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Original Article

Energy and macronutrient intake of advanced polish sport climbers

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Abstract:
The purpose of the study was to assess energy and macronutrient intakes in a group of elite sport climbers. The study group comprised 23 climbers, including 13 males and 10 females. Energy and macronutrient intakes were estimated from a seven-day food diaries. Intakes of energy, protein, carbohydrates and fat expressed in unites per kilograms of body weight were, respectively: 33.30 (±6.47) kcal, 1.48 (±0.34) g, 3.96 (±0.95) g and 1.22(±0.32) g. No differences between female and male climbers were found in mean energy and macronutrients intake, although in the case of protein intake a tendency towards significance was found (p=0.073) with males consuming relatively more proteins than females: 1.59(±0.40) g/kg BW vs 1.34(±0.17) g/kg BW. In conclusion, our data suggest that energy intake of climbers is low, taking as a point of reference current intake guidelines. Suboptimal supply especially concerns carbohydrates while intakes of the remaining macronutrients, proteins and fats, were within the recommended values.
Key Words*:* climbing, diet, energy, macronutrient intake

Introduction

Nutrition is one of the most important factors determining athletic performance in many sports not only keeping athletes' body healthy, but also allowing to optimize the targeted effort or speeding recovery and initiating tissue repairs after completing it (Benardot, 2012). Therefore athletes should consume adequate amount of energy, macro- and micronutrients to meet the needs that can be highly specific to sport and even particular events and roles played by athletes (Academy of Nutrition and Dietetics …, 2012). Particular concern is connected with sports of which relative values of biomotor abilities are valued ie. how strength or power are related to body mass of the athlete. There are two main ways of improving relative strength or power – developing these abilities and decreasing body mass or at least maintaining it while the process still occurs. The problem of athletes practicing sports in which relative strength/power is of great value meets high physical demands of training with delivering appropriate amount and quality of nutrient as athletes tend to restrict their calorie intake. Climbing, especially extreme rock climbing and competition climbing is a good example of such an activity. It involves moving our body through a series of holds, most of which are difficult to grab, because of their size (for example, they allow to place only fingertips) or location of surface (for example, their surface is inclined so hand slips down). Additionally, to move between the holds a climber has to exert much power, while holding body positions between the moves require much muscular strength, especially in the upper body (De Moraes Bertuzzi et al, 2007). All these aspects are easier to do when climbers are lightweight. Indeed, the research shows that climbers are characterized by low body mass and low body fat content, which often fluctuates at around 5% (Giles, Rhodes & Taunton, 2006), while high ratio of power and/or strength to body mass is one the most important factors to distinguish recreational climbers from elite ones (Giles, Rhodes & Taunton, 2006). This makes climbers prone to low caloric diets and even starving, however data on nutritional habits and nutrient intake of climbers are limited (Smith, Storey & Ranchordas, 2017). Therefore the main purpose of the study was to assess macronutrient and energy intake of advanced sport climbers.

Material & methods

Participants

Twenty three climbers took part in the study. Males (n=13) represented climbing level from 7a to 8c RP, after converting reported grades into standard UIAA metric [6] the mean level was 9,53 (SD=0.97). Climbing level of female climbers (n=10) ranged from 6c to 8a/8a+, and, after being converted into a similar way as in males, reaching mean value of 8,45 (SD=0.78). Both male and female participants may be therefore classified as advanced, considering the classification system of Draper et al (2011). Mean height of female participants was 164.50, body mass 55.10 and BMI 20.38. Aforementioned values in males were, respectively 177.62, 68.77 and 21.81. Climbers were recruited from the training groups in one of the sport climbing gyms in Katowice, Poland.

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Procedure

Dietary intake was assessed with the use of a food diary adapted from Kleiner (2008). Climbers were asked to record everything they ate and drank for 7 consecutive days. Prior to the "food-recording week" participants were instructed how to report food and beverages they would be consuming, especially in terms of quantifying portion sizes, and asked to be as accurate and sincere as possible.

Data collection and analysis

Calculation of nutrients intake was done by referring to tables of nutritional value published by Polish Institute of Food and Nutrition (Kunachowicz, Nadolna & Iwanow, 2012). Data were expressed as means ± SD and reported as relative ie. calculated per units of body mass. For comparisons of means between female and male participants Student's t-test was used along with Cohen's *d* as a measure of an effect size.

Results

Table 1 shows the anthropometric characteristics of climbers.

Table 1 Anthropometric data of climbers

Variable	Female	Male	Male/female difference
Body mass	55.1±5.09	68.8±4.44	$t_{(21)}$= -6.88, p<0.001, d=-3.03
Height	164.5±4.79	177.6±5.55	$t_{(21)}$= -5.96, p<0.001, d =-2.62
BMI	20.4±1.81	21.8±0.90	$t_{(21)}$= -2.48, p =0.022, d =-1.07

Male climbers were significantly higher and heavier that females, but no difference was found for BMI. The latter in both sexes were within the range between 18.5 and 24.9 considered as "normal". A tendency towards significance of differences were observed in relation to (dis)satisfaction of female and male climbers with their body mass (exact Fisher's test p=0.057). Relatively more female (8 out of 10) than male (5 out of 13) were dissatisfied with their body mass feeling of a slimming down need.BMI of climbers significantly predicted their climbing abilities expressed as the hardest route difficulty climbed in so called RP-style, ie. routes climbed in one push from bottom to top, but after previous inspection of the route. In female climbers BMI explained 46% of variance (R^2=0.46, $F_{(1,8)}$=6.72, p=0.032) and in males 32% (R^2=0.32, $F_{(1,11)}$=5.20, p=0.043). However, while in the former,difficulties of the routesrose with lowering the BMI values (ß=-0.68, $t_{(8)}$=-2.59, p=0.03), in the latter the direction of the relationship between both variables was opposite (ß=0.57, $t_{(8)}$= 2.28, p=0.043).

Reported mean ± SD and Min-Max energy and macronutrient intake are shown in Table 2.

Table 2 Mean±SD, min and max of energy and macronutrient intake for the whole sample and according to gender

Variable	Whole sample		Gender				
			Female		Male		Diff. F/M
	Mean ±SD	Min-Max	Mean ±SD	Min-Max	Mean±SD	Min-Max	
Kcal/kg BW	33.30 ±6.47	23.04-49.26	31.36 ±7.68	23.04-37.73	34.80±8.28	24.83-49.26	$t_{(21)}$= -1.28 p=0.214 d=0.46
Protein g/kg BW	1.48 ±0.34	1.03-2.16	1.34 ±0.17	1.11-1.53	1.59 ±0.40	1.03-2.16	$t_{(21)}$= -1.89 p=0.073 d=0.84
CHO g/kg BW	3.96 ±0.95	2.46-5.66	3.66 ±0.67	2.91-4.95	4.19 ±1.10	2.46-5.66	$t_{(21)}$= -1.33 p=0.196 d=0.60
Fat g/kg BW	1.22 ±0.32	0.55-2.14	1.23 ±0.29	0.55-1.48	1.21 ±0.35	0.89-2.14	$t_{(21)}$= 0.09 p=0.928 d=0.06

Mean energy intakes were 1734 (±328) kcal for female climbers and 2337 (±517) kcal for males, or after expressing these values per unit of body weight 31.4 (±7.7) and 34.8 (±8.3) kcal/kg BW, respectively. No statistical difference between males and females was found in relative values of energy intake, although according to a measure of effect size small-to-modeerate strength of relationship between sex and caloric value of food consumed by climbers. In terms of the macronutrients, average protein intake was 1.48±0.34 g/kg, carbohydrates - 3.96±0.95 g/kg and fat 1.22±0.32 g/kg. No differences between female and male climbers were found although in the case of protein intake a tendency towards significance was found (p=0.073). It should be noted however, large effect size revealing that in fact the true difference in amounts of protein consumed by male and female climbers is substantial.

Macronutrient and energy intake were not related to performance level – regression model with abovementioned variables as predictors of the highest UIAA grade was insignificant: R^2=0.12, $F_{(4,18)}$=0.62, p=0.656).

With respect to supplements intake the most popular were branched chain amino-acids consumed by nearly half of the respondents (11 out of 23), especially by males (8 out of 13 comparing to 3 women), followed by vitamins and minerals (n=9), joints supporters, like glucosamine and collagen hydrolysate (n=4, males only) and creatine (one male climber). None of the respondents declared taking beta-alanine, thermogenics, protein isolates/hydrolysates or isotonic drinks.

Dicussion

Sport climbing and extreme rock climbing are increasing in popularity. At the same time their performance requirements are also increasing. Contemporary climbers are required to fulfill regimens that involve strength, power, speed, anaerobic and aerobic endurance, and many exercises overloading joints and ligaments, especially within hand, as holds on extreme boulder problems or routes are very small and difficult to grab. Such extreme loads require proper nutrition to meet the body needs, which cannot be so easy ~~task~~ taking into consideration that climbing is a typical weight-bearing activity in which low body mass is preferred. Therefore climbers tend to have low body fat content (Watts, Martin & Durtschi, 1993, Giles, Rhodes & Taunton, 2006, Puletić, Stanković, 2014) as decreasing this tissue is considered to be the primary way to optimize indexes of body mass to such abilities as strength, power or power endurance. It may result in eating disorders and in fact some sport climbing institutions (national federations as well as an international federation IFSC and earlier the medical commission of UIAA) expressed their concerns about the risk of the abovementioned issues (Smith, Storey & Ranchordas, 2017). In 2014 an open letter to IFSC was published by leading competition and rock French female-climber Charlotte Duriff (2014). Taking the abovementioned issues into consideration it is important to monitor nutritional status of climbers. Surprisingly, it has been rarely studied. Therefore the aim of the study was assessing macronutrient intake and supplements intake by advanced sport climbers. Participants of this study, members of an athletic section in one climbing gyms in Katowice, self-reported their food and beverages intake within the 7-day~~s~~ period during their usual training and climbing activity within a preparation period. It was found that both female and male climbers followed rather low calorie diet as the mean energy intakes were 1734 (±328) kcal for the former and 2337 (±517) kcal for the latter, which corresponds to 31.4 (±7.7) and 34.8 (±8.3) kcal·kg body weight, respectively. Nearly 48% of respondents consumed less than 2000 kcal/d. Comparing these values to dietetic norms for Polish population (Jarosz, 2017) they correspond~~s~~ to energy intake of males and females with physical activity index PAL equals to 1.4, ie. typical rather for sedentary individuals than athletes, practicing sport with estimated energy cost at about 7.5 METs (Ainsworth et al, 2011).

Quite surprisingly low caloric value of climbers' diet arise not from low fat intake, which was on average 1.2 g per kg of body weight. Traditionally this macronutrient was not much popular among climbers.To illustratethe fact, suffice to say that in a worldwide known trade magazine "Climbing," in the mid-80's a paper was published by the author who encouraged climbers to consume 0% (zero) fat in their diet (Ilg, 1986). Even if such a "recommendation" may be viewed as a historical curiosity, by many climbers fat is still considered as a nutrient of the little value and a source of excess calories. Our study, however, did not confirm that. Although minimal fat intake in our study was 0.55 g/kg BW in one female climber, on average climbers consumed enough amount of fat to reach body needs and contributed to 32.4% of total energy intake in males and 35.3% in females which are values up to recommendations. It was rather carbohydrates, that consumed in amounts typical for rather low-active individuals or those who train bearing in mind achieving rather general fitness goals or performing low intensity skill-based activities ie. 3-5 grams per kilogram of body weight (Academy of Nutrition and Dietetics …, 2012, Kersick et al, 2018).

Athletes engaging in more intense training regimes should consume between 5-8 g/day and those who train or compete for several hours a day even up to 12 g/kg BW. While the latter value seems to be in excess of climbers' energy requirements not to mention psychological aspects of consuming such amounts of food by athletes concerning their body weight, the former range seems the most appropriate for them (Ranchordas, Hudson & Thompson, 2017). Undoubtedly, this macronutrient plays the most important role in fueling climbing, which involves large amounts of anaerobical and/or mixed anaerobical/aerobical efforts (Smith, Storey & Ranchordas, 2017). Meanwhile, an average intake of carbohydrates in participants of our study was about 4 g/kg BW, in some cases reaching less the 3 g/kg BW. Only three subjects consumed at least 5.0 g CHO/kg BW. On average, male climbers derived from this macronutrient ca. 49% of energy and female climbers ca 47%. Protein intake stayed within the recommended range for athletes (1.2-2.0 g/kg) being consumed in amounts from 1.03 to 2.16 g/kg BW.

There are not many studies we can compare our results with. In fact, in the literature found by the authors there were only two studies in which energy and nutrient intake by elite climbers were assessed. In the first one, Zapf et al (2001) diagnosed 20 elite rock climbers reporting that their mean energy intake was 2652 ± 486 kcal/d and ranged from as low as 1595 kcal/d to 4084 kcal/d. Energy intake decreased with increasing performance of climbers expressed as the highest UIAA grade level. Mean energy intake in our study was a bit lower (2075 kcal), and the range was between 1267 kcal and 3492 kcal. In another study Merrells et al (2008) analyzed – among others – diet patterns of two climbers during their rock climbing trip. While mean energy intake during five days at baseline was 3556±477 kcal and 2864±779 and dropped during the trip on weekdays

to 2142±346 kcal and 1892±451 kcal and on weekends to 3814±1782 kcal and 3723±1653 kcal. Especially during weekdays macronutrient intake of both climbers were dropping to suboptimal levels. However, results of the study are not easily compared to our results as climbing trips are a unique experiences – climbers usually even nearly all day long, while having two big meals during the day, breakfast and dinner. Eating behaviors during preparation period are better ordered and they reflect climbers' attitudes, values and performance goals.

Conclusions

Our data suggest that energy intake of climbers is quite low taking as a point of reference current intake guidelines. It is characteristic for sports and activities in which low body mass and especially low body fat content, and would expose climbers to a risk of nutrient deficiencies and therefore they could benefit from being under the supervision of sport dietitians. Suboptimal supply especially concerns carbohydrates while intakes of the remaining macronutrients, proteins and fats, were within the recommended values.

Additionally more in-depth research is needed to determine if climbers consume adequate amounts of other nutrients like minerals or vitamins, what kinds of carbohydrates (according to its glycemic index) and when, what is the proportion of saturated and unsaturated fatty acids etc. to name but a few questions that should be answered.

Conflicts of interest - The authors declare having no conflicts of interest.

References:

Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine (2016). Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and athletic performance. *Journal of the Academy of Nutrition and Dietetics*, 116(3): 501-528.

Ainsworth, B.E., Haskell, W.L., Hermann, S.D., Meckes, N., Basset, D.R., Tudor-Locke, C., Greer, J.L., Vezina. J., Whitt-Glover, M.C. & Leon, A.S. (2011). 2011 Compendium of Physical Activities: A second update of codes and MET values. *Medicine and Science in Sports and Exercise*, *43*(8), 1575-1581.

Benardot, D. (2012). *Advanced sports nutrition*. Champaign, Human Kinetics.

De Moraes Bertuzzi, R.C., Franchini, E., Kokubun, E. & Kiss, M.A.P.D. (2007). Energy system contributions in indoor rock climbing. *European Journal of Applied Physiol*ogy, *101*, 293–300.

Draper, N., Canalejo, .JC., Fryer, S., Dickson, T., Winter, D., Ellis, G., Hamlin, M., Shearman, J. & North, C. (2011). Reporting climbing grades and grouping categories for rock climbing *Isokinetics Exercise Sci*ence, *19*, 273–280. DOI 10.3233/IES-2011-0424

Duriff, C. (2014). available at URL: http://www.grimper.com/news-charlotte-durif-revient-toute-experience-competitrice-debut-circuit-coupe-monde-difficulte-2014)

Giles, L.V., Rhodes, E.C. & Taunton, J.E. (2006). The physiology of rock climbing. *Sports Medicine, 36*(6), 529-545.

Ilg, S. (1986). Eat to climb. Major nutrient metabolism. *Climbing*, 94.

Jarosz, M. (2017). *Nutrition norms for Polish population* [in Polish]. Warszawa, Instytut Żywności i Żywienia.

Kersick, C., Wilborn, C.D., Roberts, M.D., Smith-Ryan, A., Kleiner, S.M., Jäger, .R ,Collins, R., Cooke, M., Davis, J.N., Galvan, E., Greenwood, M., Lowery, L.M., Wildman, R., Antonio, J. & Kreider, R.B. (2018). ISSN exercise & sports nutrition review update: research & recommendations. *Journal of the International Society of Sports Nutrition, 15*, 38 https://doi.org/10.1186/s12970-018-0242-y

Kleiner, S. (2008). *Nutritional assessment and counseling of athletes*. In: Antonio, J., Kalman, J., Stout, M., Greenwood, D., Willoughby, D.S. & Haff, G., editors. *Essentials of sports nutrition and supplements*. Totowa, NJ, Humana Press, 201-234.

Kunachowicz, H., Nadolna, I. & Iwanow, K. (2012). *Nutritional value of selected foodstuff and typical dishes* [in Polish]. 6th ed. Warszawa: PZWL.

Merrells, K.J., Friel, J.K., Knaus, M. & Suh, M. (2008). Following 2 diet-restricted male outdoor rock climbers: impact on oxidative stress and improvements in markers of cardiovascular risk. *Applied Physiology Nutrition and Metabolism, 33*, 1250–1256.

Puletić, M. & Stanković, D. (2014). The influence of somatotype components on success in sport climbing. *Facta Universitatis 12*(2), 105–111.

Ranchordas, M.K., Hudson, S. & Thompson, S.W. (2017). *Nutrition for extreme sports*. In: Feletti F. Editor, *Extreme sports medicine*. Springer International Publishing.

Smith, E.J., Storey, R. & Ranchordas, M.K. (2017). Nutritional considerations for bouldering. *International Journal of Sport Nutrition and Exercise Metabolism, 27*, 314 -324. https://doi.org/10.1123/ijsnem.2017-0043

Watts, P.B., Martin, D.T. & Durtschi S. (1993). Anthropometric profiles of elite male and female competitive sport rock climbers. *Journal of Sports Sciences, 11*(2), 113-117.

Zapf, J., Fichtl, B., Wielgoss, S. & Schmidt, W. (2001). Macronutrient intake and eating habits in elite rock climbers. *Medicine and Science in Sports and Exercise, 33*(5), S72.