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Research Article

A Study on the Burpee Exercise Influence on the Endurance Indicator and Attention in School Children

Georgiy Polevoy[1*], Elina Egorycheva[1], Aleksandr Fedorov[1] and Moussa Mohammed Elamin[2]

[1] *Moscow Polytechnic University, Moscow, Russia*

[2] *University of Tahri Mohamed Bechar, Bechar, Algeria*

Abstract: Burpee is a well-known physical exercise all over the world. However, its effects on physical abilities have yet to be studied. The study aims to determine the impact of the Burpee exercise on the endurance and concentration of children aged 15-16. Inclusion criteria Age - 15-16 years, gender - boys, and girls. Schoolchildren in the control group were engaged in a standard physical education program at school, and children from the experimental group additionally performed burpee exercises. Endurance indicators were determined by the test running a distance of 2 kilometers (Running 2 km). The Bourdon test determined indicators of concentration of attention in children. The study used the T-criterion tests. During the study period, the level of endurance development improved by only 1.9% ($p>0.05$), and the concentration indicators improved from 72.2±5.8 to 75.5±6.1 ($p>0.05$). A slight increase in the indicators in both tests in the control group can be explained by the natural increase in the indicators of schoolchildren over four months and the effectiveness of using the standard physical education program at school. In the experimental group (9th grade), the indicators in both tests significantly (significantly) improved. Endurance of schoolchildren increased by 9% ($p<0.05$), and concentration indicators improved from 73.2±4.9 to 86.6±6.2 ($p<0.05$). Each student's physical load should be individual when performing the Burpee exercise. If 15-16-year-old schoolchildren perform "Burpee" exercises in physical education classes, then to a significant extent, the indicators of endurance and concentration will significantly improve.

Keywords: Health, School, Mental processes, Physical activity

***Corresponding Author**

Georgiy Polevoy , Moscow Polytechnic University, Moscow, Russia

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1. INTRODUCTION

In physical education and sports, coaches, and athletes always look for the most effective methods and means to achieve their goals. For example, a more effective technique, a new physical exercise, a sports simulator, and others.[1-4] Today, one of the most popular physical exercises is "Burpee," [5,6] even though its author R.N. Burpee invented the exercise in the 1930s. Today, games and competitions are held worldwide associated with Burpee's performance.[7] Initially, the exercise technique consisted of alternately changing four positions. However, later the Burpee exercise began to include an upward jump – thanks to which it turned into one of the most powerful fat-burning exercises. In addition, with the right technique, all the body's large muscles are included in the work. Burpee is a functional exercise that combines squats, planks, push–ups from the floor, and jumps.[5,7] During the exercise, Burpees get many muscles (chest, back, legs, abs). The advantages include an improvement in the ability to synchronize movements.[6,7] Burpee strengthens the cardiovascular system, increases the supply of oxygen to the organs, and improves muscle tone and the ability to maintain proper posture.[8-9] The Burpee exercise does not require special equipment or heavy devices; the work is carried out directly with your weight. It is important since it is highly discouraged for schoolchildren to engage in weightlifting, and lift a large load, since their body is actively growing and developing, including muscles and spine.[10,11] The most optimal Age for performing the Burpee exercise can be the Age of 15-16.[7] The Burpee exercise develops most physical qualities. At the same time, performing the exercise requires good physical fitness, a sufficient level of strength, endurance, and coordination training,[12-13], so it is quite difficult for children of primary school age to perform such an exercise due to their physiological characteristics.[14,15] A differentiated approach (group) is often used in working with younger classes. These are exercises in small groups.[16,17] In older groups, an individual approach is more common in working with children, which allows you to unlock each student's potential and physical abilities.[18,19] Thus, the components of physical activity are selected individually, and the time of the exercise comes to the fore, not the number of repetitions, since students can perform a different number of repetitions of one physical exercise simultaneously. In some scientific studies, there is a problem with the interaction between physical activity and the mental processes of schoolchildren. Namely, how physical activity affects students' mental abilities and cognitive performance; most of these studies show the effectiveness of physical activity for developing mental, mental, creative and other abilities of schoolchildren.[20-22] This is also important in our study since students aged 15-16 enter colleges or the 10th grade at the end of the 9th grade. Of course, a high level of development of the concentration of attention of schoolchildren will contribute to obtaining positive grades for teaching in other academic subjects.[20,22] The scientific problem lies in the insufficient study of the world-famous physical exercise Burpee and the need to improve children's physical and mental abilities. The study aimed to use the Burpee exercise in physical education lessons and to evaluate its effect on endurance and concentration of attention in schoolchildren aged 15-16. We can assume that if you use the Burpee exercise in school lessons, then the endurance and concentration indicators of schoolchildren can significantly improve so that the exercise can serve as an addition to the standard physical education program at school.

2. MATERIALS AND METHODS

2.1. Participants

2.2. Inclusion criteria

Fifty-two adolescents aged 15–16 years who studied in a regular Russian school in the city of Kirov took part in this study. They were boys and girls who studied in grade 9 (in two different classes: 9a and 9b). The students were divided into a control group (CG) and an experimental group (EG). Regardless of gender and level of physical fitness, only those adolescents who were admitted to physical education lessons by a doctor without any of the following restrictions for health reasons took part in the study. Students' non-inclusion criteria were: joint problems (especially at the knee and hip), chronic heart disease or high blood pressure, and being excessively overweight (more than 30% of the normal weight). Out of 32 students studying in 9a, 25 were completely healthy-as assessed by the school's physician-students (13 boys and 12 girls) were admitted to the study as the CG. In the same way, out of 33 students studying in 9b, 27 students (13 boys and 14 girls) took part in the study as the EG. This particular age group was chosen since the Age of 15-16 years lends itself to targeted endurance training. The doctor admitted children with basic and preparatory health groups to physical education classes. All procedures met the ethical standards of the 1964 Declaration of Helsinki. Informed consent was obtained from all parents of the children included in the study.

2.3. Ethical Statement

The Council of Vyatka State University approved the study. All procedures conformed to the ethical standards of the Helsinki Declaration of 2013. Furthermore, written informed consent was received from the participants to ensure anonymity of the participants, to store data, conduct and publish the study.

2.4. Exclusion criteria

Children with health problems do not have a basic medical group for physical education classes children who are not allowed to exercise by a doctor. The study involved students of the ninth grade of secondary school No. 60 (Kirov, Russia) aged 15-16 years. A total of 52 schoolchildren took part in the pedagogical experiment. The 9th-grade students are graduates of the school and treated the pedagogical experiment responsibly.

2.5. Procedure

This study has been conducted since the beginning of the academic year, from September 1, 2021. All physical education lessons were conducted by the teacher two times a week for 45 minutes each lesson in each class. A total of 30 lessons were conducted in each group until the end of the experiment. Children in both groups were engaged at the same time during the study. The control group had the 1st lesson on Tuesday and the 2nd lesson on Thursday. The experimental group had the 2nd lesson on Tuesday and the 1st on Thursday. Children from the control group (grade 9A) were engaged in the regular physical education program at school for students in grades 1-11 (senior level).[23] Children from the experimental group (grade 9B) of the class were engaged in the same program, but additionally, after a short warm-up, they performed the Burpee exercise.

2.6. *The technique of performing the Burpee exercise*

Each of the four phases of movements in the Burpee involves a change of exercise – first, a stand is performed, then a squat, then an emphasis (a bar on the elbows), push-ups, again an emphasis, and a jump.[7]

1. Spread your legs shoulder-width apart and sit down to the end, bending your knees.
2. Resting your palms on the floor, you need to jump into the plank position on outstretched arms. At the same time, the fingers of the hands are directed strictly forward; the feet rest on the toes, and the back is flat.
3. Go down, bending your arms at the elbows, and return to the previous position of the plank – this is a push-up.
4. Make a jump forward, taking a squatting position. At the same time, the hands are still palms on the floor, buttocks down, thighs parallel to the floor, and knees between the elbows.
5. Jumping up from a sitting position and throwing your arms up during the jump.

2.7. *Restrictions for performing the Burpee exercise*

It is important to note some limitations when performing the Burpee exercise, such as joint problems (knee and hip), chronic heart health problems, hypertension, and obesity (more than 30% of the normal weight).[6,7] Children with such health problems attend physical education at school with a common group but do not perform Burpees or participate in the study; they are characterized by individual workload. Students' nausea, chest pain, and other health problems should not occur in performing the Burpee exercise. If such a situation occurs, physical exercise must be completed immediately.[7]

2.8. *Physical activity*

In the introduction, we noted the importance of an individual approach when performing physical exercises, so the physical load was individual. Therefore, students performed the Burpee exercise without taking into account the number of repetitions; only the time of the exercise was recorded[7] (usually 15-25 repetitions in the allotted time. The Burpee exercise was performed immediately after the warm-up (standard warm-up, walking, gymnastic exercises on the spot), then, as a rule, the main part of the lesson went for all students. The approximate distribution of time for children aged 15-16 to perform the Burpee exercise is shown in Figure 1.

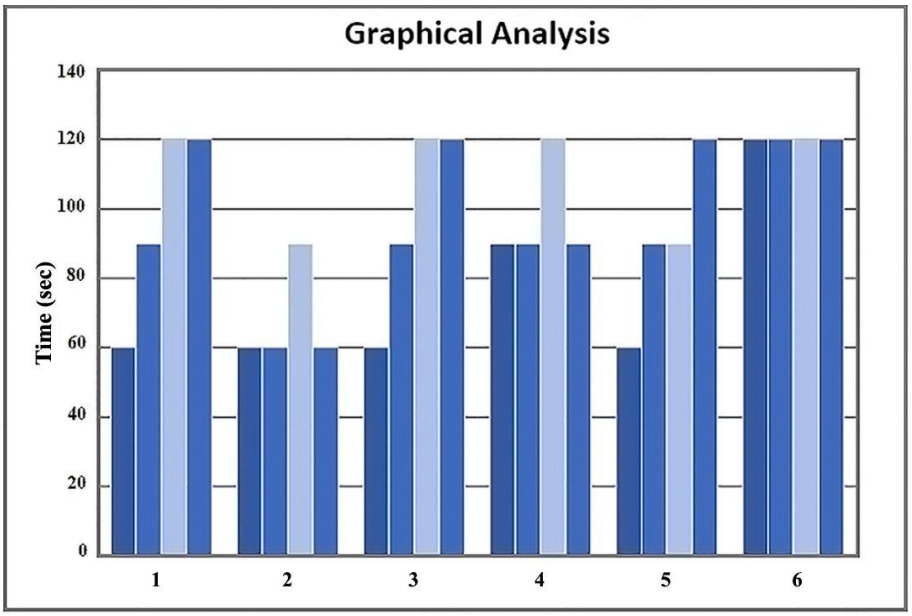

Fig 1: Physical activity of Burpee exercise and Rest according to the time and months for three series of Schoolchildren 15-16 years' old

Figure 1 shows that the duration of the Burpee exercise gradually increased. Choosing the time interval for performing the Burpee exercise, we were guided by the principle of gradualness. At the same time, a load of fewer than 60 seconds would not be effective, and more than 60 seconds in the first month is a difficult task for children aged 15-16 since the exercise pace will decrease significantly, and interest in the exercise will disappear.[5,7] It was also difficult to perform more than three episodes in the lesson, even after four months of research. Before the start of the study, all students completed two control tests (The reliability of the tests is confirmed by the authors [23,24]):

1. Running 2 Kilometers – this test determined students' endurance development level. The test was conducted on an athletics track in an indoor arena. The participants were on the starting line and performed the movement from the high start position at the teacher's command. The measurement accuracy is 1 sec.[23]
2. The "Bourdon" test determined the level of development of children's concentration. On a sheet of A4 paper, the numbers from 1 to 9 are shown in random order. An example of a test form is presented in the form of Table 1.[24]

Table 1: Fragments of the «Bourdon test»
0 9 8 2 3 4 0 9 8 0 8 7 5 8 9 5 7 6 5 8 9 7 0 3 4 9 8 5 0 3 8 9 2 8 3 2 9 8 5 3 6 8 9 3 3 6 8 0 2 7 4 3
1 8 7 4 9 0 8 1 8 0 2 8 4 0 9 4 7 3 5 8 7 5 4 6 8 9 4 5 7 0 2 8 0 9 6 5 8 9 8 6 7 3 5 4 8 7 6 2 6 9 3 6
7 5 4 9 8 7 5 4 3 0 9 5 8 4 0 9 3 7 5 4 8 7 9 3 6 5 9 2 3 8 7 5 0 9 4 7 8 7 5 6 9 8 2 0 7 5 4 3 8 3 1 5
3 9 2 8 9 8 2 6 5 4 7 6 5 4 8 9 7 5 4 0 3 8 5 4 3 5 8 9 4 0 9 8 6 7 5 8 7 6 8 9 7 5 0 9 8 0 2 8 3 4 0 9
9 8 2 0 8 0 2 3 4 8 7 2 9 8 7 4 0 1 8 0 4 7 5 4 1 7 6 5 4 8 4 6 3 8 9 4 7 3 9 2 4 8 2 0 9 5 1 8 4 1 6

Quickly cross out a certain number, for example, 4, for 2 minutes. The number of crossed-out and skipped digits are calculated. Concentration indicators are determined by the formula: X= (Y1 - Y2 - Y3): Z x 100%
X - Concentration of attention,
Y1 – the number of digits crossed out correctly;
Y2 – Number of missing digits;
Y3-the Sum of digits that were crossed out incorrectly;
Z – The Total Number of digits in the viewed rows to cross out.
Scale for assessing the concentration of attention:
81- and higher – Excellent; 61-80% – Good; 41-60% – Medium; 21-40% – Poor; 20% and below – Very poor.

3. STATISTICAL ANALYSIS

Based on the results of the tests, the data were reflected in the Excel table; then, we determined the indicators' average value and standard deviation. Finally, the difference from the beginning to the end of the study was determined by percentage, and the student's t-test confirmed the reliability.

4. RESULTS

The results of control tests at the beginning and the end of the study in both classes are presented in Table 2.

Table 2: The results of tests for schoolchildren aged 15-16

Test	Control group (n=25)				The experimental group (n=27)			
	Before	After	%	p	Before research	After research	%	p
Run 2000 m (min sec)	9.95±1.16	9.76±1.04	1.9	p>0.05	10.19±1.21	9.27±0.67	9	**p<0.05**
Bourdon test (%)	72.2±5.8	75.5±6.1	4.6	p>0.05	73.2±4.9	86.6±6.2	18.3	**p<0.05**

The study results in Table 2 showed that the test results in children of the control group (grade 9 A) improved, but not significantly (not reliably). During the study period, the level of endurance development improved by only 1.9% (p>0.05), and the concentration indicators improved from 72.2±5.8 to 75.5±6.1 (p>0.05). A slight increase in the indicators in both tests in the control group can be explained by the natural increase in the indicators of schoolchildren over four months and the effectiveness of using the standard physical education program at school. In the experimental group (9th grade), the indicators in both tests significantly (significantly) improved. Endurance of schoolchildren increased by 9% (p<0.05), and concentration indicators improved from 73.2±4.9 to 86.6±6.2 (p<0.05). The results for the experimental group indicate that during the pedagogical experiment, children who studied according to the standard physical culture program and additionally performed the Burpee exercise improved the studied indicators significantly. It means that using Burpees in physical culture lessons in working with schoolchildren of grade nine significantly positively affects children's endurance and concentration of attention.

5. DISCUSSION

The present study unexpectedly revealed the insufficient effectiveness of the ongoing physical education program in increasing endurance when running, as evidenced by the results in the control group (KG). We did not expect it, but the technique allowed us to increase the concentration of attention, and it turned out that this was indeed the case. However, it was assumed that introducing burping exercises to the chosen program into the educational process of ninth graders improved both endurance and concentration. We don't know if the Burpee exercise caused these positive effects or if it was an interaction with the program. This issue could be further studied. Of course, adding burpees to the exercise program is at least a preliminary practical approach to improving the effectiveness of physical education programs like the one that was adopted. Health is a complex and, at the same time, holistic, multidimensional dynamic state that develops in the process of realizing the genetic potential in a specific social and environmental environment and allows a person to exercise his social functions to varying degrees.[29] Primary school age is one of the most important periods of a person's life in the formation of personality. It is known that 40% of various, including mental illnesses of adults, are laid in childhood. That is why school education should shape the child's health level and lifestyle. The formation of a healthy lifestyle (HLS) is based on its components, such as a rational daily routine, work and Rest, motor activity, properly organized nutrition, and the absence of bad habits. For younger students, the observance of the daily routine is of particular importance. On the one hand, their nervous system is still far from mature. The limit of depletion of nerve cells is quite low, and on the other hand, with new living conditions, the need to adapt to the physical and mental stresses associated with systematic learning, breaking old stereotypes of behavior and activity, and creating new one's place increased demands on everyone physiological systems. The orderly alternation of work and rest contributes to optimizing body functions and better adaptation to school conditions with minimal physiological costs. Violation of the

daily routine leads to serious deviations in the child's health and neuroses. The main components of the regime are the following: sleep, outdoor activities (walking, outdoor games, physical education, and sports), educational activities at school and home, rest of your own choice (free time), eating, and personal hygiene. Motor activity is one of the most important components of a healthy lifestyle. Insufficient motor activity causes the appearance of hypokinesia, which can cause several serious changes in the student's body. Primary school age is when a child has a particularly pronounced need for motor activity. It can be said that the main tasks of this age period are mastering all functional movements and testing and improving one's motor abilities, which allows one to acquire broader power over one's body and external physical space. Regarding the optimal motor mode, it is necessary to consider the initial state of health and the frequency and regularity of the applied loads. Classes should be based on gradualness and consistency, repetition and systematicity, and individualization and regularity. It is proven that the best health effect (in terms of training the cardiovascular and respiratory systems) is provided by cyclic aerobic exercises: walking, light running, swimming, skiing, and cycling. Flexibility exercises should also be included in the set of daily exercises.[30,31] The physical activity of every fourth adult in the world does not meet the international recommended levels of physical activity. In Russia today, there is a standard physical education program for children from the first to 11th grades.[23] The purpose of this program is to promote the comprehensive harmonious development of children, develop a variety of motor skills and abilities, and form a physically cultured personality. To promote the comprehensive harmonious development of children, develop a variety of motor skills and abilities, and form a physically cultured personality. The main problems faced by modern physical education teachers are the lack of gyms and indoor playgrounds. Solving such a problem is difficult, so a physical education teacher must look for new ways to optimize the educational process. At the same time, this should not violate the main points of the physical culture program, which was developed and approved by the Ministry of Education of Russia. The problem of insufficient physical activity in schoolchildren is relevant.[3,4] In recent years, teachers and coaches have been actively trying to find unique physical exercises or methods of conducting physical culture and sports classes. One of the most effective and world-famous exercises is the Burpee exercise. It is quite popular today, even though it was invented in the 1930s. Despite the popularity of this physical exercise, there is not much scientific research.[5-7] These studies provide only a cursory knowledge of the meaning of Burpee. We have not found any specific recommendations on physical activity when performing exercises for students of different ages. In our study, we present the optimal parameters of physical activity of the Burpee exercise for children aged 15-16 years. It should be noted that physical activity (performing the Burpee exercise) for less than 60 seconds does not have a good effect. The load of more than 60 seconds in the first days of the Burpee exercise is quite difficult (mentally and physically unbearable) for children 15-16 years old.[7] Therefore, the best option for starting the Burpee exercise is a time of 60 seconds. Individual approach in physical education lessons. Physical education lessons and sports daily play an increasingly important role in the upbringing of younger youth. In the computer age, attracting children to active sports, such as basketball and skiing, is becoming increasingly difficult, as children prefer watching TV or playing computer games. The role of physical education lessons in this situation is to attract all children, regardless of their health group and physical fitness for sports. An individual approach in the classroom is closely related to the methodology of conducting classes.[26] A physical education teacher needs to plan work, taking into account the Age and typical and individual characteristics of children, and conduct training so that acquiring knowledge, skills, and abilities becomes a need for them, bringing joy and inner satisfaction. It is much more difficult to achieve in schools with high-class occupancy. Every child has different physical, technical, and other types of preparedness. In this case, an individual approach will be the most effective.[27] An individual approach is when individual students, having received a task, independently perform it. Usually, such tasks are given to laggards in mastering this or that exercise or, conversely, to the strongest who are engaged in the sports section and have a higher level of physical fitness. In this case, you must monitor the execution of tasks on time. At the same time, it is very important - the students adjust the intensity of their work, trying to perform the most accurate and high-quality physical exercise.[28] At the same time, it is important to note that we suggest using an individual approach when performing the Burpee exercise since the exercise requires a certain level of development of physical strength, endurance, coordination, and other physical qualities.[18,19] The effectiveness of using an individual approach in physical education lessons at school is confirmed by other studies. The great advantage of the Burpee exercise in physical education lessons is that the way it is performed does not require special and expensive equipment, the work is performed exclusively with its weight, and the impact of the exercise affects a large group of human muscles.[6,7] However, it should be noted that the Age for performing such a physical exercise should be appropriate. The most suitable (sensitive) Age for performing a physical exercise Burpee is 15-16 years. These are schoolchildren who have a sufficient level of development of physical strength and endurance, flexibility, and coordination.[14,15] As a result of this study, children from the control group improved their performance in both tests, but only slightly (not reliably). A slight increase in endurance over four months may improve since the Age of 15-16 years is favorable for developing this physical quality. The concentration parameters also improved over the period, but not significantly. It can be explained by the effectiveness of applying for the standard physical culture program at school for children of grades 1-11.[23.] In some studies, we have seen the effectiveness of the influence of motor activity on the parameters of cognitive processes, creative abilities, and even student performance.[20-22,25] These data are confirmed by the results of our study. In children from the experimental group, the concentration of attention during the study period (4 months) significantly improved. The data and statistical reliability of the results of the study confirm this. Summarizing the above, we can say that children who were engaged in the regular physical education program at school for Russian schools performed an additional Burpee exercise and, due to this was able to significantly improve the studied indicators, namely, endurance and concentration of attention, which is so important for the physical and mental activity of schoolchildren. These results indicate the effectiveness of using the Burpee exercise in physical education for children aged 15-16.

6. CONCLUSION

According to the results of the study, it can be concluded

that the introduction of the physical exercise Burpee in the process of physical education at school in senior children aged 15-16 years has a significant and positive effect on such important physical qualities as endurance and mental abilities - concentration of attention. It is important to note that physical activity during the Burpee exercise should be individual, depending on the physical condition of a particular student. In our study, for the first time, we formed specific parameters of physical activity for children aged 15-16 in physical education classes at school. The results of the new pedagogical experiment are relevant and promising for further research, during which it is also possible to study the influence of Burpee on other physical qualities or mental processes, such as attention, thinking, and other abilities. At the same time, it is necessary to investigate the optimal parameters of physical activity when performing the Burpee exercise for people of different ages.

7. AUTHORS CONTRIBUTION STATEMENT

Conceptualization, Georgiy Polevoy; methodology, Georgiy Polevoy; project administration, Elina Egorycheva, Aleksandr Fedorov; writing-original draft preparation, Georgiy Polevoy; writing-review and editing, all authors; Performing mathematical and statistical calculations Moussa Elamin; supervision project administration, Georgiy Polevoy. All authors have read and agreed to the published version of the manuscript.

8. CONFLICT OF INTEREST

Conflict of interest declared none.

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