Evaluation of nutritional status and body composition of young Tunisian weightlifters

Evaluation de l'état nutritionnel et de la composition corporelle chez un groupe de jeunes haltérophiles Tunisiens

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RÉSUMÉ

But : Etudier les aspects quantitatifs et qualitatifs de l'alimentation spontanée ainsi que les caractéristiques anthropométriques et la composition corporelle d'un groupe de jeunes haltérophiles.

Méthodes : Trente et un garçons âgés de 14 à 18 ans, et pratiquant l'haltérophilie pendant deux heures par jour, six jours par semaine dans quatre clubs d'haltérophilie à Tunis, ont été recrutés. Ils ont bénéficié d'une enquête alimentaire détaillée (rappel sur 3 jours avec estimation des fréquences sur une semaine) et de mesures anthropométriques (poids, taille, indice de masse corporelle et plis cutanés).

Résultats: Bien que l'apport énergétique soit satisfaisant, un déséquilibre au niveau des nutriments énergétiques était trouvé. En effet, les apports en graisses et en protéines étaient au-dessus des valeurs recommandées ($p < 0,01$). En outre, le pourcentage d'acides gras saturés était significativement supérieur aux valeurs recommandées tandis que les pourcentages d'acides gras polyinsaturés et les acides gras mono-insaturés étaient limités. Une carence d'apports était également trouvée concernant le calcium, le magnésium et le potassium ($p < 0,01$). Les apports hydriques étaient également inférieurs aux besoins ($p < 0,01$). Par ailleurs, plusieurs corrélations entre la composition corporelle d'une part et les apports énergétiques en lipides et en glucides, d'autre part ont été trouvées.

Conclusion: L'alimentation est un facteur clé de la performance et seule une éducation nutritionnelle bien adaptée et ciblée à cette population de jeunes sportifs pourrait améliorer leurs apports alimentaires tant sur le plan qualitatif que quantitatif en insistant sur une hydratation suffisante et judicieuse.

Mots-clés

Statut nutritionnel, composition corporelle, paramètres anthropométriques, haltérophiles.

SUMMARY

Aim: The aim of this study was to study the quantitative and qualitative aspects of daily spontaneous nutrition as well as anthropometric characteristics and body composition of young Tunisian weightlifters.

Methods: Thirty one boys aged between 14 and 18 years, practicing for two hours a day, six days a week in the four weightlifting clubs in Tunis were invited to attend an evaluation session for a food survey (3 days recall, with consumption frequency over a period of 7 days) and the assessment of anthropometric measurements (Weight, height and skinfolds).

Results: Energy intake was acceptable. However, an imbalance nutrient intake was revealed. Concerning macronutrient, fat and protein were above the recommended allowances ($p<0.01$). Further, the percentage of saturated fatty acids was significantly above the recommended values while the percentages of polyunsaturated fatty acids and monounsaturated fatty acids were restricted. Regarding the micronutrient, the intake of calcium, magnesium and potassium were restrictive ($p<0.01$). As for the fluid intake, a limited contribution was observed ($p<0.01$). Several correlations between body composition and dietary intake have been found.

Conclusion: Nutritional education may lead these young weightlifters to adopt appropriate nutritional habits to optimize dietary intake. This fact could be compromising of a more suitable body composition and could have a positive bearing on athletic performance.

Key-words

Nutritional status, body composition, anthropometric parameters, weightlifters.

Like all sport disciplines, weightlifting is an activity of athletic stamina. This sport consists in lifting weights above the head. It requires a good control of technics, speed, flexibility, coordination and balance. Although this discipline has led to many discussions about its practice during the period of child growth [1] because of the risk of injury and the risk of damage to the bones [2]. Several studies have shown that the practice of resistance sports with taking account of appropriate precautions and well-supervised training is rather a discipline that can be practiced safely in adolescence [3, 4]. First of all, because the injuries that occur during training are often accidental and results in most cases of bad control of the exercise [4, 5, 6]. In addition, there has been a shift in the understanding of the osteogenic effects of resistance sports which proves that regular practice of this discipline is beneficial for bone tissue and the skeleton [7]. Further, the practice of suitable weightlifting training, properly structured and supported by sports medical teams seems to be favorable for youth especially that internationals competition requires a preparation for years in advance from these young athletes to facilitate maximum performance [8]. Nutrition is one of the medical disciplines that should be more monitored in the case of growing teenagers practicing weightlifting because severe repercussions on health can take place in the case of an unbalanced diet whether in excess or deficiency. Furthermore, nutritional status has a direct bearing on the level of physical performance [1]. Actually, concerns about the diet of these young sportsmen should be a priority, in order to optimize their body composition especially that these athletes are in a period of growth. The coverage of needs of weightlifters in macro and micro nutrients is a necessity, not only to ensure the smooth progress of daily workouts and to increase muscle mass but also in order to meet the requirements of their growth and their recovery after intensive training.

For these reasons it seemed interesting to assess the nutritional status of young weightlifters relying on the analysis of quantitative and qualitative aspects of spontaneous daily intake, anthropometric characteristics and body composition.

METHODS

Subjects

The population of the present study were selected from male weightlifters (n=31), according to an age between 14 and 18 years. The sportsmen belongs to the five weightlifting club in Tunis. They were training regularly for at least a year with an amount of 6 sessions per week and participating in national and international competitions.

Methods

Young weightlifters were invited to attend the National Center of Medicine and Sports Sciences Tunis for detailed exploration of their dietary intake, their level of physical activity and assessment of their body composition.

Energetic suitability

Total routine energy expenditure (TEE), outside of sports activities, was determined by multiplying the basal metabolic rate (BMR) by the physical activity level (PAL) and adding the energy necessary for growth. Basal metabolic rate (BMR) has been calculated by applying the formula of BLACK for healthy subjects, below the age of 75 years. The level of Physical Activity (PAL) was calculated according to all daily activities with their type and duration. In addition to the energy expenditure of daily activities, we calculated for each athlete, the energy expenditure on physical activity as recommended by Mc Ardle, taking into account, the weight of every sportsman, the duration, frequency, and intensity of physical exercise. Thereafter was added the energy required for growth.

Food survey

To reflect the spontaneous dietary intake, we used the three-day food diary (two weekdays and one weekend day) with a survey of the consumption frequency over a period of 7 days. Each participant met with a trained dietitian and was interviewed about food records. Thereafter, computerized nutrient analysis software, (Bilnut, Nutrisoft, Cerelles, France) and food composition tables published by the Tunisian National Institute of Statistics in 1978 were used to analyze each of the diet records. Total daily energy intake (TDEI) were then estimated.

Anthropometric measures

Regarding the evaluation of body composition, weight (kg) was measured with a digital scale (Tanita WB-100A Professional Digital Scale), in a standing position with minimal clothes. Height (cm) was measured using a graduated stadiometer (Seca 217 Stadiometer), in stocking feet. Thereafter, body mass index (BMI) was calculated as BW/Hgt^2. Skinfolds thicknesses were taken at four different locations (biceps, triceps, subscapular and suprailiac) with a Harpenden Caliper on the right side, by the same person with the subject in a standing position. Skinfolds measures were expressed as the mean of three consecutive measurements. The density was calculated by the equation of Durnin and Rahaman. Relative fat mass was calculated by the equation of Siri amended by Westrate and Deurenberg then Lean body mass was calculated by subtracting fat mass.

Statistical analyzes:

Statistical analysis of the data was performed by using Student's t-test , followed by Pearson correlation. A p-value of 0.05 or less was considered as statistically significant

RESULTS

The baseline characteristics of the subjects are presented in (table 1). Concerning the anthropometric measures, the data presented were average height, weight, body mass index (BMI), body fat percentage and lean body mass percentage. As for the energetic suitability, the data showed were average physical activity level (PAL), basal metabolic rate (BMR), energy related to growth (EG) and total energy expenditure (TEE).

Table 1: Baseline characteristics of young Tunisian weightlifters

Baseline characteristics	
Age	15.58 ± 1.31
Anthropometric characteristics	
Height (m)	1.67 ± 0.07
Weight (kg)	60.39 ± 11.56
BMI	21.50 ± 3.35
% Body fat	12.28 ± 5.22
% Lean body mass	87.73 ± 5.22
Energy expenditure	
PAL	1.95 ± 0.06
BMR	1637 ± 108.7
EG	76.16 ± 20.24
TEE (kcal)	3257 ± 234.04

The mean daily nutrient intakes are shown in (Table 2).

Table 2: Comparison of the mean daily intakes of total energy and nutrients of young Tunisian weightlifters with the dietary reference intake

	Daily intake	**DRI**	**p value**
Energy (kcal/kg^{-1})	53.93 ± 6.68	53.64	_
Carbohydrate (g/kg^{-1})	7-8	5 – 10	_
• %Sucrose	13.81	10	p<0.01
Fat (g/kg^{-1})	1.71	0.7 – 1	p<0.01
• %SFA	45.87	25	p<0.01
• %MUFA	38.68	50	p<0.01
• %PUFA	15.45	25	p<0.01
Protein (g/ kg^{-1})	2.05	1 – 1.5	p<0.01
• %AP	59.71	50	p<0.01
• %VP	40.29	50	p<0.01
Calcium (mg)	822.51 ± 188.6	1500	p<0.01
Phosphorus (mg)	1523.88 ± 234.6	1250	_
Magnesium (mg)	199.90 ± 42.63	500 – 800	p<0.01
Potassium (mg)	3718.84 ± 1075.2	4700	p<0.01
Iron (mg)	20.5	15 – 20	_
Fluid intake (mL)	1587.10 ± 410.5	3000	p<0.01

The comparison between the observed intakes and DRI showed a corresponding energy intake p>0.05. However, concerning the macro nutrients, we found an excess of fat (p<0.01) and protein (p<0.01). Besides on protein contributions, 25.8% of the population exceeds the intake of 2.4g/kg^{-1}.

As regards micro nutrients, the contributions were in excess of SFA (p<0.01), while the intake of PUFA (p<0.01), MUFA (p<0.01), calcium (p<0.01), magnesium (p<0.01) and potassium (p<0.01) were restrictive. Furthermore, fluids intakes were limited (p<0.01).

According to (Table 3), there was a significant correlation between fat intake and fat mass (p<0.02) and a significant correlation between the intake of carbohydrates and lean body mass (p<0.03). Moreover, There was a strong correlation of the difference between the observed TDEI and TEE with fat mass (p<0.01).

Table 3 : Correlation between body composition and dietary intake

	Fat mass	**Lean body mass**	**p value**
Fat	r=0.401	_	p<0.02
Carbohydrate	_	r=0.388	p<0.03
TDEI - TEE	r=0.655	_	P<0.01

DISCUSSION

In this study, we demonstrate that energy intake by young Tunisian weightlifters was acceptable whereas an imbalance in nutrient intake was revealed. Fat and protein were above the recommended allowances. Saturated fatty acids were significantly above the recommended values while the percentages of polyunsaturated fatty acids and monounsaturated fatty acids were restricted. The intake of calcium, magnesium and potassium were restrictive. As for the fluid intake, a limited contribution was observed. We also found associations between body composition and dietary intake.

In fact, a suitable nutrition is essential for young athletes in order to optimise health status as well as performance. Adolescents practicing intensive sports activity should meet their energetic needs to ensure their growth and maturation. In addition, suitable energy intake is paramount for the body weight maintenance [9]. Low intake of energy may cause muscular mass loss, increase of fatigue risk and has a negative bearing on athletic performance [10]. While excess could promotes the increase in body fat mass and severely penalize on performance. Several studies show that strength-power athletes constantly present outstanding high energy intake comparing to other sports athletes. However, energy requirements were relative to body mass ratio. Therefore, the energy requirement expressed as a function of body mass shows lower energy intake especially in taller and very muscular subject. Nevertheless, the total daily calorie needs of young Tunisian weightlifters were covered and despite that the caloric aspect of their nutrition was slightly higher than the energy expenditure, the difference was not significant.

The analysis of the distribution of macronutrient intakes showed the following distribution 56 :29 :15 The

Table 4 : Comparison of the body composition of young Tunisian Weightlifters to others population

	Age	Weight	Height	BMI	% body fat	% lean body mass
Young Tunisian weightlifters	15.58 ± 1.31	60.39 ± 11.56	1.67 ± 0.07	21.50 ± 3.35	12.28 ± 5.22	87.73 ± 5.22
Bauer et al. (1994)	15	69.5	174	22.2	_	_
Andrew et al. (2006)	14.8 ± 2.3	63.3 ± 15.6	1.65 ± 11.7	_	_	_
American junior elite weighlifters	_	67.3 ± 10.4	_	24.1 ± 3.2	6.4 ± 2.9	94.65
American junior non elite weighlifters	_	62.3 ± 16.5	_	22.3 ± 4.3	10.3 ± 7.1	88.28

comparison of these results with those of Bauer S et al on weightlifters of the same age group 48 :37 :15 [11] shows that the distribution of the dietary intake of our population is closer to the IDR's proposals (Table 4).

In fact, resistance training cause depletion of muscle glycogen stores [12] by provoking skeletal muscle damage [13]. Whereas level of muscle glycogen has been associated with performance impairment [14, 15], the intake of carbohydrates plays an important role in the recovery and re-synthesis of the stock of glycogen especially when taken before, during and after training exercise. The average intake of young Tunisian weightlifters was higher than the values reported in strength athlete's literature. Various study on weightlifters, bodybuilders and sprinters stated values in the range of (3 - 7g/kg^{-1}) [9]. While, the recommendation proposed by Lambert and Flynn was (6g/kg^{-1}) [16]. All the same we would consider the daily intake of carbohydrate of our population conceivable.

Protein intake is always related to muscle protein synthesis (MPS) and anabolism. Actually, resistance exercise shift net protein balance (NPB) which increases the need of protein intake. However, the proteins were widely distributed in the diet of athletes and since their energy intake was very high compared to sedentary subjects, most resistance athletes have a satisfying intake [17]. The recommendations of protein intake among resistance athletes have known many controversies. Although many have agreed with the U.S. and Canadian Association recommending an intake of 1.2 - 1.7 g/kg^{-1} for endurance and resistance athletes [18,19] others believe that for athletes practicing an intensive resistance sport, an increased intake (1.8 - 2 g/kg^{-1}) may be advantageous [20]. However, 25.8% Tunisian youth weightlifters exceed the value of 2.4g/kg^{-1}. Gaine's study demonstrated clearly that from this value the anabolic response capped while the degradation of amino acids increases significantly, this may negatively impact the progression of muscle development [21]. Other studies on animals suggest that excessive protein intake raises the rate of myostatin, which decreases the rate of growth hormone [22]. In addition, an excess in protein can cause an imbalance of acid-base homeostasis [22] and many suspect the criminalization of high protein diets over a long period in renal insufficiency [23]. Most athletes practicing resistance activity in Tunisia consumed excessive amount of protein due to false belief neglecting the fact that the intake over the standard can be harmful and could affect their recovery and performance. The results of all most studies have revealed very high levels of protein intake among the athletes practicing resistance training, 3.2g/kg^{-1} observed among adults weighlifters [9] and 4.3g/kg^{-1} among Korean elite bodybuilders [24]. It is important to streamline the protein intake for these young athletes in order to maintain a positive nitrogenic balance without falling in excess intake [25].

Lipids intake was significantly below the level observed in the literature which reaches approximately 40% [11]. However, SFA intakes clearly exceed recommendations. This may be related to excessive intake of protein because foods rich in protein used by our population were often of animal origin; red meat, eggs, etc. This fact was observed in several studies among athletes practicing strength sports [26, 27]. However, the excess of SFA promotes 1lipogenesis. In contrast, the intake of MUFA observed is below recommended values and almost all of our population thinks that they should avoid the consumption of oils. In contrast, it represents a great source of essentials fatty acids and aid in absorption of fat soluble vitamins. We believe that the improvement of the quality of fat in our population diet can help to improve body composition and performance.

The average calcium intake of Tunisian weightlifters was significantly lower than the recommended. The need for calcium was therefore not assured. This should not be neglected because calcium is a major element for optimizing the density of bone mass during growth and a resistance factor to fractures. Inadequate calcium intake with resistance training during this critical period may inflict damage to the bone density and make these young athletes vulnerable to osteoporosis [28, 29]. The contribution of magnesium was less than the recommended intake. Magnesium deficiency can affect glycogen utilization at the cellular level. Furthermore, inadequate intake of calcium and magnesium can cause disorders of muscle contraction [30, 31].

The needs for phosphorus, potassium and iron are widely covered. However, there was an excess of these elements that could exacerbate deficiencies in calcium and magnesium by reducing their absorption by competitor mechanisms.

Regarding fluids intake it was noted that the amount of water and beverages consumed by our population could barely cover the needs of a sedentary subject while these

athletes are physically active for 2 hours per day. The consequences of dehydration during exercise could compromise physiological function and negatively influence performance [32, 33]. Severe hypo-hydration, especially when body mass loss exceeds 3% of body weight affects exercise performance and impairs heat dissipation, cardiovascular function, mental functioning and even exposes the athlete to the risk of injury [34, 35] The BMI of our population was lower than that observed by Bauer S et al [11] as well as the one found by Andrew C. Fry et al among American youth elite weightlifters and not elite American weightlifters respectively [36]. The comparison of the body composition of our population with the two groups studied by Andrew C. Fry et al which are of the same average age shows that the average stature of our population 1.67m ± 0.07 was higher than that of the American Junior Weightlifters (Table 4). However, lean body mass of our population was significantly lower than that of the elite group and non elites respectively. In contrast, the fat was higher in our population. The body composition of weightlifters is a distinguishing factor of elite weightlifters because it is a performance predictor factor [36, 37]. However, Tunisian weightlifters still need improvement of their body composition (Table 4).

In fact, according to the result of table 3 the body composition was strongly related to food consumption. We have already observed in our study of correlations that the body composition of our subjects evolves in the same direction as the food intake, fat mass was correlated with fat intake and lean body mass was correlated with carbohydrate. Furthermore, the fat was as well correlated to the difference between energy intake and observed TEE estimated of the studied population that was to say that the fat varies with the excess of daily energy intake.

CONCLUSION

Good nutritional status of weightlifters plays a key role in promoting the progress of the training of athletes from this discipline especially in a period of growth. Providing a balanced and appropriate diet is directly related to the improvement of body composition and performance. In addition, it ensures the recovery of athletes after intensive training and protects them from the dangers of resistance activities. The dietary intakes of young Tunisian weightlifters still need more improvement. A stronger nutritional education intervention will be of great interest for these young athletes.

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