al.* (1989)[18] evaluated 10 weight lifting male elite athletes, with average age of 21 years, showing daily energetic consumption of 4.597 kcal. This index was approximately 1.500 daily kcal higher than the one of the athletes from the Brazilian Olympic team. Grandjean (1989)[19] followed 28 weight lifting elite athletes

as well and obtained a register of 3.643 kcal. These results show that the energetic consumption of the Brazilian team, especially the male one, is inadequate and should be increased.

In weight lifting, as well as in other modalities categorized by body weight, the athletes usually limit the energetic consumption in order to reduce body weight, with the purpose to adapt to the category of lower weight, trying thus, to take advantage over the other competitiors[3]. Concerning the eating habits of a group of jockeys[20], it was observed that, regardless the sex, the average daily intake was below the daily needs, since 72% of the sample even reduced the food consumption at the day of the race. In school wrestlers[21], it was observed that 24% of the evaluated athletes decreased the diet calories at least once a week and 10% did that on a daily basis. Since these athletes dedicate a large part of their time to training and competitions, the low caloric consumption will be able to result in nutritional problems, which is not compatible with health and optimum performance[3].

Low energetic consumption may be associated with lack of qualified orientation given to the athletes. Burke (1995)[22] observed in his study a close relation between nutritional knowledge and inadequate dietetic habits in athletes. Cuspiti *et al.* (2002)[23] verified better nutritional suitability in athletes compared with ordinary individuals, suggesting a favorable influence of sport in the eating habits and in the nutritional knowledge.

The body composition may be an indirect indicator about the nutritional status. The anthropometrical registers of fat percentage are in its totality below the ones proposed by Fleck (1983)[24] for the male team evaluated·. Such evidence implies two hypotheses: the athletes present low fat percentage by natural constitution, and the negative impact of the daily caloric balance (table 2) is crucially influencing in the body composition. Should one consider the second hypothesis true, it will be interesting to search for nutritional orientation that aims to adequate the energetic waste.

Caloric restriction in sports in which weight classification is present, is frequent. However, the evaluated male team has such low indices of fat percentage that makes this kind of strategy unviable or extremely dangerous, both in physical performance and health matters.

Considering that the energetic consumption of the athletes, especially the ones from the male team, is below their daily needs (table 2), it is necessary to increase the daily energetic consumption, either through the energetic density of the meals or the number of daily meals.

According to data presented in table 1, the body fat percentage of female athletes was suitable only for 25%; 58% was above the recommended, and 17% lower than the recommended, according to reference standards suggested by Heyward and Stolarczyk (2000)[16]. The extreme indices of fat percentage varied between 10 and 30% for women. These indices show that the female athletes also need dietetic and training planning, aiming reduction of adipose tissue without acute interventions so that the lean body mass is preserved and the training quality is kept. Such procedure will probably imply in modification of category in which the athletes are currently competing.

Concerning the analyses of the average indices for macronutrients distribution (table 3), it was confirmed that they are according with the IDR's proposals[10]. The distribution of the CHO consumption percentage of 54,09 ± 6,8% for the male team and 56,3 ± 4,7% for the female represents a degree of consumption performed by other athletes such as triatheltes[25]. Nonetheless, such behavior is not always observed, since there are dietetic registers with CHO consumption by athletes below the recommended such as the elite weight lifting ones, where 38% (Chen *et al.*, 1989)[18] and 43% of consumption were registered (Grandjean, 1989)[19], besides Greek swimmers[5] with 41,8 ± 6,5% and swimmers[26].

Concerning the CHO consumption by kg of body weight, Sherman (1988)[27] established it between 7 and 10 g/kg. The results of the present study for men show consumption of 5,97 g/kg of body weight, and for women the average index was 4,36 g/kg. In both cases, the indices are below the recommendation[27]. Considering that the CHO are an important energetic source during exercise, it is necessary to implement the consumption of this nutrient, whenever the body weight is considered as reference.

Costill (1988)[28] proposed for daily energetic waste of up to 4.000 kcal, which is the specific case of the evaluated athletes (table 2), daily consumption between 400 and 600 g of CHO. The average index obtained for energetic waste of CHO in the male team was 407,1 ± 115,3 g/day, while for the female team was 286 ± 106 g/day. These indices show that the athletes of the male team are at a threshold lower than the one proposed by Costill (1988)[28], while the women have insufficient consumption. These conditions may partly explain the caloric debt observed in table 2.

The carbohydrates consumption is highly recommended before, during and after exercise[29]. Before exercise, simple carbohydrates sources should only be ingested at the five minutes that precede the competitions, avoiding thus possible counter back hypoglycemia. During exercise, the carbohydrates consumption saves glycogen, delaying fatigue appearance[29], and results in lower circulating indices of pro-inflammatory cytokines[30]. After exercise, the intake of carbohydrate drink is essential in order to accelerate the muscular and hepatic glycogen resynthesis[29].

Especially in high intensity sport modalities, the carbohydrates metabolism is higher. Restrictions in carbohydrates consumption will lead to reduction in the glycogen storages, which will impair the work ability, leading them to fatigue[31]. Considering that weight lifting also represents a high intensity intermittent activity, it is clear that the suitable CHO consumption is important to high quality training.

In this work, it was possible to confirm that the protein intake in the athlete's diet, when the consumption percentage is considered (table 3), fulfilled their needs. Nevertheless, only two cases were registered, one male and one female, in which the percentage distribution was below the suitable. There are results similar to this research's, when the percentage distribution is considered, as the ones by Nogueira and Costa (2004)[25], with triathletes, in which the protein intake was considered 16 ± 5% (men) and 15 ± 4,3% (women); Farajian *et al.* (2004)[5], with Greek swimmers, with 17,4 ± 3,8%; and Chen *et al.* (1989)[18] and Grandjen (1989)[19], with registers of 22 and 18% respectively, in elite male weight lifting athletes.

Traditionally, athletes and coaches believe that high indices of dietetic protein are necessary for an optimum physical performance. Proteins are important for endurance, strength training and repair of muscular fibers and their needs are affected by factors such as sex, age, previous intake index, training level and exercise type, duration and intensity[32].

Several athletes believe that they should ingest more protein than the average population. However, it is necessary to ingest suitable quantities of energy and protein so that increase in the muscular mass occurs[32]. In the study by Tarnopolski *et al.* (1992)[33], with athletes who performed strength training, it was observed that the daily consumption of 0,86 g. Kg^{-1}. PC^{-1} results in maintenance of lean mass, however, a higher consumption (1,4. Kg^{-1}. PC^{-1}) resulted in higher protein synthesis. In the present study, the consumption by kg of body weight was of 1,56 ± 0,32 g for men and 1,11 ± 0,6 g for women. Despite the protein intake suitability, when the percentage consumption is considered, we have evidence that the energetic intake was not ideally followed, when g/kg is considered for the evaluation.

The recommendations for the daily consumption of athletes submitted to strength training are between 1,5 and 2,5 g/kg of the body weight[34]. As previously seen, the male athletes were at the lower threshold with register of 1,54 g/kg. The female athletes on the other hand, presented consumption of 1,07 g/kg. These indi-

ces, especially in the female team, show protein deficiency, which probably will imply in training ability deficit, mainly concerning the recovery phase.

Protein excess may bring, in the long term, health consequences, such as hypercalciuria, dehydration, and increase in the renal and hepatic work, besides having high specific dynamic action, increasing hence the oxygen consumption[35]. This is the case of some Brazilian swimmers[26] with register of 2,27 ± 0,5 g/kg the body weight. High protein consumption was not registered in the athletes from the Permanent Weight Lifting Olympic Team, which makes clinic manifestations caused by excess unlikely.

The lipids consumption of the evaluated athletes showed in energetic distribution percentage terms that three athletes, two men and one woman, representing 13% of the sample, were with the consumption below the recommendation. When they had excessive consumption, one of them with lipids consumption of 42,8%, they demonstrated total energetic imbalance. Regarding the excess or deficiency deviations in the lipids consumption, we have in the studied group 30% of them in need of nutritional orientation.

Inadequate lipids consumption was also observed in other works, in which prevalence of excess was identified, as in the ones by Chen *et al*. (1989)[18], with 40%; Grandjean (1989)[19], with 39%, both with elite weight lifting athletes, and more recently, with Greek swimmers[5] in which 40 ± 5.5% of the daily consumption in lipids were registered.

Low consumption is usually present in athletes of modalities in which body weight control is extremely severe, such as gymnasts, artistic gymnastics athletes' members, jockeys, dancers, body shapers and fighters in general[36]. Onywera *et al*. (2004)[4] mentioned Kenyan endurance runners with lipids consumption of only 13% of the diet.

The increase of lipids consumption substituting the CHO consumption is recommended in cases in which the energetic demand is higher than 6.000 kcal (Leser, 2005)[37]. Concerning the evaluated group, the energetic waste estimate of all athletes showed indices lower than this threshold (table 2), stating thus, that there increase in the lipids consumption beyond the index considered normal should not occur.

The lipids are important in the production of energy during exercise. The lipids catabolism during exercise represents metabolic advantage, since greater fatty acids oxidation will result in savings of the glycogen storages[2]. Generally, high consumption of lipids is not recommended. It is suggested that its dietetic consumption is limited in 30% of the energetic total, with the saturated fatty acids contributing with less than 10% of the total. Intake above 35% of the daily energetic total has been associated with health problems, as well as the reduction of physical ability[38].

Possibly, the low caloric consumption of the athletes resulted in low percentages of body fat in male athletes (table 1), who should not keep fat percentage lower than 5%. The found average in the sample was 3,6%, being lower than the one observed by other studies in elite weight lifting athletes[17]. This fact is dangerous, since athletes who keep the fat percentage below the recommendation are at risk of developing eating disorders and other health problems related with energetic deficiency and nutrients intake[2].

The patterns proposed by Fleck (1983)[24] were used as reference for the body fat percentage for male weight lifting athletes (10 to 12%) and the ones by Heyward and Stolarczyk (2000)[16], for the female athletes (12 to 16%). However, for Wilmore and Costill (2001)[39] the fluctuation levels of the body composition will be able to be broader, for the male athletes, ranging from 5 to 12%, and the female ones as well, with breadth of 10 to 18%. During an anthropometrical test of a male high level weight lifting team 9,9 ± 1,9 % of the body fat[40], were obtained. Stone and Kirksey (2003)[17], registered in men with average age of 26 ± 4 years a fat percentage of 11,7 ± 5 %, while for women with average age of 27 ± 5 years a percentage of 20,4 ± 3,9%.

The indices previously presented showed body fat percentage for men between 9,9 and 11,7%, which are much higher than the ones observed in athletes from the Brazilian Olympic team. The results are higher than the ones proposed by Heyward and Stolarczyk (2000)[16], for the female team, despite being below registers of a high level female Olympic team (20,4 ± 3,9%)[17].

CONCLUSIONS

The results of this research showed that the energetic intake of the athletes was inappropriate comparing with the total energetic need recommended, hence inadequate for the body weight maintenance and the modality's practice. Such imbalance was crucial in the occurrence of low percentage of body fat, especially in the male athletes.

Concerning the percentage distribution of energetic macronutrients, the diet's carbohydrates and protein intake was suitable for the majority of the athletes, comparing with the Daily Reference Intake of 2001. The lipids consumption was inadequate in 29% of the team (17% in excess and 12% deficient), that is why dietetic planning is recommended.

Men presented fat percentage below the expected for the modality, showing thus chronic nutritional deficiency Women on the other hand, showed opposite results, demanding hence, better nutritional balance.

The obtained data in the present study show the need of continuous support of professionals of nutrition in the Olympic sports, especially weight lifting, since inadequate nutritional behaviors, as shown in this study, may negatively influence in the final performance results.

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