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ORIGINAL ARTICLE

The Outdoor Game "Catch-Up" is A Tool to Support the Development of Coordination Abilities in Children

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ABSTRACT

Background. The actual problem of physical inactivity among schoolchildren can be solved by supplementing the school program on physical culture with outdoor games. **Objectives.** To assess the impact of the outdoor game named "Catch-up" on some variables (throwing, running and agility) featuring coordination abilities of schoolchildren 7-8 years old. **Methods.** Assessment was performed at the Kirov primary school in Russia. 120 boys and girls participated in the study over 4 months. As they went to the same school, it was assumed them to have similar previous coordination development and performed similar extra-school physical activities. First-graders from the control group were engaged in a standard program of physical education at school and children from the experimental group were additionally engaged in a physical activity game Catch-up. To match the effort between the two groups, the control group prolonged the standard program (warm-up phase) by a time corresponding to how long it took the control to play Catch-up. The level of development of coordination abilities of schoolchildren was assessed using two tests: throwing a ball to a target and 3×10-meter shuttle running. **Results.** The variables in the control group in the throwing test improved from 3.35±0.92 to 3.60±0.69 hits (7.5%, $p>0.05$) and in the shuttle running from 10.20±0.40 to 9.85±0.39 seconds (3.4%, $p<0.001$). In the experimental group, there was a significant improvement in both tests. In the ball throw test, the experimental group improved from 3.15±0.76 to 4.30±0.62 hits (36.5%, $p<0.001$) and in the shuttle running from 10.50±0.48 to 8.95±0.46 (14.8%, $p<0.001$). **Conclusion.** The physical activity game Catch-up could be included in physical education lessons in schools to improve some variables featuring the coordination abilities of young schoolchildren.

KEYWORDS: ***Physical Exercises, Dexterity, Physical Culture, Lesson.***

INTRODUCTION

Especially in adult life, the amount of actions to be carried out under probabilistic and unexpected conditions is significantly high and thus requires resourcefulness, quickness of reaction, spatial, temporal and dynamic accuracy of biomechanically rational movements (1-3). All these qualities or abilities are associated with the concept of dexterity in the theory of physical education (4, 5). The most important ones are highly developed muscle feeling and the so-called plasticity of cortical nervous processes, on which the speed of formation of coordination

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connections and the transition from one set of attitudes and reactions to others depend (6, 7). The basis of dexterity is coordination ability (8-10).

Well-managing coordination abilities depends on several factors namely:

1) a person's ability to accurately analyze movements;

2) analysis activity, especially movements' analysis;

3) difficulties with the motor task;

4) the level of development of other physical abilities (speed abilities, dynamic strength, flexibility, etc.);

5) grit and determination;

6) age and

7) general preparedness of the schoolchildren.

Primary school physical education has a big role in the development of motor coordination (11, 12). The school program aims at teaching the schoolchildren a wide range of new motor skills and, on this basis, at supporting the development of coordination abilities over phasic and cyclic (locomotion) movements, gymnastic exercises, accurate and broad-range throwing movements, movement and sports games. Effectively teaching these physical education tasks to support the development of coordination abilities makes the schoolchildren master various motor actions soon and well. Schoolchildren constantly remodel their motor experience, which they need to cope with more complex tasks demanding increasing coordination due to their complexity (viz., occupational activity and sports; 13, 14). Day by day, children acquire the ability to successfully spend their energy resources on motor activity and this makes them experience positive feelings of joy and satisfaction thanks to self-acknowledging to properly manage new and diverse movements in proper ways (15-17). Significant potential coordination abilities featuring adult life as well are, among others (e.g., balance and rope jumping), throwing an object to a target (18) and shuttle running (19, 20).

A review of the literature shows that a sensitive (i.e., favourable) period for the development of coordination abilities is the young age and the first half of adolescence (7÷11 years). The natural growth of coordination abilities outcomes from 7 to 10 years amounts to – on average – 60% of its whole-life total. Consequently, pedagogical influences aimed at the development of coordination abilities have the greatest effect if they are systematically and purposefully carried out at this age (21, 22). Targeted development of coordination abilities of young schoolchildren is appropriate exploiting the fact that motor activity is already an essential component of the lifestyle and behaviour of the children (23-25). The determining influence on the development of coordination abilities in primary school age is fueled by the motor experience of the schoolchildren (21, 26). The greater the pool of motor skills and abilities they can manage, the higher the level of development of their coordination and motor abilities available variety (22, 27). Purposeful and systematic development of coordination abilities over sensitive periods, according to many researchers, will generally contribute to the training of the child for everyday life, educational, sports and work activities (21, 22).

It should be noted that the need for enriching currently adopted standard physical education programs at school with modern means and methods is urgent for a large number of teaching systems around the world (28-31). In particular, the modern school curriculum in physical culture in Russia presents a wide range of physical exercises and techniques for the development of coordination abilities of schoolchildren, but the game method is rarely used, particularly regarding outdoor games (26, 27, 32).

At the same time, the effectiveness of the use of the game method and the use of outdoor games for the development of coordination abilities, especially when teaching children of primary school age, has been proven (33). The game method is characterized by the fact that the schoolchildren must solve the emerging motor tasks independently, based on their analysis of the current situation. This method is meant to teach how to improve the performance of exercises either over a restricted time, under certain constraining conditions or while performing certain motor actions (33-36).

Thus, there is a contradiction between the need for developing coordination abilities at primary school age (37) and the lack of use of outdoor games in physical education lessons (38) as an effective means and method for the development of such coordination abilities. Primary school physical education programs could benefit from the introduction of validated outdoor games aimed at improving at least some coordination abilities in children. Overall, specific training

programs have already shown their effectiveness in special children populations (39) even when game-based (40). Therefore, this study aimed to assess the impact of the outdoor game named "Catch-up" on the outcomes of coordination abilities of schoolchildren 7-8 years old.

MATERIALS AND METHODS

Participants. At the time of the study, 133 first-graders aged 7-8 years were studying at the Kirov school number 60. These were 4 classes of 32÷34 schoolchildren each. Since in the school curriculum, the control standards for the level of development of coordination abilities of boys and girls 7-8 years old were the same, we differentiated all first-graders into a control group (CG) and an experimental (EG) without taking into account gender and physical fitness level. Children who were admitted to physical education classes underwent a medical examination. Thus, 123 schoolchildren were admitted to physical education classes at the school by a doctor. Informed consent to participate in the pedagogical experiment was obtained from the parents of 120 first-graders, who took part in the study (Table 1).

Table 1. Differentiation of children in control and experimental groups

First grade schoolchildren	Control Group		Experimental Group	
	1 "A"	1 "B"	1 "C"	1 "D"
Total children	34	32	33	34
Admitted to physical education classes	31	30	31	31
Participated in the study	30	30	30	30

During the school year, physical education classes were organized in such a way that other physical activities in children did not affect the test results. The first-graders, who took part in the study, did not practice further exercise or sport. All procedures conformed to the ethical standards of the Helsinki Declaration and were approved by the local university ethics committee. Informed consent was obtained from each parent. At any time, schoolchildren could withdraw from the study.

Study procedure. This research was conducted in primary school number 60 in the city of Kirov in Russia from February 1 until May 30, 2022 (4 months). Physical education classes were held at the same time of the day twice a week lasting 40 minutes each. A total of 32 physical education lessons were held in each class.

Coordination exercises should be planned for the first half of the main part of the lesson, as they quickly lead to fatigue (8, 15). Therefore, the children from EG played Catch-up – outdoors – for 9 minutes immediately after a preliminary warm-up (5 minutes) made of slow and fast runs interspersed by jumps and crouches. The rest of the lesson was held according to the physical education program at school (32).

Aim and rules of the game of Catch-up

The game of Catch-up aims to improve some coordination abilities namely throwing, running and agility.

Within three minutes, two or three driving schoolchildren must hit with a volleyball ball the remaining schoolchildren (throwing conditioning), who are running away from them (running). If the ball hits a schoolchild, then she or he remains in place with his legs wide apart and is considered "frozen" (agility). He can be considered "unfrozen" back if another schoolchild crawls between his legs (agility). Then he can run away from the driving schoolchildren again. After three minutes of play, the driving schoolchildren change (i.e., the "catchers" become "preys" and some of the preys become catchers). Catch-up is repeated three times.

Over the same time, the children from CG did not perform any additional special physical exercises, but their warm-up was prolonged by 9 minutes. The rest of the lesson was delivered to both groups according to the physical education curriculum at the school. The main goal of the physical education program at school is to strengthen children's health, let them gain knowledge about the importance of physical education for health and improve their physical skills through exercise (32). In summary, EG underwent a 5-min warm-up (jogging), 9-min Catch-up and 26-min standard program of physical education (e.g., runs, jumps and throws). Differently, CG underwent a 14-minute warm-up and a 26-minute standard program.

Control tests. The variety of all the types of motor coordination abilities does not allow us to assess the level of their development according to one single unified criterion. Therefore, various variables are taken into account in physical education and sports, the most important of which are:

1. The stability of performing a complex motor task, which is evaluated by the variable featuring target accuracy, that is, the number of hits of various objects to a target.

To assess this outcome, the test of throwing a ball to a target was administered (18). Throwing a tennis ball to the target was performed from a distance of 6 meters, indicated by a throwing line, into a gymnastic hoop with a diameter of 90 cm fixed on a wall. The lower edge of the hoop was at a height of 2 meters from the floor. To throw the tennis ball to the target, a ball weighing 57 grams was used. The participant was allowed five attempts. The number of hits in the area bounded by the hoop was counted.

It was considered an error (and thus the attempt discarded) if the schoolchildren crossed the throwing line while throwing (32).

2. The time spent on performing the movement. The shorter it is, the higher the coordination abilities.

To assess this outcome, a 3×10-meter shuttle running test was administered (20). The shuttle running was performed in a gym with marked start and finish lines. At the signal, the schoolchildren had to run 10 meters, touch the platform behind the turn line, turn around and run back, thus, two more segments of 10 meters. The result is measured with a precision of 0.1 seconds.

It was considered error (and thus the trial was discarded and repeated [to the bitter end] after 15 minutes of lightly active rest until completed correctly) if the schoolchildren started the test before the teacher's command or if he did not cross the line during the U-turn (32).

Statistics. The results are shown as means and standard deviations. Statistics was analyzed with SPSS 20.0 (IBM, Armonk, NY, USA). The normality of results was tested by means of the Kolmogorov-Smirnov test (K-S, threshold with $p<0.05$). The reliability of the measurements was assessed with the Intra-class Correlation Coefficient (ICC). The between-group differences in throwing and shuttle running tests change over time were analyzed using a two-way analysis of variance (ANOVA) with time as a repeated-measure factor (two levels: pre- and post-training) and group as a between factor (two levels: CG and EG) with Bonferroni post-hoc test. The ANOVA effect size was evaluated with partial eta squared (η_p^2) and classified as follows: small, <0.06; medium, 0.06-0.14 and large, >0.14 (41). The magnitude of differences between variables was interpreted using standardized effect size (Cohen's d): $d<0.1$ (no effect), $0.20<d<0.40$ (small effect); $0.50<d<0.70$ (intermediate effect), $0.80<d<1.0$ (large effect) and >1.0 (very large effect). The statistical significance level was set at $p<0.05$.

RESULTS

Regarding shuttle running test K-S did not reject the null hypothesis of normality with $p=0.2875$ ($D=0.1234$) and $p=0.55$ ($D=0.1$) for CG and EG, respectively. Conversely, regarding the throwing test, K-S rejected the null hypothesis of normality with $p<0.05$ for both groups ($D=0.3162$ and $D=0.2793$ for CG and EG, respectively). ICCs were regarding shuttle running test 0.841 and 0.845, whereas regarding throwing test were 0.215 and 0.580 for CG and EG, respectively.

Before the start of the study, the variables featuring coordination abilities in the control and experimental groups did not show significant differences in both the shuttle running and the throwing test ($p>0.05$, Table 2).

Table 2. Results of control tests of both groups at the beginning and at the end of the study

Test	Control group (n=60)				Experimental group (n=60)			
	Before	After	p	*d*	Before	After	p	*d*
Throwing test (number of hits)	3.35±0.92	3.60±0.69	p=0.12	0.31	3.15±0.76	4.30±0.62	p<0.001	1.51
Shuttle running test (seconds)	10.20±0.40	9.85±0.39	p<0.001	0.87	10.50±0.48	8.95±0.46	p<0.001	3.22

ANOVA revealed a time interaction effect with $F_{(1,237)}$=61.193, η_p^2=0.205 (large effect size) and p<0.001 and an interaction for groups with $F_{(1,237)}$=11.938, η_p^2= 0.048 (small effect size) and p<0.001 regarding the throwing test. Regarding the shuttle running test, ANOVA revealed a time interaction effect with $F_{(1,237)}$=257.137, η_p^2=0.520 (large effect size) and p<0.001 and an interaction for groups with $F_{(1,237)}$=5.796, η_p^2=0.131 (medium effect size) and p=0.001.

The analysis of Table 2 shows that after the end of the study, the variables featuring the coordination abilities of children in both tests improved, both in the control group and in the experimental group, but the improvements in the variables were different.

In CG, the variables in the throwing test improved from 3.35±0.92 to 3.60±0.69, which corresponded to 7.5% (p>0.05, small effect size, Table 2). Conversely, in the shuttle running test CG improved by 3.4% (p<0.001, large effect size). Differently, in EG, during the study period throwing and shuttle run tests improved by 36.5 and 14.8%. (p<0.001, very large effect size), respectively.

DISCUSSION

The present study revealed insufficient effectiveness of a standard physical education program at school (at least the one taken into account) for the development of coordination abilities, as evidenced by the variables featuring them before and after the study in both groups. Maybe a little bit unexpectedly, the addition of just a little (i.e., a few minutes) of outdoor play, in the form of the Catch-up game, to the standard program – keeping the same duration of the physical education lesson – improved the variables featuring coordination abilities of children 7-8 years old. The addition of outdoor games in working with younger schoolchildren in physical education classes increases the effectiveness of standard programs in Russian schools.

As for the results of the study in comparison with the normative data of the physical culture program at school, the following can be noted. In Russia, the standard variables featuring coordination abilities are the same in the physical education curriculum for boys and girls aged 7-8 years. It was noticed that after the age of nine, boys achieve a higher level of development of coordination abilities than girls (32).

According to Fuentes-Barría et al. (21), before the start of the study, the average CG scores in the throwing test could be assessed as 3 (hits, i.e., “Middle”), whereas at the end the average group variable resulted only close to 4 seconds (“High”, Table 2). In the shuttle running test, the assessment of the average group variable at the beginning of the study resulted in close to 10.0÷10.7 seconds (“Low”), whereas at the end the average group variable resulted in only close to 9.2÷9.9 seconds (“Middle”). The improvement in this variable may be caused by the effectiveness of the standard physical education program at school (32), as well as by a natural increase in the variables featuring coordination abilities in children 7-8 years old (21, 22).

As for the schoolchildren from the EG, before the start of the study, the variable of the throwing test was assessed on average as 3 (hits), but, after the end, the variable increased significantly and the average variable overtook 4 (Table 2). In the shuttle running test, before the start of the study, the group’s variable corresponded to a score close to 9.2÷9.9 seconds, but after the end, the variable increased significantly with the average score reaching ≤9.1 seconds. The very large effect sizes witness the magnitude of the measured mean differences.

In the process of physical education of schoolchildren, the creative and modern approach of the teacher to conduct a lesson in physical culture is of great importance (42, 43). Success in the development of physical qualities, including coordination abilities, depends on how many correct means and methods the teacher chooses for a particular lesson and how she/he selects them taking into account age, gender, technical and physical training (44, 45).

The importance of coordination abilities is explained by the following main reasons (9, 10, 17):

1) well-developed coordination abilities are necessary prerequisites for successful training in any sport. They influence the pace, type and method of mastering sports equipment, as well as its further stabilization and situationally adequate diverse application;

2) coordination abilities contribute to the effective performance of work operations with ever-increasing demands in the course of work and increase a person’s ability to manage her/his movements;

3) coordination abilities ensure the economical expenditure of energy resources and affect the amount of their use, since in this way muscle effort is precisely dosed in time, space and degree of filling and optimal use of the corresponding relaxation phases leads to rational expenditure of forces and

4) a variety of exercise options, the use of outdoor games in primary school and sports games in the middle level are necessary for the development of coordination abilities. This is a guarantee that it is possible to avoid monotony in lessons and therefore to ensure the joy of participating in physical education activities.

A literature review has shown that a favourable period for the development of coordination abilities is primary school age (21, 22). The results of the present study confirm those data, since even without a targeted impact on coordination abilities, the children's CG scores improved in both tests. At the same time, a targeted impact on the development of coordination abilities gives a significant increase in them, this is confirmed by the results of children in EG.

It is proved that the use of outdoor games in working with children of primary school age increases emotional interest in a lesson or training and is an effective means and method for the development of physical qualities of children, including coordination abilities (33-36). The present study confirms previous research since children who were engaged in outdoor games at each physical education lesson were able to significantly improve the variables featuring coordination abilities.

It should be noted that the playing time during the physical education lesson was not determined by chance. The usual duration of the lesson in primary classes is 40 minutes. If the outdoor game continues too short, then children do not have time to delve into the essence of the game, get the necessary skills for themselves and satisfy their motor and emotional needs. On the contrary, if the duration of the game is half a lesson or more, then – emotionally and physically – children are not able to maintain interest in the game and its high pace of movement and this also affects the implementation of blocks of the standard physical education program.

Of course, this study can be improved. In the future, the positive effect of Catch-up practice needs to be confirmed compared with other standard school-based physical education programs as well. Moreover, it would be desirable to determine the impact of further outdoor games on variables featuring other physical qualities. It is also interesting to study the influence of games on the variables featuring mental processes and cognitive functions of children.

CONCLUSION

When the outdoor game of Catch-up was performed during a physical education lesson at school, the variables featuring some coordination abilities of 7- to 8-year-old children, namely throwing, running and agility, significantly improved. The present study shows the importance of developing coordination abilities in primary school age and the effectiveness of introducing outdoor games into the process of physical education at school, in particular, the game Catch-up.

APPLICABLE REMARKS

- The problem of insufficient motor activity needs to be solved, this problem is often talked about, but there is still no optimal solution.
- Teachers at school in physical education classes at school are recommended to include outdoor games in the lesson process. Such games not only increase students' interest in classes but also develop physical qualities, such as coordination abilities.
- Subsequently, it is possible to study the influence of outdoor games on the development of other physical qualities in school-age children, for example, in the middle level.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Georgiy Polevoy. Acquisition of data: Georgiy Polevoy. Analysis and interpretation of data: Ibrahim Ouergui. Drafting the manuscript: Johnny Padulo. Critical revision of the manuscript for important intellectual content: Luca Paolo Ardigò. Statistical analysis: Johnny Padulo.

Administrative, technical, and material support: Georgiy Polevoy. Study supervision: Luca Paolo Ardigò.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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