Journal Sport Area
http://journal.uir.ac.id/index.php/JSP
Vol. 7. No. 3. December, (2022)

Analysis of energy requirements and nutritional needs of rock climbing athletes

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Received 05 November 2022; Accepted 04 December 2022; Published 14 December 2022
Ed 2022; *7*(3): 437-445

ABSTRACT

Measuring the nutritional needs of rock climbing athletes can help athletes, coaches, and managers determine the portion of food and portion of the athlete's training. The purpose of this study is to determine the energy requirements and nutritional needs of FPTI rock climbing athletes in Buleleng Regency as recommendations for feeding. This research is a cross-sectional study that seeks to reveal quantitative variables and qualitative comments involving 12 rock climbing athletes. Data collection procedures by measurement of the nutritional needs of rock climbing athletes are carried out by providing an explanation of nutritional needs and measurement procedures, measuring BMI, calculating BMR and SDA, interviews for non-sports and sports physical activities, calculating total energy needs, determining food portions, and discussing the needs and eating of athletes per day. The calculation results show that the athlete's BMI is in the ideal category. The average energy requirement of athletes per day is 4568.45 calories. The average carbohydrate requirement for rock climbing athletes is 2741.07 calories or 685.27 grams. Energy needs that can be met by fat are 1142.11 calories or 126.9 grams. The energy requirement that can be supplied by protein is 685.27 calories or 171.32 grams. Rock climbing athletes require a diet with a rather low intake of protein and carbohydrates to keep body weight low. Adolescent rock climbing athletes must be careful in managing energy consumption which has an impact on growth and achievement.

Keywords: Nutritions; energy; rock climbing

https://doi.org/10.25299/sportarea.2022.vol7(3).10886

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How to Cite: Mashuri, H., Mappaompo, M.A., & Purwanto, D. (2022). Analysis of energy requirements and nutritional needs of rock climbing athletes. *Journal Sport Area*, *7*(3), 437-445. https://doi.org/10.25299/sportarea.2022.vol7(3).10886

Authors' Contribution: a – Study Design; b – Data Collection; c – Statistical Analysis; d – Manuscript Preparation; e – Funds Collection

INTRODUCTION

Rock climbing is a sport that is increasingly popular in the world (Michael et al., 2019a; Michael et al., 2019b) as evidenced by the increased interest after rock climbing became one of the sports contested the 2020 Tokyo Olympics which consists of three categories, namely boulder, speed, and lead climbing (Krawczyk et al., 2018; Pyszczek et al., 2019). The competition format combines the three rock climbing categories (combined format) during the 2020 Tokyo Olympics (Krawczyk et al., 2018). Rock climbing is classified as a complex sport because the dynamics of the climber's activity and the work of muscle energy used have aerobic and anaerobic features that participate in the production of adenosine triphosphate (Simič et al., 2022),

so it is necessary to plan individual nutrition according to the climber's training and minimize the risk of injury (Pyszczek et al., 2019). Several studies on rock climbing focused on the physiology of athletes, such as arm strength, arm power, leg strength, leg power, and finger strength (Hardiyono, 2018, 2019). However, no research aims to assess nutritional needs (nutritional status, energy requirements, nutrient requirements) (Pyszczek et al., 2019).

Nutrition is an integral component of any athlete's training and performance program (Smith et al., 2017). Nutritional status is a discussion of the state of the human body seen from food intake and physical activity. Nutritional status is one indicator to determine the state of the body in proportion to normality or not (Herpandika et al., 2019). Athletes' nutritional status must be regularly determined by coaches, managers, athletes, and sports nutrition teams as an important part of sports training and the selection of proper nutrition in diet (Ersoy et al., 2019). Proper nutrition is essential for the health and participation of athletes in competition by providing energy, body construction, and necessary biological substances (Abdumalikovich, 2022).

Through nutritional status, energy needs, and activities that must be carried out by athletes can be known because nutrients function as energy producers, build and maintain tissues, and regulate the body's life processes (Nugraheni & Mukti, 2013). So nutritional arrangements need to be periodized concerning daily training demands and overall nutritional goals (Thomas et al., 2016). The focus of nutrition for training is used for performance adaptation, while the focus of match nutrition is for optimal performance (Thomas et al., 2016). The use of necessary biological substances in the form of supplements must be carried out safely and effectively by checking that the supplements consumed have been tested by a doping agency (Doherty et al., 2019). The nutritional needs of athletes must be balanced with body activity (metabolism), bodywork, energy needs at rest, exercise, and competition (Rasyono & Yanto, 2022). Balanced nutrition is an eating arrangement by paying attention to the food groups consumed by athletes, including staple foods, animal side dishes, vegetable side dishes, vegetables, and fruit (Puspaningtyas et al., 2019).

Proper nutrition is the basis for athletes' performance when competing or training. Nutrients are needed in the body's biological work to provide energy when athletes perform various physical activities, for example during competition, training, and post-match recovery (Nur, 2019). Good nutrition will provide sufficient energy when athletes perform physical activities and can hasten recovery so that athletes do not get tired easily when competing. The nutritional needs of athletes vary depending on the intensity of the exercise. So the food menu should contain 60-70% carbohydrates, 20-25% fat, and 10-15% protein from the total energy needs of an athlete (Husaini, 2002). Carbohydrates are a type of micronutrient whose main function is to provide energy for the body, and the muscles and, the brain will use carbohydrates as their main energy source (Rismayanthi, 2015). Carbohydrates will be stored in the muscles and liver in the form of glycogen and the blood in the form of glucose (Rismayanthi, 2015). Fat is the most efficient way to store energy used for long-term activities, while protein is rarely needed by the body for more than 5% to 10% of energy needs (Rismayanthi, 2015).

The implementation of nutrition regulation in sports indirectly provides a positive lifestyle for athletes (Mashuri, 2022a; Mashuri et al., 2021b) that pleasure physical activity and sports (Mashuri, 2019a). The enjoyment of sports activities has a real impact on the biomotor of athletes which is manifested in sports abilities (Mashuri & Artanayasa, 2021b) so biomotor training to improve and develop the physical condition is also very necessary (Mashuri et al., 2019b). Thus, the regulation of balanced nutrition for athletes has an impact on the athlete's lifestyle and helps athletes achieve physical conditions that are manifested in sports performance. Balanced nutrition regulation is applied to all athletes in sports, including rock climbing athletes. The sport of rock climbing has a great opportunity to excel because it offers many medals (Hardiyono, 2019) in three categories, namely the lead, speed, and boulder categories. This great opportunity certainly requires great physical condition, so it is necessary to measure the nutritional needs of rock climbing athletes to achieve maximum performance.

Based on the results of the situation analysis, FPTI Buleleng Regency is active in every rock climbing event or multi-event in Bali Province. In 2021, FPTI Buleleng will send 20 climbing athletes to take part in a rock climbing event in Karangasem Regency, Bali. The Buleleng FPTI contingent is the favorite for the overall champion and is expected to win all medals in the event. But in reality, FPTI Buleleng only won 15 of the 35

numbers that were contested. These results provide concrete evidence that it is necessary to measure the degree of nutritional status and determine the daily and weekly nutritional portions of rock climbing athletes. Based on the situation analysis, the problems faced by the FPTI in Buleleng Regency are the limited knowledge and understanding of rock climbing coaches about calculating the nutritional status and nutritional needs of athletes and the lack of data about athletes, especially data on the nutritional status of rock climbing athletes.

So it needs a lot of research that accompanies the development of rock climbing. But not much research discusses rock climbing. There is limited information available about the nutritional needs and nutritional intake of young climbers (Simič et al., 2022). Nutritional recommendations for rock climbing performance remain limited (Michael et al., 2019b). This study was designed to determine the calorie needs and the number of food consumption of rock climbing athletes. Due to the limited number of studies regarding the especially rock climbing athletes, the finding of this study can be considered useful for rock climbing athletes and coaches in Indonesia.

METHOD

This research used mixed method approach. This research is a cross-sectional study that seeks to reveal quantitative variables and qualitative comments. Quantitative variables are used to determine the calorie needs of athletes and nutritional needs of rock climbing athletes. While the athlete's interview was to find out the non-sports physical activities and sports activities carried out by rock climbing athletes. The research subjects were all rock climbing athletes of FPTI Buleleng Regency, totaling 12 athletes. The characteristics of rock climbing athletes at FPTI Buleleng Regency are as follows.

Table 1. Demographics of Research Subjects

No.	Research Subject Category	Sum	Average Age	Average Weight	Average Height	Percentage
1	Woman	5	16.60	46.96	156,80	42%
2	Man	7	16.29	58.27	166.07	58%
	N	12				

The procedure of this research is to conduct interviews with athletes, coaches, and managers of FPTI Buleleng Regency. Interviews were conducted to find out the activities/physical activities outside of sports carried out by athletes in everyday life. The results of the interview are used to determine the degree of physical activity which will be calculated with a formula in determining the energy and nutrition of rock climbing athletes. Then, the measurements were made by measuring the athlete's height and weight. Calculations are carried out using the formula BMR, SDA, Physical Activity Energy, Sports Activity Energy, and Macro Nutrient Portion Distribution.

RESULTS AND DISCUSSION

This study begins with measuring the athlete's body mass index (BMI) by measuring height and weight and age. BMI calculation by weighing body weight (kg) and measuring height (m) squared (Astuti et al., 2022; Mocha-Bonilla et al., 2018). There are 1 (8%) athletes in the underweight category and 11 (92%) athletes in the normal or ideal category. Based on the results of the BMI calculation, it can be said that the BMI of rock climbing athletes in Buleleng Regency is normal or ideal.

Table 2. Body Mass Index Distribution

No.	BMI	Category	Frequency	Percentage
1	<18.5	Underweight	1	8%
2	18.5 – 24.9	Normal	11	92%
3	25 – 29.9	Overweight	0	0%
	>30	Obesity	0	0%
	Total		12	100%

After measuring and calculating BMI, it is continued by calculating the basal metabolism rate and specific dynamic action as well as the athlete's basic energy to determine the basic energy needed for rock climbing

athletes in Buleleng Regency. BMR calculations are carried out to determine the energy needs of athletes in a state of doing nothing or just to maintain life. While SDA is done to calculate the energy needs used for body metabolism that come from food. The average rock climbing athlete in Buleleng Regency has a basal energy requirement of 1470.1 cal. The energy requirement due to the food consumed is on average 147.01 cal. So that it can be obtained the average basic energy requirement of rock climbing athletes in Buleleng Regency is 1617.11 cal.

Table 3. Calculation of BMR, SDA, and Basic Energy Needs

No.		BMR	SDA	Basic Energy Needs
1	mean	1470,10	147.01	1617.11
2	SD	146.54	14.65	161.19
3	Min	1710,5	171.05	1881.55
4	Max	1255.42	125.542	1380,962

Furthermore, conducting interviews to find out the athletes' daily non-sports physical activities and sports physical activities carried out in training or competitions. The calculation of energy for non-sports rock climbing athletes comes from the daily activities of athletes without sports which are summarized in light, moderate, and heavy categories with each containing a value calculated with energy with basic energy. The calculation results show that the average athlete needs 2561.92 calories of energy. Sports energy needs come from the sports activities of rock climbing athletes. The average energy requirement for rock climbing athletes in Buleleng Regency is 1965.36 calories. The results of the measurement and calculation and analysis of non-sports and sports physical activity.

Table 4. Distribution of Non-Sports Physical Activity

No.	Gender	Category	Score	Frequency
1		Light	1.55	4
2	Woman	Currently	1.7	1
3		Heavy	2	0
4		Light	1.56	6
5	Man	Currently	1.76	1
6		Heavy	2.1	0
		Total		12

Table 5. Energy Calculation of Non-Sports and Sports Physical Activities

No.		Non-Sport Energy	Sports Energy	Activity Energy
1	Average	2561.92	1965,36	4527.28
2	SD	263.64	352.85	430.18

It is necessary to pay attention to the age of the athlete because athletes under the age of 18-19 years are in a period of growth, so additional nutrition is needed to support the growth of athletes.

Table 6. Age distribution of rock climbing athletes

No.	Age	Score	Frequency
1	10 – 14 years	2 cal/kg BW	2
2	15 years	1 cal/kg BW	2
3	16 – 18 years	0.5 cal/kg BW	6
	> 19	0 cal/kg BW	2
	Total		12

Table 7. Calculation of Additional Energy for Growth Age Athletes

No.		Age	Activity Energy	Additional Energy	Total Energy
1	Average	16.42	4527.28	41.17	4568,45
2	SD	1.98	430.18	38.59	441.63

The total energy needs of rock climbing athletes in Buleleng Regency are formulated with the theory of the athlete's food portion and the calorie content in macronutrients, then analyzed so that later the recommended macronutrient needs per gram in one day can be recommended. The macronutrient needs of rock climbing athletes in Buleleng Regency are divided into three nutrients, namely carbohydrates, fats, and proteins. The average carbohydrate requirement (carbohydrates) for rock climbing athletes is 2741.07 or 685.27 grams of carbohydrates. Energy needs that can be met by fat are 1142.11 calories or 126.9 grams of fat. The energy requirement that can be supplied by protein is 685.27 calories or 171.32 grams.

Table 8. Nutritional Needs of Rock Climbing Athletes in Buleleng Regency

No.		Nutritional Needs					
		Carbohydrate		Fat		Protein	
		Calories	gram	Calories	gram	Calories	gram
1	Average	2741.07	685.27	1142.11	126.90	685.27	171.32
2	SD	264.98	66.24	110.41	12.27	66.24	16.56

Rock climbing achievement is always associated with hard training and balanced nutrition. However, the problems that often arise are unbalanced nutritional intake, behavior, and community attitudes in overcoming nutritional problems (Astuti et al., 2022). One of the real manifestations of nutritional problems in rock climbing is the BMI of athletes who are classified as underweight, this shows an imbalance between nutritional intake and the nutritional needs of athletes. This condition will cause athletes to be more susceptible to disease, get tired easily, and reduce their rock climbing ability.

Anthropometric measurements for climbers are essential for designing nutritional recommendations. Rock climbing athletes usually have relatively short, slender, and lighter bodies than athletes in non-climbing sports, the profile of rock climbing athletes are more like ballet dancers or marathon runners. The anthropometry of rock climbing athletes is related to the athlete's body composition which consists of height and weight. In anthropometric studies of rock climbing athletes, the average rock climbing athlete has a small stature (mean height = 162.13 cm) with a lighter body weight (average weight = 54.18 kg). Such anthropometric conditions are still worth stating relative to body mass index. Young climbers, show a slimmer body shape and fall into the ideal or normal category (Michael et al., 2019b). Smaller body sizes allow the climber to perform faster and achieve better times in speed climbing (Krawczyk et al., 2018). The results of this study indicated that the height of rock climbing athletes is more supportive in the speed climbing category. So that it can be predicted that the FPTI Buleleng Regency team will achieve more in the speed climbing category.

Calculation of basal energy or commonly referred to as resting energy using the Harris-Benedict formula (Meseri et al., 2022). BMR is the average energy expenditure of the body during physical, mental rest, and complete digestion (Pethusamy et al., 2022). Resting energy accounts for 60-75% of the athlete's total daily energy expenditure, so it will have a drastic impact on the athlete's body mass and performance (Watson et al., 2019). However, this study shows that the average basal energy requirement of rock climbing athletes is 32% of the total energy requirement. This shows that the physical activity performed (non-sports or sports) is very strenuous so it requires more energy. Basal energy requirements will have an impact on natural resources which take a value of 10% of the BMR value. SDA is a physiological process of the body that represents the use of energy for all body activities related to food consumption, digestion, absorption, and assimilation of food (Mashuri, 2022b). Thus, the basic needs of rock climbing athletes can be identified by adding BMR with SDA.

Rock climbing athletes in their daily life also do non-sports physical activities. The average rock climbing athletes in Buleleng Regency are students and students with an average light physical activity but some work after studying at school or on campus. Types of physical activity are grouped based on the severity of the activity carried out and each activity factor is different according to gender (Welis & Rifki, 2013). The activity factor value is calculated with the basic energy requirement. There are 2 (17%) rock climbing athletes in Buleleng Regency who work after studying at school 10 (83%) athletes do not work and do not do light activities.

Sports energy needs are calculated by taking into account the type of exercise performed, the duration of each exercise per day, and the frequency of exercise in one week. Rock climbing athletes in Buleleng Regency practise rock climbing 5 times a week. The training menu consists of a static and dynamic warm-up, jogging for 30 minutes, 400 meter sprint, weight training, and rock climbing technique exercises. The total duration of each exercise is 4 hours (240 minutes) with a break of about 1 hour (60 minutes). The sport of rock climbing does require the main physical conditions, namely strength, flexibility, power, and coordination (Hardiyono, 2018, 2019). Therefore, the energy needs of rock climbing athletes are greater than the basic energy needs.

The distribution of the portion of nutrients is adjusted to the sport. The proportion of nutrients from the total calorie requirement for carbohydrates is 60-70%, for fat as much as 20-25%, and for protein as much as 10-15% (Sandi, 2019). The sport of rock climbing requires excellent physical condition with lean body proportions so that the proportion of nutrients determined is 60% carbohydrates, 25% fat, and 15% protein. The macronutrients are then adjusted to the amount of nutrient weight (in grams) to determine the type of food that can be consumed by rock climbing athletes. The determination of food weight is based on Atwater and Bryant's reduction theory, namely 1 gram of carbohydrates contains 4 calories, 1 gram of fat contains 9 calories, and 1 gram of protein contains 4 calories. The average energy requirement of rock climbing athletes in Buleleng Regency is 4568.45 calories divided according to the percentage portion, namely 60% carbohydrates (2741.07 cal), 25% fat (1142.11 cal), and 15% protein (685.27 cal). The energy requirement is converted by Atwater and Bryant's theory, which is 685.27 grams of carbohydrates. The energy requirement that can be met by fat is 126.9 grams of fat. The energy requirement that can be supplied by protein is 171.32 grams.

Several studies related to the intake of macro and micronutrients in the diet of climbers have found that weight management is kept low by consuming protein and carbohydrates lower than the recommendations given (Simič et al., 2022). The recommended diet is based on the condition of the body and physical activity in sports and non-sports, so reducing the amount of consumption given, it will cause the rock climbing athlete to lack energy which can affect the performance of the rock climbing athlete. The discipline of rock climbing athletes, coaches, and managers of the Buleleng Regency FPTI team regarding the athlete's diet needs serious attention, especially in participating in provincial events (Bali Provincial Sports Week 2022).

Nutrition in youth rock climbing athletes, especially athletes in their infancy must gain growth and achievement (Michael et al., 2019b). Therefore athletes under 19 age should be given additional nutrition according to body weight. Average FPTI rock climbing athletes in Buleleng Regency get additional growth energy of 41.17 cal (SD=38.59). However, youth rock climbing athletes need to be careful in providing the right fuel for training to maintain energy availability for both performance and growth (Smith et al., 2017). The results of a recent study on energy use in rock climbing, the food intake patterns of competitive rock climbing athletes show a failure to meet energy targets, carbohydrate requirements, and fat requirements, but meet protein requirements (Michael et al., 2019a). Failure to meet energy targets and nutritional needs is at risk for eating disorders and performance rock climbing athletes.

CONCLUSION

Measuring the nutritional needs of rock climbing athletes in Buleleng Regency provides important information for athletes, coaches, and managers in determining food portions, physical activity, and exercise periodization. The measurement results show that the BMI of rock climbing athletes in Buleleng Regency is in the ideal category with an average energy required of 4568.45 calories. Based on these calculations, it can be determined that the average macronutrient requirements of rock climbing athletes are 685.27 grams of carbohydrates, 126.90 grams of fat, and 171.32 grams of protein. Rock climbing athletes require a diet with a rather low intake of protein and carbohydrates compared to athletes in other sports because energy intake is often used to keep body weight low. All FPTI Buleleng Regency coaches who are involved in rock climbing training must apply the discipline of food consumption for athletes and limit eating foods whose calorie content is unknown. It is necessary to detail the amount of food that must be consumed by athletes according to the athlete's habits as well as the measurement of the dominant physical condition of rock climbing regularly as material for monitoring the weight of rock climbing athletes. This research is limited to measuring the

calories required and nutritional needs of rock climbing athletes. There needs to research on menu proportions that are in accordance with the habits of rock climbing athletes.

ACKNOWLEDGEMENTS

Acknowledgments to Ganesha University of Education through the Institute for Research and Community Service for providing financial support for this research. Thank you to FPTI Buleleng Regency for providing the opportunity to contribute to improving human resources and improving rock climbing achievements.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest

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