

Endurance and a sensitive period for its development in children

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Abstract

Background. Addressing the purposeful development of endurance can be approached by examining its formation across various age periods. **The aim of this study** is to identify optimal age periods for fostering endurance among schoolchildren aged 7–18 years. **Materials and methods:** From September 15, 2022 to May 23, 2023, a total of 1,215 students from grades 1- to 11 from a school in Kirov in, Russia participated in this pedagogical investigation. The study involved girls (637) and boys (578), aged 7-18 years. All students were engaged in physical education at school 3 times a week for 40 minutes each lesson, while the children did not attend sports sections. During the study, endurance was assessed by the Cooper test (6 minutes). The Biostat program was used for statistical processing. **Results.** After the pedagogical experiment, boys from the 2nd grade had a significant improvement in endurance indicators, and a high increase was also noted in grades 8-11. The indicators became 12-16% higher ($p<0.05$). As for girls, the indicators in the 2nd grade, grades 9-11 increased significantly, the indicators became 12-15% higher ($p<0.05$). It should be noted that the indicators increased by 8% in all children in grades 4 ($p>0.05$). **Conclusion.** After analyzing the results of the study, we can say that the sensitive period for the development of endurance in girls and boys is the age of 8-9 years, as well as in boys it is 14-18 years, and in girls it is 15-18 years. Such results will make it possible to adjust physical education programs at school and the training of athletes in sports sections.

Keywords: Physical culture, Physical qualities, Aerobic abilities, health of schoolchildren, Favorable periods, School curriculum.

Introduction

Great attention is paid to the health of children from birth and preschool age (Vale et al., 2011; Terrón-Pérez et al., 2021). Teaching a child at school is a time when the body grows and develops under the attention and influence of not only parents, but also teachers. Physical culture plays an important role in the normal growth and physical development of a child. Physical education of students is an integral part of the entire educational work of the school and occupies an important place in preparing students for life, for socially useful work. Physical education at school solves the tasks of not only preserving and strengthening health, but also increasing the level of sociability and social activity of the child.

The high importance of physical education during the period of children's schooling is emphasized by a number of authors who speak about the comprehensive physical development of children (Kainov & Kuryerova, 2019). Unfortunately, the percentage of children who play sports outside of school is quite low (Oberle et al., 2020; Hu et al., 2021). Physical activity of children plays a very important role in the development of a child's motor skills, in the formation of nerve connections between the musculoskeletal and nervous system, and internal organs, in the development of muscles and skeleton, in the formation of a child's posture, in the regulation of metabolic processes, blood circulation and respiration, in the development of the cardiovascular system. The development of technology in modern life and automation of work have led to the fact that people move much less (Aliss et al., 2020; Heradstveit et al., 2020).

Low motor activity (physical inactivity) is a decreased muscle strength. Sedentary lifestyle or physical inactivity affects not only adults and adolescents, but also children in early childhood and preschool age. Most often, the causes of infantile inactivity are due to an incorrect lifestyle of the child. The beginning of school life reveals serious problems in the development of such children, both physically and mentally. Physical inactivity leads to serious disorders in the child's body, whose systems do not receive motor activity and do not develop properly. This has a negative effect on the work of the musculoskeletal system, respiration, blood circulation, digestion, and nervous system (Mannocci et al., 2020; Volmut et al., 2021):

- 1) reduced ability to work;
- 2) muscles weaken and atrophy, endurance and strength decrease;
- 3) there is a malfunction in the metabolism;
- 4) obesity and atherosclerosis develop;
- 5) the blood supply to tissues is disrupted, the supply of oxygen and nutrients to cells decreases;
- 6) the strength of heart contractions and vascular tone weakens.

Low activity contributes to the fact that the body, reducing immunity, is more often infected with infections. Usually, children are more likely to suffer from chronic diseases (Chen et al., 2021; Mikaelsson et al., 2021). The overall level of development of schoolchildren is decreasing from year to year, and indicators of such physical qualities as endurance are becoming lower (Azevedo et al., 2021; Toshboyeva, 2022).

Endurance is understood as the capabilities of a person, providing him with a long-term performance of any motor activity without reducing its effectiveness (Sanjar & Maftuna, 2022; Khakimovich & Soyibjon, 2023). The level of development and manifestation of endurance depends on a number of factors (Rozmatovich & Maftuna, 2022; Nazirjonovich, 2023):

- 1) the availability of energy resources in the human body;
- 2) the level of functional capabilities of various body systems (cardiovascular, central nervous system, endocrine, neuromuscular and others);
- 3) the speed of activation and the degree of consistency in the operation of these systems;
- 4) the resistance of physiological and mental functions to adverse changes in the internal environment of the body (an increase in oxygen debt, an increase in lactic acid in the blood, and others);
- 5) the cost-effectiveness of using the energy and functional potential of the body;
- 6) fitness of the musculoskeletal system;
- 7) perfection of technical and tactical skills;
- 8) personal and psychological characteristics (interest in work, temperament properties, the level of maximum mobilization of such strong-willed qualities as: determination, perseverance, perseverance, endurance, patience).

Among other factors affecting human endurance, age, gender, morphological characteristics of a person and conditions of activity should be highlighted.

Quite a large number of researchers have been engaged in the problem of developing the endurance of schoolchildren. The authors note the leading importance of endurance for optimal growth and development of all human body systems (Azevedo et al., 2021; Abdullaevich, 2023).

Some pedagogical experiments that have been conducted in school institutions prove the effectiveness of a particular technique and emphasize the importance of endurance for the growth and development of schoolchildren in general (Sanjar & Maftuna, 2022; Khakimovich & Soyibjon, 2023).

It is known that a good level of endurance development is the foundation for the development of other physical qualities, such as special endurance, strength abilities, speed of movement, flexibility and coordination abilities (Faigenbaum et al., 1999; Mikkonen et al., 2023). Also, high levels of endurance have a positive effect on the result in individual and team sports (Doma et al., 2019; Yuliandra et al., 2020).

Many authors call endurance aerobic abilities of a person, and these abilities have a direct impact on intellectual abilities and mental growth and development of a person (Rozmatovich & Maftuna, 2022; Toshboyeva, 2022; Khakimovich & Soyibjon, 2023).

However, despite such a large number of studies, we were unable to find data that would indicate a favorable (sensitive) period of endurance development, for example, at school age.

Sensitive periods are periods of time in the body that are hypersensitive to external factors, including pedagogical factors or the training process. Proper consideration of such periods in the process of exercising or improving physical qualities is very important.

If we miss this moment, it will be almost impossible to catch up. In modern sources on the problem of sensitive periods, the development of some abilities has been studied very limited. All experts note that the value of such periods is quite high and recommend purposefully developing one or another physical quality in a given period of time (Goldfield et al., 2012; Kabanov et al., 2019).

In Russia, several scientists have summarized the available data on favorable periods of endurance development. (Guzhalovsky, 1986; Kholodov & Kuznetsov, 2018; Solodkov & Sologub, 2018; Guba et al., 2021; Kuramshin, 2021; Matveev, 2021).

The famous physiology scientist Guzhalovsky in 1986 noted that the best period for the development of aerobic capabilities would be the age of 8-9 years, 10-11 years, 12-13 and 14-15 years for boys, and for girls it is 9-10 years and 11-12 years (Guzhalovsky, 1986).

At the same time, other physiology experts note that aerobic qualities are better developed in boys and girls at 15-17 years old (Solodkov & Sologub, 2018).

The authors of textbooks on the theory and methodology of physical culture and sports believe that the sensitive period for the development of endurance is the age from 8 to 10 years and from 12 to 15 years for boys, and for girls it is the age from 10 to 13 years and from 15 to 17 years (Kholodov & Kuznetsov, 2018).

Experts in the theory and methodology of physical education note that a favorable period for the development of aerobic abilities (endurance) is the age of 8-10 years and 12-15 years for boys, and for girls it is 10-13 years and 15-17 years. (Guba et al., 2021; Kuramshin, 2021; Matveev, 2021).

Summarizing the above, we come to the conclusion that in modern literature there is no consensus on favorable periods for the development of the most important quality - endurance, despite its importance for athletic success and everyday life.

The aim of the study is to identify optimal age periods for fostering endurance among schoolchildren aged 7–18 years.

Research objectives:

1. To study the problem of endurance and summarize data on favorable periods for its development.
2. To conduct a large-scale study with the participation of schoolchildren in grades 1-11 (7-18 years old) to determine favorable periods of endurance development at different ages.
3. Compare the data obtained with the results of previous studies on the issue of favorable periods for the development of endurance and formulate conclusions.

Materials and methods

Study participants:

Schoolchildren of grades 1-11 (boys and girls aged 7-18) participated in the pedagogical experiment. A total of 1,215 children (578 boys and 637 girls) participated in the study. From the first to the ninth grade, the school has 5 classes of students (for example, 1 "A" class, 1 "B", 1 "C", 1 "D" and 1 "E" class). In grades 10 and 11, there are 3 classes of students (10 "A", 10 "B", 10 "C"). On average, there are 30-33 students in each class.

Inclusion criteria:

1. Students who were healthy and admitted by a paramedic to physical education lessons at school.
2. Students whose parents have given written consent to the child's participation in the study.
3. Students who were engaged only in physical education and did not play sports in other sections. Since this could affect the average results of schoolchildren in a particular age group.

Exclusion criteria:

1. Children who had illnesses and did not have a doctor's admission to physical education classes in the general group and permission to comply with control standards.
2. Students whose parents have not signed an informed consent to participate in a pedagogical study.
3. Children who play sports or other types of active physical activity that somehow affect endurance performance during the study period.

Organization of the study:

The experiment was conducted at school number 60 in Kirov (Russia) from September 15, 2022 to May 23, 2023. Physical education classes at the school were held for 40 minutes and were in each class 3 times a week. All lessons in the school schedule were evenly distributed, physical education classes were scheduled every other day (Monday, Wednesday and Friday or Tuesday, Thursday and Saturday). All students completed the standard school physical education program (Kainov & Kuryerova, 2019). The program consists of the following sections:

1. September is athletics.
2. October and November are outdoor and sports games.
3. December and January are ski training.
4. February is gymnastics and martial arts.
5. March and April are outdoor and sports games
6. May is athletics.

The sections in the physical education program are the same, but they get more complicated from year to year, and students' skills improve.

Control tests

All students took the Cooper test for 6 minutes before and after the study. This is running a distance for 6 minutes at a selected pace. As a result of the test, the distance in meters that the student ran in 6 minutes of his work is determined. The Cooper test for schoolchildren is indicative for determining the aerobic capabilities of children and is used in many studies (Jaakkola et al., 2016; Alvero-Cruz et al., 2017).

Statistical analysis:

All the results of the students were marked in the Excel table. In it, we determined the arithmetic mean and standard deviation. And the percentage increase in indicators was calculated. The study used a modern Biostat program, which determined the reliability of the results according to the Student's Criterion at $p < 0.05$.

Results

Before the start of the pedagogical experiment, all students took the Cooper test. Baseline data, averages and deviations were determined. After completing the study, the students also took the Cooper test. The percentage increments and the reliability of the values were determined.

Table 1. Students' results in the Cooper test at the beginning and at the end of the study

Class	Age	Gender	Amount of children	Before M±m	After M±m	p	Growth in %
I	7-8	Boys	58	941±7	969±8	>0,05	3%
		Girls	67	844±10	886±9	>0,05	5%
II	8-9	Boys	51	956±10	1109±8	<0,05	16%
		Girls	68	851±8	978±7	<0,05	15%
III	9-10	Boys	56	1081±9	1135±7	>0,05	5%
		Girls	64	898±11	933±10	>0,05	4%
IV	10-11	Boys	58	1109±8	1198±10	>0,05	8%
		Girls	59	926±10	1009±9	>0,05	9%
V	11-12	Boys	52	1192±8	1240±9	>0,05	4%
		Girls	64	997±10	1047±8	>0,05	5%
VI	12-13	Boys	57	1201±10	1261±8	>0,05	5%
		Girls	62	1021±9	1052±11	>0,05	3%
VII	13-14	Boys	61	1255±7	1293±8	>0,05	3%
		Girls	54	1084±9	1127±8	>0,05	4%
VIII	14-15	Boys	56	1259±10	1435±9	<0,05	14%
		Girls	60	1102±8	1157±7	>0,05	5%
IX	15-16	Boys	59	1322±9	1493±11	<0,05	13%
		Girls	56	1083±8	1213±9	<0,05	12%
X	16-17	Boys	37	1349±11	1538±9	<0,05	14%
		Girls	41	1096±7	1239±8	<0,05	13%
XI	17-18	Boys	33	1372±8	1550±10	<0,05	13%
		Girls	42	1132±10	1268±9	<0,05	12%

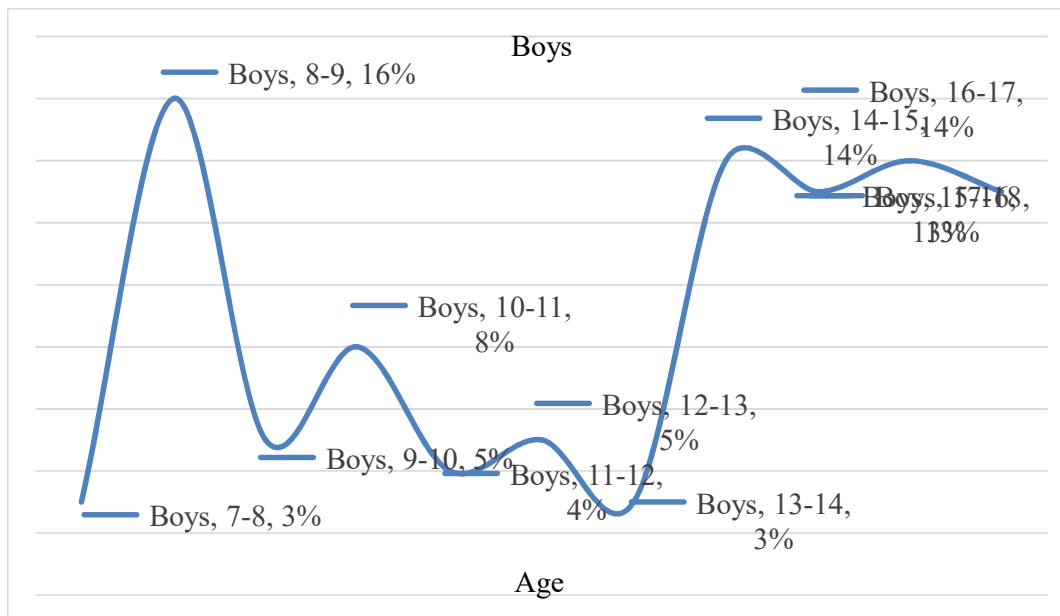
M – Arithmetic average; m – Standard deviation

Table 1 shows that the average values in each age group improved from the beginning to the end of the study. However, the increase in indicators in each age group was different. A slight increase in indicators (3-5%) was recorded in boys and girls in grades 1,3,5-7, as well as in girls in grades 8.

It should be noted that the data increased in grades 4 in all children (8-9%), despite the fact that the increase turned out to be significant, but unreliable ($p < 0.05$).

The greatest success in the growth of endurance indicators was achieved by children of grades 2,9 and 10 and boys of grades 8, the indicators were higher by 12-16% ($p < 0.05$).

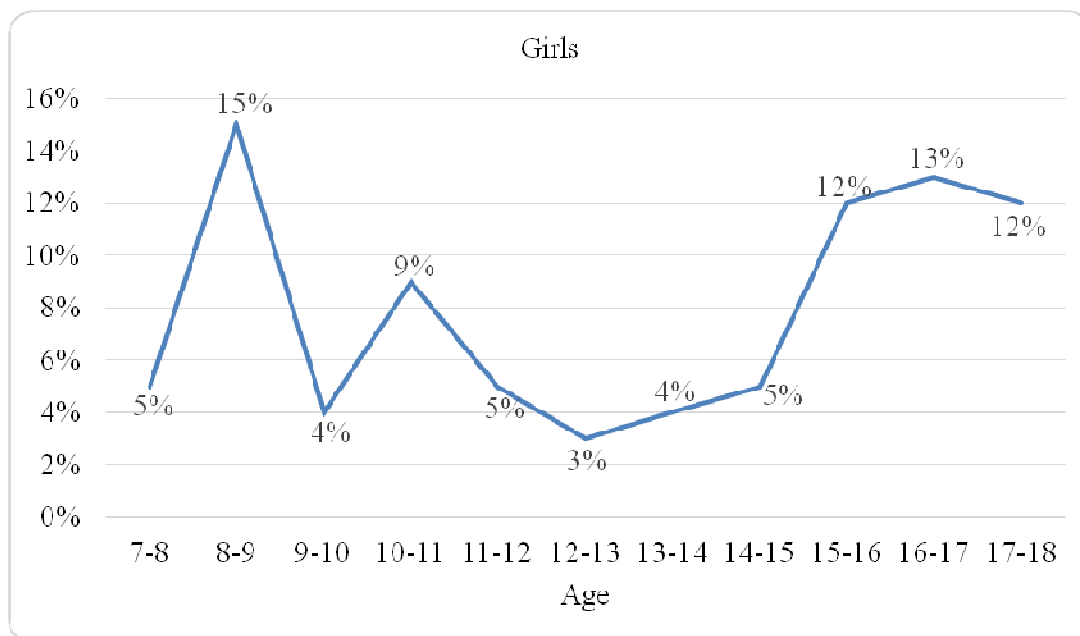
Such results allow us to talk about the presence of favorable periods for the development of aerobic abilities in boys (Graph 1) and girls (Graph 2).



Graph 1. Favorable periods for the aerobic abilities in boys

Graph 1 shows that the most favorable periods for the development of endurance in boys include the ages of 8-9 years (2nd grade), 14-15 years (8th grade), 15-16 years (9th grade), 16-17 years (10th grade) and 17-18

years (11th grade). Also, a high increase in endurance indicators in boys is observed at the age of 10-11 years (4th grade).



Graph 2. Favorable periods for the aerobic abilities in girls

Graph 2 shows that the most favorable periods for the development of aerobic abilities in girls can be attributed to the age of 8-9 years (2nd grade), 15-16 years (9th grade), 16-17 years (10th grade) and 17-18 years (11th grade). Also, a high increase in endurance indicators in girls is observed at the age of 10-11 years (4th grade).

Discussion

Special attention should be paid to physical activity of students. In recent years, due to the high academic load at school and at home and other reasons, most schoolchildren have insufficient motor activity, which causes the appearance of hypokinesia, which can cause a number of serious changes in the student's body. Schoolchildren not only have to limit their natural motor activity, but also maintain an uncomfortable static position for them for a long time while sitting at a desk or study table (Aliss et al., 2020; Heradstveit et al., 2020; Chen et al., 2021; Mikaelsson et al., 2021; Volmut et al., 2021). Sufficient motor activity is a necessary condition for the harmonious development of personality. Physical exercises contribute to the good functioning of the digestive system, helping the digestion and assimilation of food, activate the activity of the liver and kidneys, improve the endocrine glands. Systematic training of blood circulation improves its function, also increases the vital capacity of the lungs, improves the mobility of muscles and muscles of the chest (Piñeiro-Cossio et al., 2021; de Bruijn et al., 2022).

Human aerobic abilities play a significant role in everyone's life and are an essential component of physical health. It should be noted that general endurance is an important prerequisite for the development of special endurance, such as speed endurance or strength endurance (Azevedo et al., 2021; Rozmatovich & Maftuna, 2022; Sanjar & Maftuna, 2022; Toshboyeva, 2022; Khakimovich & Soyibjon, 2023; Nazirjonovich, 2023).

Well-known experts in Russia on sensitive periods for the development of endurance are similar in their opinion that aerobic qualities undergo significant changes in preschool and school age. Constant endurance training has a significant and positive effect on the body as a whole and is a good prerequisite for the development of other physical qualities, such as speed, strength or motor qualities (Goldfield et al., 2012; Kabanov et al., 2019).

However, despite the fact that experts are unanimous in the opinion that the school period, in general, is quite favorable for the development of all physical qualities, but we could not find an unambiguous answer to the question of favorable life periods for the development of aerobic qualities.

As a result of this study, sensitive periods for the development of aerobic qualities were identified. If we are talking about younger schoolchildren, that the optimal period for development will be 8-9 years old, the increase in endurance indicators in this age range was significantly positive. It should also be noted the age of 10-11 years (grade IV), the result in the Cooper test from the beginning to the end of the study was not reliable,

but the natural increase in endurance indicators was at the level of 8-9%. Such results coincide with the data of previous studies conducted by some authors (Guzhalovsky, 1986; Kholodov & Kuznetsov, 2018; Guba et al., 2021; Kuramshin, 2021; Matveev, 2021).

In secondary school age (grades V-VIII) According to the results of our study, there is a slight increase in endurance in both boys and girls. The indicators increased on average from 4% to 5% ($p > 0.05$). Only boys in grades VIII have a sharp increase in endurance indicators of 14% ($p < 0.05$). Such results coincide with some previous studies (Guzhalovsky, 1986; Guba et al., 2021; Kuramshin, 2021; Matveev, 2021).

Senior school age (grades IX-XI) It is characterized by a sharp jump in endurance indicators in both boys and girls. During the period of our study, the indicators increased by an average of 12-14% ($p < 0.05$). These data coincide with some previously conducted studies by some authors (Kholodov & Kuznetsov, 2018).

Thus, to date, there is no consensus on the sensitive periods of endurance development at school age. Despite the fact that there are several points of view in the literature on the issue of age periods for the development of aerobic abilities, in a detailed analysis, the authors of the studies point to different ages, which are favorable for a targeted impact on the endurance of schoolchildren. Our study with the participation of schoolchildren in grades I-XI showed certain age periods in which the increase in endurance indicators is significant.

The problem of children's health at school age is quite common (Apriyano et al., 2023; Eldiasty et al., 2023). Problems with insufficient motor activity in children also need to be addressed (Gatti et al., 2023; Masrun et al., 2023). The development of physical qualities in school is one of the ways to solve this problem (Bossmann et al., 2023). Aerobic abilities (endurance) are an essential component of health and athletic success (Dzimbova & Markov, 2023; Ndlomo et al., 2023).

Of course, the design of the study could be improved by adding additional tests to determine endurance in schoolchildren, and it is also possible to study favorable periods for the development of other physical abilities in different age periods.

Conclusion

Currently, there are several studies that are devoted to the effectiveness of the development of aerobic qualities, it has been proven that this is an effective tool in combating such a problem as physical inactivity. In some studies, we were able to find data on favorable periods for the development of endurance, but in some age ranges these data differ and in some are very contradictory.

As a result of our research, we believe that there are certain age periods for the development of endurance, experimental research has proved that for boys it is the age of 8-9 years (II grade) and 14-18 years (VIII-XI grades), and for girls 8-9 years (II grade) and 15-18 years (IX-XI grades). It should also be noted that there was a high increase in indicators of aerobic abilities among schoolchildren aged 10-11 (grades IV), despite the fact that the value turned out to be unreliable.

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Conflict of interest

None. The authors declare no conflict of interest

Author contributions

Author Contribution: Study design; Data collection; Statistical analysis; Manuscript Preparation; Funds Collection – Georgiy Polevoy.

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References

- Abdullaevich, Z. A. (2023). Development of Endurance Qualities of Young Football Players with The Help of Types of Athletics Running. *European Journal of Economics, Finance and Business Development*, 1(9), 7-12.
- Aliss, E. M., Sutaih, R. H., Kamfar, H. Z., Alagha, A. E., & Marzouki, Z. M. (2020). Physical activity pattern and its relationship with overweight and obesity in Saudi children. *International Journal of Pediatrics and Adolescent Medicine*, 7(4), 181-185. DOI: 10.1016/j.ijpam.2020.03.007
- Alvero-Cruz, J. R., García, M. G., & Carnero, E. A. (2017). Reliability and accuracy of Cooper's test in male long distance runners. *Revista Andaluza de Medicina del Deporte*, 10(2), 60-63. <https://dx.doi.org/10.1016/j.ramd.2016.03.001>
- Apriyano, B., Zainuddin, Z. A., Hashim, A. H. M., Sayyd, S. M., Mazlan, A. N. (2023). Physical fitness levels of junior high school students in different regions: Highlands, lowlands, and islands. *Journal of Physical Education and Sport*, 23(12), 3378-3384. DOI:10.7752/jpes.2023.12387

- Azevedo, R. D. A., Silva-Cavalcante, M. D., Lima-Silva, A. E., & Bertuzzi, R. (2021). Fatigue development and perceived response during self-paced endurance exercise: state-of-the-art review. *European journal of applied physiology*, 121, 687-696. DOI: 10.1007/s00421-020-04549-5
- Bossmann, Th., Woll, A., Wagner, I. (2023). Factors influencing flow experiences of adolescents during physical education. *Journal of Physical Education and Sport*, 23(10), 2531-2542. DOI:10.7752/jpes.2023.10291
- Chen, P., Wang, D., Shen, H., Yu, L., Gao, Q., Mao, L., ... & Li, F. (2020). Physical activity and health in Chinese children and adolescents: expert consensus statement (2020). *British journal of sports medicine*. DOI: 10.1136/bjsports-2020-102261
- de Bruijn, A. G., Mombarg, R., & Timmermans, A. C. (2022). The importance of satisfying children's basic psychological needs in primary school physical education for PE-motivation, and its relations with fundamental motor and PE-related skills. *Physical Education and Sport Pedagogy*, 27(4), 422-439. DOI: 10.1080/17408989.2021.1906217
- Doma, K., Deakin, G. B., Schumann, M., & Bentley, D. J. (2019). Training considerations for optimising endurance development: an alternate concurrent training perspective. *Sports medicine*, 49, 669-682.
- Dzimbova, T., Markov, A. (2023). Anthropometric and anaerobic parameters in young female artistic swimmers. *Journal of Physical Education and Sport*, 23(10), 2660-2665. DOI:10.7752/jpes.2023.10304
- Eldiasty, H. A. E. S., Hassan, A. K., Elhakim, B. E. H. A. E., Ahmed, Y. A. R. S. (2023). Impact of a dexterity programme on motor skills and inventiveness in 5–6-year-old children. *Journal of Physical Education and Sport*, 23(8), 2041-2050. DOI:10.7752/jpes.2023.08235
- Faigenbaum, A. D., Westcott, W. L., Loud, R. L., & Long, C. (1999). The effects of different resistance training protocols on muscular strength and endurance development in children. *Pediatrics*, 104(1), e5-e5. DOI: 10.1542/peds.104.1.e5
- Gatti, A., Cudicio, A., Giuriato, M., Lovecchio, N. (2023). Exploring shuttle run test performance and adiposity indices among Italian high school students: a comparative analysis with European norms. *Journal of Physical Education and Sport*, 23(8), 1982-1989. DOI:10.7752/jpes.2023.08228
- Goldfield, G. S., Harvey, A., Grattan, K., & Adamo, K. B. (2012). Physical activity promotion in the preschool years: a critical period to intervene. *International journal of environmental research and public health*, 9(4), 1326-1342. doi: 10.3390/ijerph9041326
- Guba VP, Bulikina LV, Achkasov EE, Bezuglov EN. Sensitive periods of children's development. Definition of sports talent. Moscow, Russia: Sport, 2021; p. 176.
- Guzhalovskiy AA. Fundamentals of the theory and methodology of physical education: Textbook for institutes of physical culture. Moscow, Russia: Fizicheskaya kultura i Sport, 1986; p. 351.
- Heradstveit, O., Haugland, S., Hysing, M., Stormark, K. M., Sivertsen, B., & Bøe, T. (2020). Physical inactivity, non-participation in sports and socioeconomic status: A large population-based study among Norwegian adolescents. *BMC Public Health*, 20(1), 1-9. <https://doi.org/10.1186/s12889-020-09141-2>
- Hu, D., Zhou, S., Crowley-McHattan, Z. J., & Liu, Z. (2021). Factors that influence participation in physical activity in school-aged children and adolescents: a systematic review from the social ecological model perspective. *International journal of environmental research and public health*, 18(6), 3147. DOI: 10.3390/ijerph18063147
- Jaakkola, T., Yli-Piipari, S., Huotari, P., Watt, A., & Liukkonen, J. (2016). Fundamental movement skills and physical fitness as predictors of physical activity: A 6-year follow-up study. *Scandinavian Journal of Medicine & Science in Sports*, 26(1), 74-81. DOI: 10.1111/sms.12407
- Kabanov, Y. M., Venskovich, D. A., Trushchenko, V. V., & Koloshkina, V. A. (2019). Sensitive periods in human ontogenesis. *Theory and Practice of Physical Culture*, (12), 4-4.
- Kainov AN, Kuryerova GI. Working programs. Physical culture. Grades 1-11. A comprehensive program of physical education for school children. Moscow, Russia: Teacher, 2019; p. 169.
- Khakimovich, K. S., & Soyibjon, I. M. (2023). Development of Students' Endurance Quality in Physical Culture Classes (in the Case of Grades 5-6). *Best Journal of Innovation in Science, Research and Development*, 2(5), 181-183.
- Kholodov ZhK, Kuznetsov VS. Theory and methodology of physical culture and sports. Textbook for universities. Moscow, Russia: Academia, 2018; p. 496.
- Kuramshin YuF. Theory and methodology of physical culture: Textbook. Moscow, Russia: Sport, 2021; p. 464.
- Mannocci, A., D'Egidio, V., Backhaus, I., Federici, A., Sinopoli, A., Ramirez Varela, A., ... & La Torre, G. (2020). Are there effective interventions to increase physical activity in children and young people? An umbrella review. *International Journal of Environmental Research and Public Health*, 17(10), 3528. doi: 10.3390/ijerph17103528
- Masrun, Khairuddin, Umar, Val Yauma. (2023). Implementation of fun game training model toward improving kids locomotor movement and concentration. *Journal of Physical Education and Sport*, 23(12), 3364-3370. DOI:10.7752/jpes.2023.12385
- Matveev LP. Theory and methodology of physical culture. Textbook. Moscow, Russia: Sport, 2021; p. 520.

- Mikaelsson, K., Rutberg, S., Lindqvist, A. K., & Michaelson, P. (2020). Physically inactive adolescents' experiences of engaging in physical activity. *European Journal of Physiotherapy*, 22(4), 191-196. <https://doi.org/10.1080/21679169.2019.1567808>
- Mikkonen, R. S., Ihalainen, J. K., Hackney, A. C., & Häkkinen, K. (2023). Perspectives on Concurrent Strength and Endurance Training in Healthy Adult Females: A Systematic Review. *Sports Medicine*, 1-24. <https://doi.org/10.1007/s40279-023-01955-5>
- Nazirjonovich, K. Z. (2023). Improving endurance from physical qualities in student youth. *Open Access Repository*, 9(9), 115-118.
- Ndlomo, K., Lombard, A., Green, A. (2023). The effects of high-intensity training on aerobic capacity of football players. *Journal of Physical Education and Sport*, 23(9), 2291-2299. DOI:10.7752/jpes.2023.09263
- Oberle, E., Ji, X. R., Kerai, S., Guhn, M., Schonert-Reichl, K. A., & Gadermann, A. M. (2020). Screen time and extracurricular activities as risk and protective factors for mental health in adolescence: A population-level study. *Preventive Medicine*, 141, 106291. DOI: 10.1016/j.ypmed.2020.106291
- Piñeiro-Cossio, J., Fernández-Martínez, A., Nuviala, A., & Pérez-Ordás, R. (2021). Psychological wellbeing in physical education and school sports: A systematic review. *International Journal of Environmental Research and Public Health*, 18(3), 864. DOI: 10.3390/ijerph18030864
- Rozmatovich, U. S., & Maftuna, I. (2022). Development of students'endurance in physical culture lessons. *Asia pacific journal of marketing & management review*, 11(10), 102-106.
- Sanjar, U., & Maftuna, I. (2022). Developing students'endurance quality in physical education classes (on the example of grades 5-6). *International journal of research in commerce, it, engineering and social sciences*, 16(06), 24-28.
- Solodkov AS, Sologub EB. *Human Physiology. General. Sports. Age group. Textbook*. Moscow, Russia: Sport, 2018; p. 624.
- Terrón-Pérez, M., Molina-García, J., Martínez-Bello, V. E., & Queralt, A. (2021). Relationship between the physical environment and physical activity levels in preschool children: a systematic review. *Current Environmental Health Reports*, 8(2), 177-195. DOI: 10.1007/s40572-021-00318-4
- Toshboyeva, M. B. (2022). Wellness exercises for human endurance development. *Web of Scientist: International Scientific Research Journal*, 3(4), 1214-1220.
- Yuliandra, R., & Fahrizqi, E. B. (2020). Development of endurance with the ball exercise model in basketball games. *Jurnal Pendidikan Jasmani, Olahraga Dan Kesehatan*, 4(1), 61-72. DOI: 10.33503/jp.jok.v4i1.980
- Vale, S., Santos, R., Soares-Miranda, L., Silva, P., & Mota, J. (2011). The importance of physical education classes in pre-school children. *Journal of Paediatrics and Child Health*, 47(1-2), 48-53. DOI: 10.1111/j.1440-1754.2010.01890.x
- Volmut, T., Pišot, R., Planinšec, J., & Šimunič, B. (2021). Physical activity drops during summer holidays for 6- to 9-year-old children. *Frontiers in public health*, 8, 631141. <https://doi.org/10.3389/fpubh.2020.631141>