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**Original Article**

# Effectiveness of a specialized climbing method for beginners on the physical and technical fitness of 8-10 year old children

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**Abstract:**
In recent years climbing has become more and more popular. It is increasingly becoming an attractive and spectacular sport. Evidence for this trend is the growing trend of climbing competitions being held on bigger and bigger overhangs and ceilings, as well as the upcoming debut of the climbing sport at the Olympic Games 2020. That is why the preparation of the climbers is turning into a serious problem that requires responsible attitude and rationality in the application of different training methods. This applies especially to the training of children, beginner climbers, since childhood is a time in which motor habits are being formed and the proper technique of climbing is being studied. The purpose of the study is to check the effectiveness of a specialized climbing method for beginners on the physical and technical fitness of 8-10 year old children.
**Key words:** climbing, physical development, specialized training, climbing methodology for beginners.

## Introduction

Nowadays sport climbing has become more popular throughout all over the world. Sport climbing is an extreme sport where people climb an artificial wall with various artificial holds using their hands and feet (Kyungsik, Lee, Heo, Shin, Son & Kim, 2015). Sport climbing is also unique sporting activity, in that the role of the upper limbs and the predominantly vertical motion distinguish it from all other land-based movements (Quaine & Martin, 1999; Anderson & Anderson, 2015).

Evidence for this is the tendency for races to be held on bigger and bigger overhangs and ceilings, the increased public interest, as well as the adoption of sport climbing in the Olympic programme and its debut in 2020 in Tokyo. In this regard, the climbing training process has become an even more responsible process, requiring rationality and expedience in the application of the training methods. Even more important is the problem of the training of novice climbers at early age because it is at that age when proper technique is built and motor habits are formed.

In climbing, emphasis is placed primarily on developing physical strength, endurance and flexibility, but in order to achieve good results, a number of other motor skills are necessary – psychological flexibility, rapid-response capability and fast decision-making, excellent command of climbing technique and others (Watts, 2004). According to Draper et al. (2008) different types and styles of climbing differ in intensity, duration, methods used for protection and terrain. This may set different physical and technical demands and may induce different physiological and psychological responses (Draper, Jones, Fryer, Hodgson & Blackwell, 2008). Climbing requires use of a significant portion of whole body aerobic capacity. Increasing of climbing difficulty and climbing more steeply angled climbs requires use of anaerobic energetic pathways (Sheel, 2004).

In climbing performance is not related linearly with the speed of climbing (this affects to the least extend the "speed" competitive discipline). An optimal climbing speed should be achieved during an ascent in order to limit the effort's time and fatigue, respectively (Michailov, 2014).

An experienced climber can usually be distinguished from a novice climber by observing the number of hand placements used on a climb: the experienced climber will usually pick the most advantageous handholds the first time while the novice will need to seek out and test more holds before committing to moves. Accuracy also distinguishes experts from novice climbers. Experts will place their hands or feet precisely on handholds and footholds, whereas a novice might be more apt to over or under reach for holds, necessitating recovery from the inefficient effort. Finally, intensity is also important. Expert climbers use the least force necessary to grasp a hold (Fleming & Hörst, 2010).

Technique trainings are related to use of hands and feet which is important for beginners in climbing, hence we need effective training contents (Kyungsik, Lee, Heo, Shin, Son & Kim, 2015).

Sport climbing with children and adolescents, both in other countries and in Bulgaria, is developing dynamically. While in the first years of democracy in Bulgaria (since 1989) mainly speed competitions were


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organized, now the age limit for training and competitions in the "lead climbing" and "bouldering" categories is progressively declining. This suggests the use of a wide range of means of influencing the adolescent climber's body, taking into account their gender, age and individual characteristics.

***The purpose*** of scientific research is to check the effectiveness of a specialized climbing method for beginners on the physical and technical fitness of 8-10 year old children.

**Material and Methods**

For the purposes of the study, a test battery was used which included a total of 13 tests divided into the following groups:

1. Indicators for physical development.
2. Indicators of physical fitness.
3. Specific physical qualities.

Test protocol, units of measurement, accuracy of measurement and direction of increasing of measurement are presented on *Table 1.*

Table 1. Test protocol, units of measurement, accuracy of measurement and direction of measurement

| № | Indicators | Units of measurement | Accuracy of measurement | Direction of increasing |
|---|---|---|---|---|
| 1. | Height - s | cm | 1 | + |
| 2. | Weight - kg | kg | 1 | + |
| 3. | BMI | kg/m² | 0.01 | + |
| 4. | Manual Dynamometry /right hand/ | kg | 1 | + |
| 5. | Manual Dynamometry /left hand/ | cm | 1 | + |
| 6. | Lifting of the body from supine position to standing posture for 30 s | s | 1 | + |
| 7. | Long jump - cm | s | 1 | + |
| 8. | Bend forward - cm | cm | 1 | - |
| 9. | Throwing of dense ball - m | cm | 1 | + |
| 10. | Hang on folded arms and elbows - lever | number | 1 | + |
| 11. | Sample for special endurance of hand grip - lever block | s | 1 | + |
| 12. | Hang on two hands with an open grip to a 2 cm until exhaustion | s | 1 | + |
| 13. | Hang on two hands with an open grip to a 2 cm | min | 0,1 | + |

The tests were conducted at the beginning of September 2017 and at the end of May 2018. The test battery, which was applied at the beginning and end of the study, consisted of a total of 13 indicators of physical development, physical fitness and specific physical qualities.

***Contingent of the study***

During the sport-pedagogical experiment, a study was carried out in a group of 30 children aged 8-10 years, who were all novice climbers. A methodology for initial climbing training was applied within 8 months during the school year. We applied methods of research tracking the physical development, the physical fitness and the specific preparedness of the children. All children were enrolled in a beginner group in Alpine Club "Edelweiss 74" - city of Kilifarevo and Alpine Club "Trapezitsa 1957" - city of Veliko Tarnovo, Bulgaria.

***Specialized climbing method for beginners***

An eight-month climbing program for beginners aged 8-10 years has been developed. During the training, the students are fully secure and safe.

The training method includes demonstrations and repetitions of the exercises. The course focuses on the use of climbing techniques, the proper handling of technical equipment, the proper implementation of climbing exercises and activities. The exercises are organized in the form of trainings, which are held three times a week for 90 minutes with the following structure:

***1. Preparatory part.*** Its tasks are to organize the learners, to draw their attention to the requirements of the training and the coach, to prepare the body for physical loading by means of general exercises, in which joints are involved. Duration: 15 min.

***2. Main part.*** The tasks are related to learning and improving the technique of the hands and the feet when moving on an artificial wall or rock for different racing disciplines, pivot points, viewing a route without and with time measuring, as well as improving the physical qualities of the trainees. Duration: 60 min.

***3. Final part.*** It includes exercises for calming, relaxing and recovery of the body. Duration: 15 min

The detailed description of the content of the experimental methodology for climbing training for beginners can be found in *Table 2* and the legend below.

Table 2. Programme for climbing training for beginners

| Month | Monday | Tuesday | Wednesday | Friday | Saturday |
|---|---|---|---|---|---|
| *first month* | *Module 1* | | *Module 2* | *Module 3* | |
| *second month* | *Module 4* | | *Module 5* | *Module 6* | |
| *third month* | *Module 7* | | *Module 8* | *Module 9* | *Module 10* |
| *fourth month* | *Module 11* | | *Module 12* | *Module 13* | *Module 14* |
| *fifth month* | *Module 15* | | *Module 16* | *Module 17* | *Module 18* |
| *sixth month* | *Module 19* | *Module 20* | | *Module 21* | *Module 22* |
| *seventh month* | *Module 23* | *Module 24* | | *Module 25* | *Module 26* |
| *eighth month* | *Module 27* | *Module 28* | | *Module 29* | *Module 30* |

***Legend to Table 2***
***First month***
**Module 1:** Basic climbing techniques
**Module 2:** Basic techniques of climbing and safety
**Module 3:** Climbing technique for a "boulder" wall.
***Second month***
**Module 4:** Climbing technique for "lead climbing". Learning safety with top roping.
**Module 5:** Climbing technique for a "boulder" wall.
**Module 6:** Improving the climbing technique. Exercises for qualities.
***Third month***
**Module 7:** Improving climbing technique. Speed climbing.
**Module 8:** Climbing technique and tactics
**Module 9:** Technique for "boulder" climbing. Exercises for qualities.
**Module 10:** Technique of climbing on natural structures (rocks)
***Fourth month***
**Module 11:** Improving the climbing technique. Learning climbing with “bottom” roping
**Module 12:** Climbing technique and tactics
**Module 13:** Technique for "boulder" climbing
**Module 14:** Technique and tactics of climbing on natural structures (rocks)
***Fifth month***
**Module 15:** Climbing technique. Learning the technique of safety with “bottom” roping
**Module 16:** Climbing technique and tactics. Improving the climbing technique for "difficulty"
**Module 17:** Improving the technique of "boulder" and "speed" climbing
**Module 18:** Technique and tactics of climbing on natural structures (rocks)
***Six month***
**Module 19:** Improve climbing technique and safety with “bottom” roping. Exercises for the quality "strength".
**Module 20:** Climbing technique and tactics. Exercises for the quality "endurance".
**Module 21:** Improving technique and tactics for boulder climbing.
**Module 22:** Improving technique and tactics in climbing on natural structures (rocks).
***Seventh month***
**Module 23:** Improving the technique of climbing with bottom roping. Improving the technique for "speed" climbing. Exercises for qualities.
**Module 24:** Improving technique and tactics in climbing for "difficulty". Exercises for qualities.
**Module 25:** Training in the regulation of various racing disciplines ("speed", "difficulty" and "boulder")
**Module 26:** Improving technique and tactics when climbing on natural structures (rocks). Basic training in “rappelling” and organizing "fixtures"
***Eight month***
**Module 27:** Improving the techniques and tactics of "bouldering" climbing. Exercises for qualities.
**Module 28:** Improving climbing technique and tactics for "difficulty". Exercises for qualities.
**Module 29:** Improving technique and tactics for “speed” climbing. Exercises for qualities
**Module 30:** Competition

## Results

The data collected have been statistically processed and subjected to comparative analysis.

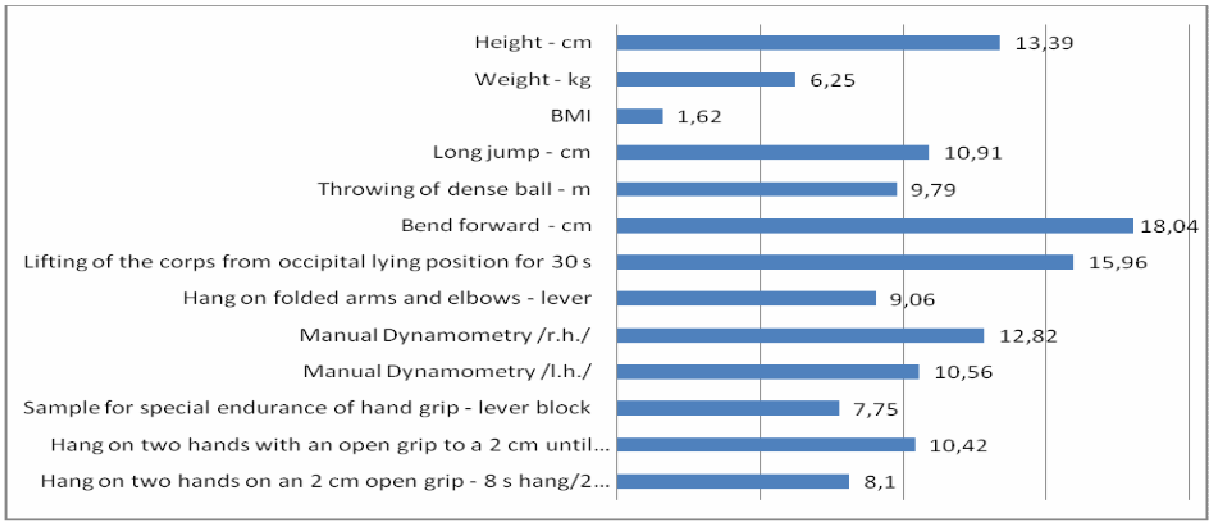
In order to establish the statistical reliability of the indicator growth between the two studies, a comparative t-criterion of Student for dependent samples was applied. The results of the second test should provide an answer to the question to what extent the applied methodology has a constructive effect on the physical development, the physical fitness and the specific preparedness of the people participating in the experiment. The reliability of the 13 indicators between the two tests is presented in *Table 3*. A statistically significant increase can be observed in 12 of the indicators.

Table 3. Credibility of indicator growth in the experimental group (ta = 2.04)

| № | Indicators | N | I test X1 | S1 | II test X2 | S2 | D | d % | t | Pt % |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Height - s | 30 | 130,43 | 6,34 | 134,87 | 7,10 | 4,43 | 3,40 | 13,39 | 99,9 |
| 2. | Weight - kg | 30 | 29,00 | 6,14 | 30,70 | 6,67 | 1,70 | 5,86 | 6,25 | 99,9 |
| 3. | BMI | 30 | 16,90 | 2,64 | 16,70 | 2,41 | 0,20 | 1,18 | 1,62 | 88,40 |
| 4. | Manual Dynamometry /right hand/ | 30 | 6,17 | 3,37 | 8,03 | 4,00 | 1,87 | 30,27 | 10,91 | 99,9 |
| 5. | Manual Dynamometry /left hand/ | 30 | 5,03 | 3,23 | 6,40 | 3,63 | 1,37 | 27,15 | 9,79 | 99,9 |
| 6. | Lifting of the body from supine position to standing posture for 30 s | 30 | 21,67 | 4,25 | 29,53 | 5,46 | 7,87 | 36,31 | 18,04 | 99,9 |
| 7. | Long jump - cm | 30 | 146,33 | 17,64 | 154,70 | 19,04 | 8,37 | 5,72 | 15,96 | 99,9 |
| 8. | Bend forward - cm | 30 | 96,83 | 3,73 | 94,87 | 3,62 | 1,97 | 2,03 | 9,06 | 99,9 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 9. | Throwing of dense ball - m | 30 | 2,79 | 0,53 | 3,15 | 0,54 | 0,36 | 12,77 | 12,82 | 99,9 |
| 10. | Hang on folded arms and elbows - lever | 30 | 28,70 | 12,28 | 109,93 | 49,30 | 81,23 | 283,04 | 10,56 | 99,9 |
| 11. | Sample for special endurance of hand grip - lever block | 30 | 3,73 | 4,33 | 14,37 | 10,06 | 10,63 | 284,82 | 7,75 | 99,9 |
| 12. | Hang on two hands with an open grip to a 2 cm until exhaustion | 30 | 12,20 | 6,90 | 52,87 | 26,46 | 40,67 | 333,33 | 10,42 | 99,9 |
| 13. | Hang on two hands with an open grip to a 2 cm | 30 | 26,57 | 12,88 | 119,80 | 71,32 | 93,23 | 350,94 | 8,10 | 99,9 |

The result of the comparative analysis of the investigated indicators at the beginning and at the end of the experiment is presented in *Figure 1*.




*Fi.e 1. Significance of the differences between the average levels of 13 of the tested indicators in the experimental group at the end of the experiment*

**Discussion**

The critical value of the Student t-criterion for the sample at 95% confidence probability is t=2.04. The empirical values of Student's t-criterion for dependent samples are very high - from 6.25 to 18.04 (exception is t3=1.62), which means that the observed differences before and after the experiment are statistically reliable.

The analysis of *Figure 1* shows that the experimental group had positive changes in regard to the 12 of the tested indicators, which is confirmed by a 95% confidence probability of the high values of the Student's t-criterion.

Only with the indicator associated with the body mass index, the confidence probability is less than 95%, which, in our opinion, is due to the fact that the participants in the experiment are children aged 8 to 10 years and none of the children were found to be overweight at the beginning of the experiment.

From the data in *Table 2*, it can be seen that during the pedagogical experiment there was a significant development in all the studied indicators. The comparative analysis of the increase in the average values of the studied anthropometric indicators showed that the novice climbing competitors increased their average height by 4.43 cm and in a significantly lesser extent the weight increased by an average of 1.70 kg. According to Michailov et al. (2009) the height is not a limiting factor of performance as taller climbers may have an advantage when the distances between the handholds are big but may also have a disadvantage if the handholds and foot holds are situated too close.

The increase of the length of the body naturally affected the BMI results, which decreased by 0.20 compared to the first test of the group (*Table 3*). This indicator is important for the successful development of the people practicing climbing and its decrease is a sign that there are no overweight children.

The analysis of the data in *Table 3* shows an increase in the average values of indicators providing information about the level of development of overall physical fitness. The most significant are the changes in the level of explosive force development of the lower limbs (d=8,37) and the abdominal muscularity (d=7,87).

The greatest increase is observed in indicators providing information about the specific physical qualities. In the strength test for the upper limbs and the shoulder girdle, the increase in averages values was d=81.83 s, with the specific static strength endurance of the fingers in the open grip - d=93.23 s, and for the specific endurance test of hand grip d=93.23. According to España-Romero et al. (2009) climbers overcome considerable resistance (their body weight) the type of endurance in climbing is the strength endurance which was proved to be a performance factor of highest importance. Measured through climbing time until exhaustion it correlated strongly with climbing performance. Both qualities are important for climbing, especially in the "boulder" and "speed" disciplines.

This indicates that the training methodology applied in this group has significantly influenced the level of specific climbing skills in children and is supported by Pt> 95% in all tests except for BMI (*Table 3, Figure 1*).

The result of the application of the methodology developed by us, which includes many general, preparatory and specialized exercises, is that it increases the level of motor skills and the specific preparedness. The most significant is the increase in indicators providing information about the level of development of specific physical qualities. A significant increase was observed for indicators 10, 12 and 13 (hang on folded arms and elbows - lever, hang on two hands with an open grip to a 2 cm until exhaustion and hang on two hands with an open grip to a 2 cm) respectively d=49.03, d=23.57 and d=55.83. We believe that this increase is due to two facts: first, climbing is a sport that has a very positive effect on the muscles of the upper limbs and the shoulder girdle, and second, that the experimental methodology has a priority impact in this direction. According to Schweizer et al. (2007) within the forearm musculature, concentric wrist flexion may be considered as the best predictor for climbing performance. Fuss et al. (2009) conducted in their study that the grip force should be applied as economically and as energy saving as possible.

Comparing the results providing information about specific physical qualities and climbing technique of the children participating in the experiment at the end of the impact we can conclude that the method applied by us has a high level of effectiveness.

**Conclusions**

1. As a result of the applied experimental climbing methodology for 8-10 year olds novice climbers with duration 8 months, the level of their physical working capacity and their specific fitness significantly increased.

2. There are statistically significant differences in the growth between the initial and the final test in 12 of the 13 studied indicators, which shows that the applied methodology for the initial climbing training is effective and considerably contributes to the improvement of the children's fitness.

3. The greatest increase was observed in the studied indicators referring to the specific physical fitness qualities of 8-10-year-old climbers.

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