The Effects of Mountain Hiking on Physical Condition of Youth Basketball Players during the Preparatory Phase

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***Abstract**: In team sports, according to perform variety of motor skills, development of special abilities and overall physical fitness it is of great importance to optimize the training programs which involves progressive cycling of various aspects during a specific periods of time. Most coaches and athletes change the intensity, volume, and exercises in their workouts to improve performance. Little is known about the effects of mountain hiking on physical condition and preparation of youth basketball players and implementation of such activities in the training programs. Therefore, this study aims to analyze the effects of a mountain hiking on the physical condition of youth basketball players during the preparatory phase and to compare the results with the results of a control group of players performing standard training sessions in the same training period.*

***Keywords:** Mountain hiking, Basketball, Youth basketball players, Physical condition.*

Introduction

Basketball players' physical conditioning is focused on enhancing aerobic capacity, speed, agility, muscular strength and power. Physical conditioning is the results of physical preparation process, which is manifested in the acquisition of movement skills and physical characteristics at a determined level, described by physical peculiarities – endurance, strength, speed, agility, and flexibility [9], related to the overall motor control of the human movements [1]. These different components of the preparation of basketball players must be objects of training during a macro cycle, or an annual cycle, or even in a preparation of long years. It is of great importance to outline a plan in which these qualities will be trained and at what time of the year. The periods of training can be put together so as to optimize the stimulus provided to the player and limit the effect of fatigue. It will also enable prioritization of certain types of training during the off, pre and post season. Periodization is a process of dividing the annual plan into small phases of training in order to allow a program to be set into more manageable segments and to ensure a correct peaking for the main regatta of the year. During the pre-competitive preparatory stage, the micro cycles should resemble the

model of the upcoming competitive regime [3]. From two to three weeks before the competition, the volume of the training workload should be lowered while maintaining the intensity of the competitive rigor. Moreover, from two to -four days before the competition, the intensity should also be decreased, allowing the players to fully recover and attain emotional readiness before the competition [4]. The so called preparatory phase is considered to be the off-season and the players are not involved in any form of competitions. This phase is the longest of the training periods and has only a select few sport-specific activities. The purpose of this period is to get athletes ready for intense training and increase their strength and conditioning [8]. The physical trainings in this period are longer and less intense than in other periods. There is not a large amount of sport-specific movements because the athletes will most likely be more fatigued from the high volume and would not improve as much from those movements during this time. The scope of training, especially during the preparatory phase, is to create a training program that will result in the highest adaptation or athlete's best adjustments of the neuromuscular and cardio-respiratory systems to the training program. Higher adaptation and increased physical potential, is the dominant factor in reaching peak performance during the competitive phase. The principle of training during preparatory phase lies in appropriate volume and intensity of load, the kind of exercise, and including these components to the training plan at the right time and in the right rate. The preparatory phase can be divided into more specific phases called hypertrophy/endurance phase, basic strength phase, and strength/power phase [10]. During the preparatory phase, the athlete gradually changes the rate of specific and general training means. In the first stage, general training means prevail, in the second and third stages specific training means are prevalent. During the preparation period the physical conditioning training team expects the greatest improvement in an athlete' physical fitness. At the beginning of this period, the training process is focused on volume, in the second part of the period, intensity increases. In general, there are a good number of training modalities for physical improvement in both indoor and outdoor conditions. While indoor specific activities, such as training in the gym or conditioning exercising in the basketball hall are quite well studied, there is little knowledge about the effects of preparation in outdoor natural environment conditions on the basketball players physical condition. One of the most accessible and easily implemented outdoor activities in the natural environment is mountain hiking. It is a form of a long, vigorous walk, usually on trails or footpaths and most studies present a consensus that hiking benefits people's physical and mental health [7]. In a view of this, the purpose of the present study is to investigate the effects of mountain hiking as a part of preparatory phase training program on the physical performance of youth basketball players.

Materials and methods

The study participants were divided into two groups according to their training programs: experimental (group A; $n = 7$) standard (group B; $n = 6$). The experimental training program included days with conditional trainings (in the form of mountain hiking) alternating with days with basketball and fitness training sessions in a hall. For the whole vacation (ten days) the team had five days with mountain hikes and four days with fitness and basketball practices. The hikes' difficulty and duration was gradually increased which can be found explicitly described in Table 1. The standard training program included basketball training sessions in a hall and fitness every other day. In the end of every basketball practice in the hall the team went out at the track for conditioning training. In order to investigate the effect of the proposed experimental training methodology on the physical condition of the players, several physical tests, analysis of hemodynamic parameters and laboratory tests of blood parameters were carried out.

Table 1. Mountain hike difficulty and duration

Hiking day	Duration (movement), h	Distance, km	Elevation (+), m	Max altitude, m
1st	2	7	550	1340
2nd	4	10	850	1840
3rd	5	14	900	1800
4th	5:30	15	1000	1860
5ft	7	24	1500	2290
Summary	23:30	70	4800	2290

Physical tests

- 2000 m running

The objective of this test is to evaluate the aerobic endurance. The test is conducted on a 400 meter running track. The participants start from a standing start hearing a sound signal. The time is measured with an accuracy of 1.0 s.

- Shuttle running (252 m)

The objective of this test is to evaluate the power speed endurance. The players run three lengths of the basketball court with short sprints and change direction on the lines (Fig. 1). The participants start after a sound signal from standing start position and always run facing front. When changing direction, they need to make a step behind the line. The time is measured with an accuracy of 0.1 s.

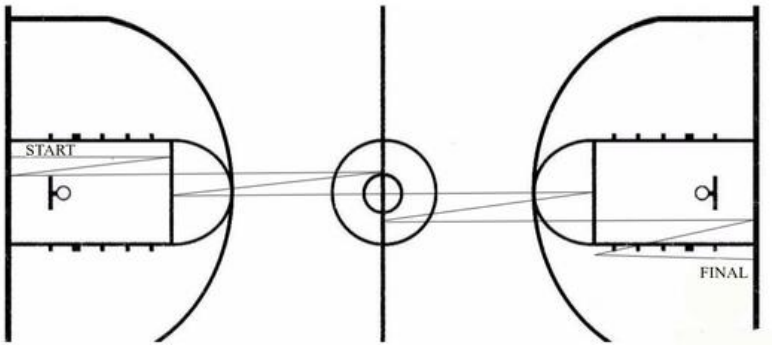


Fig. 1 Shuttle running test setup

- Standing long jump test

The objective of this test is to evaluate the "elastic" leg strength. The participant places their feet over the edge of a line then crouches, leans forward, swings his arms backwards, then jumps horizontally with both feet aiming to land as far as possible from their starting point. Results are measured as distance from the edge of the line to the nearest point of contact of the participant's body with the ground. The distance is measured with an accuracy of 1.0 cm. The participant performs two jumps out of which the best result is considered final.

Hemodynamic measurement and blood parameters tests

The measuring of the hemodynamics of the participants was conducted with the non-coded Sigma PC15 heart rate monitor with chest belt. Measuring the test performer's heart rate (bpm) was performed within 5 s after finishing the running physical tests. The blood parameters recorded in our study are hemoglobin concentration in g/l and red blood cell count in cells/mcL. The subjects were carefully explained about the purpose and importance of the testing procedure. Subjects before collection of blood were instructed not to take any food in

the morning. All of the tests were performed in specialized private laboratory, conducted from a trained professional staff.

Results and discussion

The variables (physical indicators, hemodynamic measurements and blood composition) were: 2000 m running (min), heart rate after 2000 m running (bpm), 252 m shuttle run (min), heart rate after shuttle run (bpm), standing long jump (m), red blood cells (erythrocytes) count (RBC) and hemoglobin levels (Hgb, g/l). The data from the result obtained from the tests of the two groups of participants in our study is presented in Tables 2-5.

Table 2. The overall results from the physical, hemodynamics and laboratory tests of the experimental group A in the beginning of the study

Experimental group A, n	2000 m, min	2000 m, bpm	252 m, min	252 m, bpm	Standing long jump, m	RBC	Hgb, g/l
1	8.42	195	1.08	196	2.58	4.86	158
2	7.15	205	1.15	185	2.00	4.72	140
3	8.34	174	1.13	171	2.25	4.93	144
4	8.15	202	1.08	193	2.45	4.98	141
5	8.43	173	1.13	175	2.00	4.36	130
6	8.19	199	1.11	192	2.00	4.89	142
7	8.24	201	1.13	185	2.01	4.70	158

Table 3. The overall results from the physical, hemodynamics and laboratory tests of the experimental group A in the end of the study

Experimental group A, *n*	2000 m, min	2000 m, bpm	252 m, min	252 m, bpm	Standing long jump, m	RBC	Hgb, g/l
1	8.36	204	1.07	195	2.58	4.96	161
2	7.11	203	1.10	187	2.00	4.81	145
3	8.01	185	1.07	180	2.40	5.16	148
4	8.03	200	1.06	194	2.50	5.03	146
5	8.27	175	1.11	176	2.00	4.45	134
6	8.09	205	1.09	191	2.00	5.28	154
7	8.26	208	1.14	188	2.10	4.82	150

Table 4. The overall results from the physical, hemodynamics and laboratory tests of the control group B in the beginning of the study

Control group B, *n*	2000 m, min	2000 m, bpm	252 m, min	252 m, bpm	Standing long jump, m	RBC	Hgb, g/l
1	9.27	195	1.14	187	2.45	4.48	133
2	9.28	200	1.14	200	2.25	4.57	141
3	8.58	197	1.05	180	2.2	4.86	141
4	7.51	196	1.11	187	2.7	4.63	141
5	8.06	192	1.09	180	2.45	4.6	138
6	7.55	198	1.06	182	2.5	4.57	140

Table 5. The overall results from the physical, hemodynamics and laboratory tests of the control group (B) in the end of the study

Control group B, *n*	2000 m, min	2000 m, bpm	252 m, min	252 m, bpm	Standing long jump, m	RBC	Hgb, g/l
1	9.30	198	1.11	190	2.40	4.49	138
2	9.58	200	1.14	197	2.20	4.62	140
3	8.42	200	1.07	185	2.25	5.01	144
4	7.52	185	1.06	185	2.65	4.45	133
5	8.15	197	1.11	180	2.40	4.65	137
6	7.52	200	1.07	184	2.50	4.77	144

Data, expressed by their means were entered into a SPSS-10 package. *t*-test was used for comparisons to find significant differences in any of the variables. Differences with a 0.05 or less probability of occurrence were considered to be statistically significant.

After the data analysis we found that the experimental group shows significantly difference in several indicators before and after the mountain hiking, represented on Table 6.

Physical performance

The results from the tests of heart rate after 2000 m running (bpm), heart rate after shuttle run (bpm) and standing long jump (m) did not differ between the experimental and the control group. In 2000 m running test, experimental group has significantly increased in time ($p = 0.037^{*}$, mean = -0.11) compared to the control group ($p = 0.548$, mean = 0.04). Almost the same result has been found in 252 m shuttle run test ($p = 0.035^{*}$, mean = -0.02).

Blood parameters

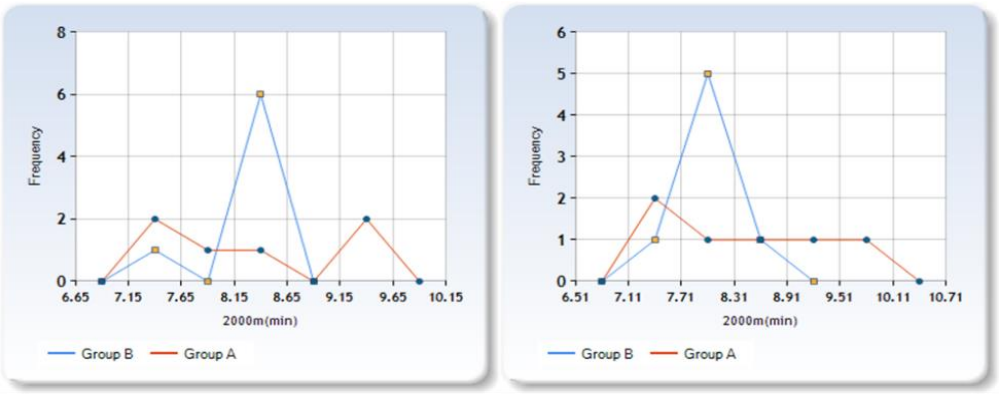
The experimental shows statistically an increase in RBC and hemoglobin levels ($p = 0.014$**, mean = 0.04, $p = 0.003$**, mean = 0.04) compared to the control group ($p = 0.425$, mean = 0.04, $p = 0.871$, mean = 0.04)

Table 6. *p* values from the statistical *t*-test analysis of the two groups after the training program ("*" marks statistically significant result at $p < 0.05$)

Participants	*p*-value						
	2000 m, min	2000 m, bpm	252 m, min	252 m, bpm	Standing long jump, m	RBC	Hgb, g/l
Group A	0.037*	0.064	0.035*	0.172	0.230	0.014*	0.003*
Group B	0.548	P0.893	0.688	0.534	0.203	0.425	0.871

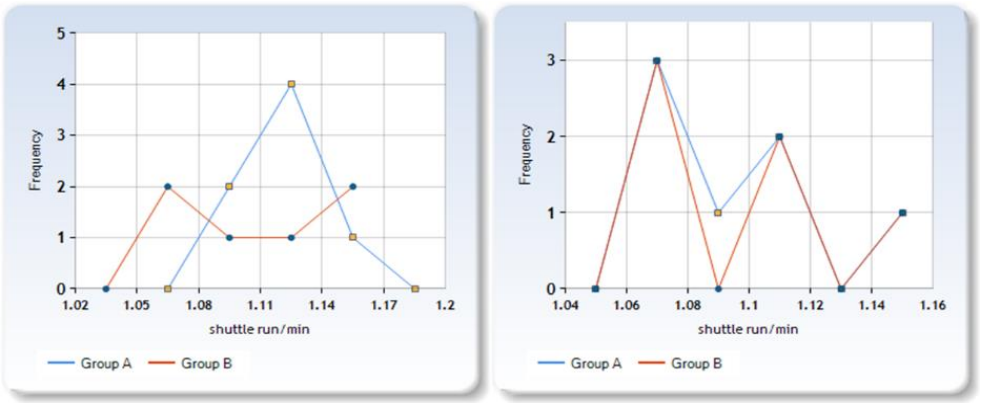
Frequency of data distribution in the two groups of participants is presented on Figs. 2-5.

To the best of our knowledge, this is the first study to experimentally compare the effects of implementation of mountain hiking in the preparatory training program on the physical performance of youth basketball players. Mountain hiking is the best-known physical activity for the improvement and maintenance of fitness and health. It is an easy, simple, accessible, and cost-effective activity that enhances fitness levels.



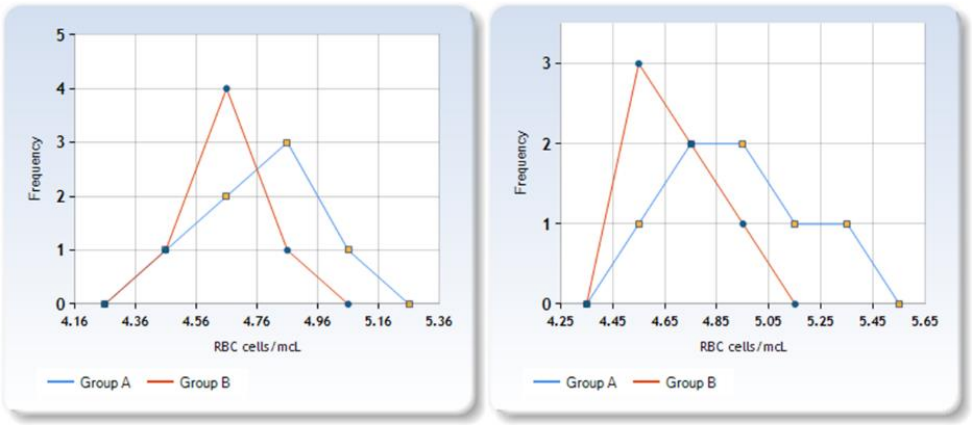
a) b)

Fig. 2 Frequency polygon representing the data distributions of 2000 m running test:
a) data distribution from the results of the two groups before the training program;
b) data distribution from the results of the two groups after the training program.



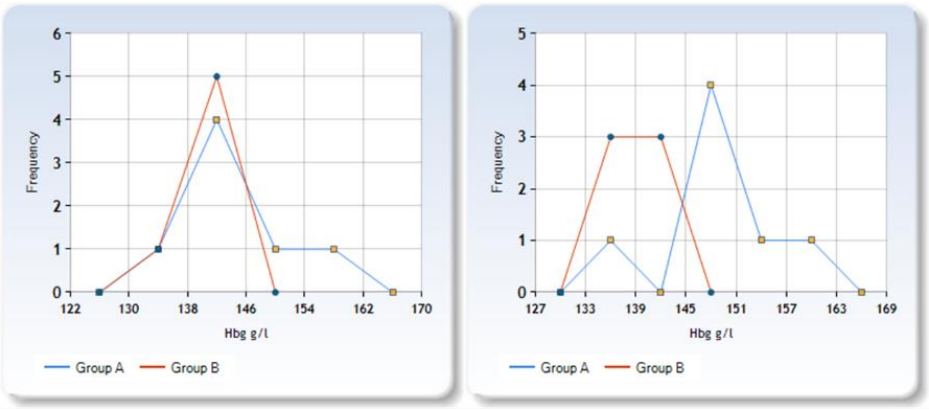
a) b)

Fig. 3 Frequency polygon representing the data distributions of the 252 m shuttle run test:
a) data distribution from the results of the two groups before the training program;
b) data distribution from the results of the two groups after the training program.



a) b)

Fig. 4 Frequency polygon representing the data distributions of the red blood cells count test:
a) data distribution from the results of the two groups before the training program;
b) data distribution from the results of the two groups after the training program.



a) b)

Fig. 5 Frequency polygon representing the data distributions of the hemoglobin levels test:
a) data distribution from the results of the two groups before the training program;
b) data distribution from the results of the two groups after the training program.

In addition, hiking has been found to have direct and rapid effects on an individual's metabolism. It is well known that hiking improves not only the cardiovascular health but also can lead to changes in blood composition. Mountain hiking can increase total Hgb and red cell mass, which enhances oxygen-carrying capacity. Hemoglobin within erythrocytes establishes a fundamental link between oxygen (O_2) in ambient air and aerobic metabolism by transporting O_2 in the blood from lung to tissue. O_2 must be transported effectively from the atmosphere to the tissues in order to maintain essential cellular metabolic pathways. The oxygen-carrying capacity is directly related to endurance. In many sports including basketball endurance ensures optimum speed of motor actions. The ability to maintain pace or tempo or an exercise during a competition is impossible without high level of endurance, which may result in high quality or skill of movement execution which accuracy, precision, rhythm and consistency. Basketball is one of the most physically demanding sports. Therefore the rules of the game allow unlimited numbers of substitutions in every stop of the game. The players have been found to cover about 4500-5000 m (2.8-3.1 mi) during a 48-minute game [2]. Also, in a simulated practice game, players were found to spend 34.1% of the time playing, 56.8% walking, and 9.0% standing [5, 6]. Therefore, both the aerobic and anaerobic metabolic systems are required. Aerobic endurance is the foundation for successful development of the basketball-specific endurance. Not only does it increase efficiency of the players during the game, but also impacts positively every aspect of basketball preparation – conditioning, technical, tactical and psychological. The important to note the contribution of the mountain hikes as a method for achieving the results represented in the study. Some of the positive factors of the mountain hikes are: the unusual for basketball training environment, the diversity of the activities, the clean air, altitude, beautiful views and the opportunity for informal communication between the team players. This is especially beneficial after spending long months in the basketball gym for training and competitions.

Conclusion

Our results show that the implementation of mountain hiking during the preparatory training program in youth basketball players, significantly increases the volume of red blood cells and hemoglobin, and improves the physical condition, particularly in the running performance. The hallmark of basketball players' performance is a high aerobic capacity which is directly related to the volume of red blood cells (hemoglobin) in the blood. A high red blood cell volume facilitates a high oxygen transport to the active skeletal muscles by facilitating a high cardiac output. Higher volume of red blood cells equals higher athletic performance.

Moreover, making the choice of training in the mountains is logical for Bulgaria, as well as for countries with similar geographical topography and mountainous areas near major cities. Those areas' accessibility is a great advantage for coaches and athletes for accessibility of the program. Our results suggest that in the development of a training program for youth basketball players, a specific mountain hiking workout in the preparatory phase training cycle should be taken into account. Naturally, given the relatively small size of the considered data it is not possible to claim with absolute certainty that our interpretations are doubtlessly valid but they provide a starting point for further investigations.

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