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CHANGES IN ENERGY CONSUMPTION DURING TRAINING OF ATHLETIC ATHLETES AND SWIMMERS

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ABSTRACT

Objective: Assess the total energy needs during the general and professional preparation phases (total energy consumption) for national athletic athletes and swimmers.

Subjects and methods: Cross-sectional descriptive study with analysis. This research evaluates the Total Energy Expenditure (TTEE) in track and field athletes participating in sprints, jumps, and throw events (2 men, 3 women), as well as swimmers specializing in sprint and medium-length events (3 men, 2 women) in Ho Chi Minh City National Sports Training Center in February 2023. Heart rate monitoring devices were employed to assess the Exercise Energy Expenditure (ExEE) during professional training. Additionally, the study employed methods to calculate Basal Metabolic Rate (BMR) and Physical Activity Level (PAL). Energy consumption was calculated during the first 10 days of both the general and specific preparation phase.

Results: In the athletics team, there was a significant increase in ExEE from 684.46 kcal (SD = 324.5) during the general preparation phase to 936.12 kcal (SD = 636.3) in the specific preparation phase (Sig = 0.007*). TTEE also rose from 2795.7 kcal (SD = 494.5) to 3062.66 kcal (SD = 802.1) (Sig = 0.005*). In contrast, swimmers displayed a slight but statistically insignificant rise in ExEE from 2981.08 kcal (SD = 843.45) to 3237.88 kcal (SD = 751.9) and TTEE from 4811.86 kcal (SD = 941.5) to 5068.34 kcal (SD = 864.6) (Sig = 0.094).

Conclusion: The swimming team required greater energy for their training process compared to the track and field athletes.

Keywords: Nutrition, Energy consumption, Energy needs, Swimmers, Athletics.

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1. INTRODUCTION

In a review of research on energy expenditure in athletes, a number of methods and conclusions contributed to general knowledge about nutrition and athletic performance. M. Ismail et al. (1997) studied 84 male and 24 female athletes in 13 sports, the study showed that most had normal BMI and total daily energy expenditure (TTEE) of athletes ranged from 2938 kcal to 4861 kcal in men and 2099 kcal to 3098 kcal in women, with estimated energy requirements ranging from 38-55 kcal/kg/day [1]. A 2022 study by Bas Van Hooren and colleagues on professional cross-country athletes, the study argued that current methods of calculating daily TTEE are not accurate enough and proposed a new method based on running power data. activity, basal metabolic rate (BMR) and non-exercise physical activity level (basal exercise energy) (PAL) [2]. B. Frączek et al. (2019) studied 30 high-level Polish athletes in aerobic endurance and speed-power sports, and found that although gender significantly influences daily energy expenditure, (TTEE), but sports content is not; The study also noted that computational methods can yield significantly different results [3]. Additionally, T. Trappe et al. (1997) used the doubly labeled water method to evaluate the TTEE of five female swimmers during high-volume training, finding an energy imbalance of 43% and average TTEE is 5593 kcal/day [4]. Through these studies, it is clear that athletes' energy needs vary widely and are influenced by many factors, including gender, sport type and training intensity, and the choice of measurement method. Measurement can also significantly influence the results.

The field of sports nutrition is constantly evolving with innovative research that goes beyond general dietary recommendations. Swimmers spend a lot of time practicing underwater to improve technique, increase optimality in overcoming water resistance during movement and improve the energy production process of the two aerobic and anaerobic systems. Athletes who run short, throw, and jump must move their total mass or add standard weight equipment as quickly as possible over a short distance, and total mass is a factor determining movement speed. Therefore, these athletes must have the most optimal strength to weight ratios to provide an advantage over their opponents. One of the effects of using high carbohydrate loading techniques is to prepare the muscles for activity. Glycogen is stored in water in a ratio of 1:3. Therefore, we conducted "Research to evaluate the energy needs or total energy expenditure (TTEE) and energy expenditure during professional training (ExEE) of track and field athletes in short running and high jumping and throwing, and swimmers in short and medium-long events" to properly assess the energy and nutritional needs of athletes through different stages of training.

2. RESEARCH METHODS

2.1. Research subjects: 05 athletes in short running, high jump, and throwing events (2 men, 3 women), and 05 swimmers in short and long middle (3 men, 2 women) in Ho Chi Minh City National Sports Training Center in February 2023.

2.2. Research design: The cross-sectional design was applied.

2.3. Research procedure: The study determined the time to analyze and collect data during 10 days of the general preparation phase and 10 days of the professional preparation phase. Athletes are informed and the data collection process is explained and guided. Athletes participating in the study were notified 1 week in advance, ensuring the training and rest process followed the plan set by the Coaching Board. The study used a specialized Polar Verity Sense heart rate sensor during all athletes' daily training sessions.

2.4. Data analysis: Research used Polar Flow software of the Finnish company Polar, which supports storing, analyzing and evaluating indicators of exercise volume, exercise energy, sleep, training and competition performance.

The study used Cunningham's formula to estimate Basal Metabolic Rate (BMR) and used the exercise coefficient 1.2 to estimate energy during rest and light exercise (Resting Metabolic). Rate – RMR). Formula of Cunningham (1980) [5]: RMR = 550 + 22* (LBM)*1.2.

The study used the method of measuring fat folds using

the Skinfold Index device and analyzing and estimating the Body Fat mass index according to Dunin's formula (1974) [6]. Use Excel 365 software to store and process raw data, use IBM statistics software SPSS version 26 to analyze descriptive statistics and comparative analysis.

3. RESULTS

Table 1: Characteristics of research subjects

Athletes	Expericence (year)	Heigh (cm)	Weight (kg)
Track and field 05	12.5 ± 1.1	175.32 ± 6.1	71.75 ± 18.31
Swimmers 05	7.4 ± 1.5	164.82 ± 7.79	53.94 ± 8.75

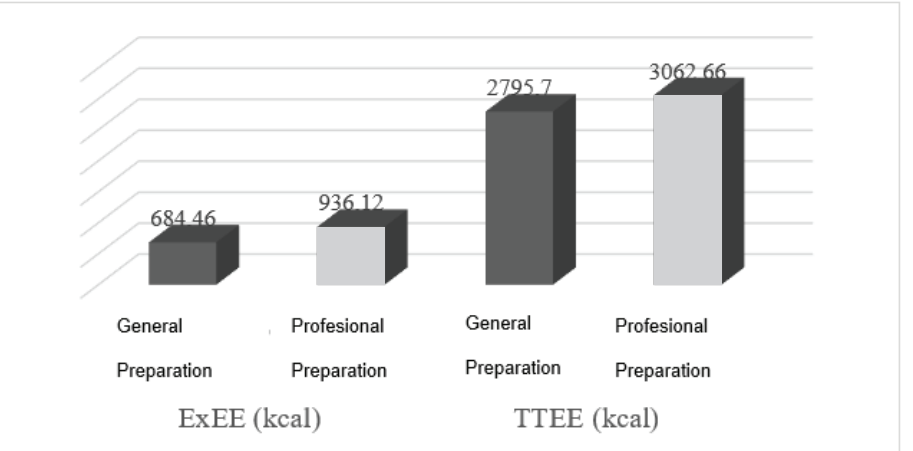
The results showed that: Athletes in short running, high jump, and throwing events (2 men, 3 women): height 175.32 ± 6.1, weight: 71.75 ± 18.31, and swimmers in short and long middle (3 men, 2 women): height: 164.82 ± 7.79, weight: 53.94 ± 8.75.

Table 2: Changes in energy expenditure of athletes due to training and total energy expenditure of the athletics team in the general and professional preparation stages

		Mean	SD	d	Sig.
ExEE (kcal)	General preparation	684.46	324.5	251.6	0.007*
	Professional Preparation	936.12	636.3		
TTEE (kcal)	General preparation	2795.70	494.5	266.9	0.005*
	Professional Preparation	3062.66	802.1		

** statistically significant, p<0.05*

Chart 1: Changes in energy expenditure of athletes due to training and total energy expenditure in the general and professional preparation stages

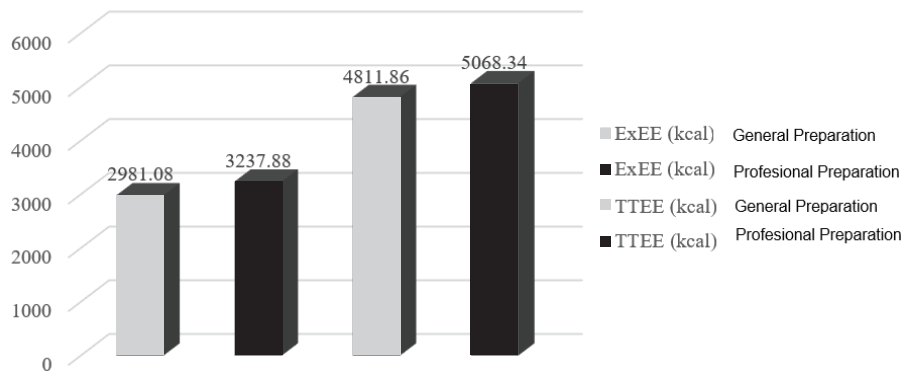


The results show that there is a statistically significant change in energy expended during exercise (ExEE) and total energy expenditure (TTEE) between the two stages of general and professional preparation phase of track and field athletes. ExEE - average energy expenditure during exercise increased from 684.46 kcal in the general preparation phase to 936.12 kcal in the specialized preparation phase, the results showed a significant increase, with $p < 0.01$ (Sig = 0.007). The standard deviation also increased from 324.5 to 636.3, indicating more variability during the professional preparation period. Similarly, total energy expenditure (TTEE) increased from 2795.70 kcal in the general preparation phase to 3062.66 kcal in the specialized preparation phase. This increase is statistically significant ($p < 0.01$, Sig = 0.005), with the standard deviation increasing from 494.5 to 802.1.

Table 3: Changes in energy expenditure of swimmers due to training and total energy expenditure in the general and professional preparation stages

		Mean	SD	d	Sig.
ExEE (kcal)	General preparation	2981.08	843.5	256.8	0.094
	Professional Preparation	3237.88	751.9		
TTEE (kcal)	General preparation	4811.86	941.5	256.5	0.094
	Professional Preparation	5068.34	864.6		

Chart 2: Changes in energy expenditure of swimmers due to training and total energy expenditure in the general and professional preparation stages



Research results show that the energy expended during exercise (ExEE) and total energy expenditure (TTEE) of swimmers between the two training periods also change, however, this change was not statistically significant. The average energy consumed during training by swimmers increased from 2981.08 kcal in the general preparation phase to 3237.88 kcal in the professional preparation phase. However, this change was not statistically significant (Sig = 0.094). The standard deviation decreased from 843.45 to 751.9 kcal, showing stability in the swimmer's energy expenditure. Similarly, TTEE increased slightly from 4811.86 kcal to 5068.34 kcal, and was not statistically significant (Sig = 0.094). The standard deviation also decreased from 941.5 to 864.6 kcal, demonstrating stability in total energy requirements during both periods. This result also showed that there is no change in basal metabolic energy, or it can also be said that swimmers do not have much change in fat-free body weight.

4. DISCUSSIONS

For track and field athletes (short track, full throw, high jump), both ExEE and TTEE had significant increases between the two periods, which may reflect increases in intensity and/or amount of practice during the professional preparation phase. This shows that it is necessary to pay attention to adjusting nutrition to match the increased needs during this period. Increasing standard deviations in both indices are also indicative of higher variability in energy requirements, possibly due to variety in exercises and exercise intensity. Research results also show that the energy needs of track and field athletes change depending on the training phase. Therefore, it is necessary to adjust energy and nutritional needs through each stage of training. Compared to track and field athletes, swimmers have higher total energy needs during exercise. However, the change between the two training periods of the swimmers is not statistically significant, which can confirm that the swimmers have a balanced training program in terms of exercise volume (volume, intensity and frequency) across training phases.

High-level short runners have an activity frequency of usually 1.5 - 4 hours/day and 5-6 days/week, with 1 to 2 days of light intensity or training volume. The training process often focuses on optimizing the maximum capacity of large muscle groups, specialized short running exercises with different resistances, additionally, Olympic weight lifting sessions to optimize torso strength, and limbs. Therefore, the process of energy expenditure also often comes from specialized running sessions and strength training sessions with weights and resistance equipment. Research by Slater GJ (2019) on short runners compiled the energy needs for short runners from 2007.7 to 2390 calories for women; and about 2630 calories for men [7]. Schiffer's research (2011, 2012) showed that female jumpers have an overall energy consumption of 2500 to 3200 calories, men from 3000 to 3600 calories [8], [9]. Research by Trappe TA (1997) on female middle-distance swimmers, the average energy consumption during exercise was 3,107 calories and the total energy consumption/day was 5,592 calories [4] . When comparing the research results with the above author's studies, the overall energy consumption of athletes in each content is quite similar, however the amplitude of the results is very large, this may may be due to huge differences from many factors such as age, gender, sport, professional content, subjects and different research methods... Research results also show that both groups of athletes need to be considered energy and nutritional needs during different phases of the training cycle to optimize performance and prevent injury.

5. CONCLUSIONS

Research results show that there are fluctuations in the energy needs or total energy expenditure of both swimmers and athletes through training stages. For athletes, there was a significant increase in exercise energy expenditure (ExEE) from 684.46 kcal (SD=324.5) during the general preparation phase to 936.12 kcal (SD=636.3) during the professional preparation phase (Sig = 0.007*). Total energy expenditure (TTEE) also increased from 2795.7 kcal (SD=494.5) to 3062.66 kcal (SD=802.1) (Sig = 0.005*). Similarly, swimmers also had an increase in ExEE from 2981.08 kcal (SD=843.45) to 3237.88 kcal (SD=751.9) and TTEE from 4811.86 kcal (SD=941.5) to 5068.34 kcal (SD=864.6). However, this increase is not statistically significant (Sig = 0.094). This could come from many reasons such as the small research sample, athletes in different professional content, training programs... Research results also show the energy needs for individual athletes. Sports are very different, requiring specialized and individualized planning and energy supply strategies.

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