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Original Article

Street Workout is the new gymnastics - strength development in a very short school-based program

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Abstract:
An essential part of teaching physical education (PE) is looking for effective and attractive education tools. One of the better solutions are short interventions that aim to develop various aspects of physical fitness and overall health. Street workout is a modern and popular sports discipline based on exercises using one's own body. The equipment includes benches, bars and parallel bars that are usually placed outdoors. It is a sport that can also be done with children in PE. 48 children (25 boys and 23 girls) aged 10–11 took part in the research. The group took a test of strength (push-up, hang hold, plank hold, squat) and flexibility (sit and reach). A real four-week Street Workout training programme (2x45 minutes PE classes) was designed for the experimental group. The program consisted of static and dynamic bodyweight exercises (pull-ups, dips, levers, holds, lunges etc.) and additional games. The control group visited normal PE classes. The results of the experimental group showed statistically significant improvement (p=0.05) in all the tests — push-up (33.4 %), hang hold (24.6 %), plank hold (34.1 %), squat (7.6 %), sit and reach (3.2 %). The control group showed improvement only in plank hold (26.9 %). The greatest difference between the groups was found in push-up (ES=1.356) and hang hold (ES=1.036) tests. Street Workout proved to be an effective tool as a part of a short-term intervention programme to develop (especially upper body) strength. Thanks to that, it can be an interesting alternative to gymnastics and also a functional tool for physical fitness development.
Keywords: physical fitness, exercise, bodyweight, children

Introduction

A grave health problem of the west world is high incidence of overweight and obesity of children and teenagers—in European countries, it ranges from 10 to 39 % (Garrido-Miguel et al., 2019). Besides many flaws in the overall lifestyle, it is necessary to point out the lack of physical activity. On average, 45–60 % of children under 16 participate in regular (higher intensity) physical activity (Inchley et al, 2020). In general, there is also a lack of exercising outside organized sports activities (school, sports clubs), such as steps walked throughout the day, work, games, etc. A way to improve this situation is inclination to physical activities which is mostly influenced by family, close friends and school.

One of the main aims of physical education (PE) is to develop positive attitude towards exercise. Motivation of children is based on multiple factors including school environment, teachers' personality and also the contents of the education. Besides that, "enjoyment" is related to activity in classes and positive attitude towards extracurricular activities (Cairney et al., 2012). It is important for the children to keep up with and follow current trends—using modern technology or choosing popular physical activities. Gymnastic exercises have been a part of school PE since the 19th century, but they are not very popular in their usual form (Correa et al. 2021). Activities, such as parkour, Street Workout (calisthenics) or exercise using interesting equipment (e.g. TRX), look more attractive for both the spectators and the sportsmen. An important goal of PE is to design attractive and also effective education methods.

Street Workout is a relatively new sports discipline that gained popularity especially with the young generation. It can be seen as a variant of calisthenics oriented to outdoor environment. Its boom is also evident in the organization of contests by World Street Workout & Calisthenics Federation (Sanchez-Martinez et al., 2017). Outdoor workout places are common in both large and small cities so the children can come across this sports activity. It is based on bodyweight exercises using bars, parallel bars, gymnastics rings, benches. Besides typical movements, also static holds or eccentric phases of movement are performed. To a lesser degree, also coordination exercises are used, such as spins, flips and turns. External weight can be used mainly to increase the difficulty of the exercises. This type of exercise develops strength, flexibility and balance (Taipe-Nasimba & Cantón Chirivella, 2020). Street Workout is an easily accessible activity from the material and financial point of view, it is available for anyone regardless of their current fitness level and it can also be adapted for practising at home (Thomas et al., 2017).

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The development of strength is different for children and young people than for adults. The prepubertal organism is not yet hormonally mature, and therefore the result is a different adaptation. Children's muscle is almost incapable of hypertrophy, the increase in strength is due to intra- and intermuscular coordination. Strength gain can be very well achieved with a controlled short-term resistance program (Faigenbaum et al., 2019; Lloyd et al., 2016). Positive results in prepubescents are also reported when using bodyweight exercises (Moran et al., 2018). However, it should be noted that bodybuilding methods (3 series, 8-12 repetitions) and traditional exercises were applied. Commonly used exercises and methods in Street Workout are very different and their potential for strength development in children is not yet known.

The optimal range of motion is important for health and allows you to perform compound exercises and everyday tasks. Flexibility development is a regular part of exercise programs. Children have been shown to respond very well to interventions with a time allowance of 1-2 times per week, for 4-6 minutes (Mayorga-Vega et al., 2016). Acute adaptation to stretching takes place in these cases based on control of the stretch reflex and central nervous system. An increase in range of motion can also be achieved by regular exercise or by increasing the amount of physical activity (Freitas et al. 2017).

Studies with children and teenagers have shown that PE long-term programs can be effective for the development of physical fitness. The positive effect of a one-year intervention on strength parameters in comparison with the control group is reported, for example, by Stenevi-Lungren et al. (2010). Unfortunately, this kind of research carries a moderate risk of bias (Dobbins et al., 2013). It is difficult to discern the effect of the intervention from other factors including biological maturation or children's other physical activities. In this respect, shorter programmes seem more appropriate. The usual duration of an intervention is 6–12 weeks and it has been proven effective in strength and flexibility parameters improvement (Behm et al., 2017; Mayorga-Vega et al., 2016; Peitz et al., 2018). Very short programmes lasting for less than 6 weeks are an exception (Lloyd et al., 2012; Wright et al., 2015). The authors do not know of a study that would use a short-term school-based program for prepubertal children focused on developing strength and flexibility.

Training using calisthenics has proven effective for the strength and flexibility development of both youth and adults (Thomas et al., 2017; Guerra et al., 2019). Positive effects had been observed also after a 12-week school programme (Santos et al., 2015) or after 8 weeks in adolescents (Katsanis et al., 2021). In order to allow transfer to real education, it is desirable to carry out researches whose design is applicable for common PE. The aim of this study was to find out if a school-based Street Workout programme lasting for four weeks was going to affect children's strength performance and flexibility.

Material & methods

Participants

The group consisted of two school classes, a total of 48 children (25 boys, 23 girls) aged 10–11. The study was performed in a regular school with no specialisation and with two PE classes (2x 45 min) per week. The classes were divided by random in the experimental (N=25) and control (N=23) groups. Both groups were explained the purpose of the project. For the control group, the purpose was to assess the level of selected parts of physical fitness. The experimental group was explained that instead of traditional gymnastics, they will be introduced to a new sport—Street Workout—and that their progress in selected tests will be evaluated. The pupils who did not participate in 100 % of the classes (N=5) were excluded from the final evaluation. The research design is shown in Figure 1.

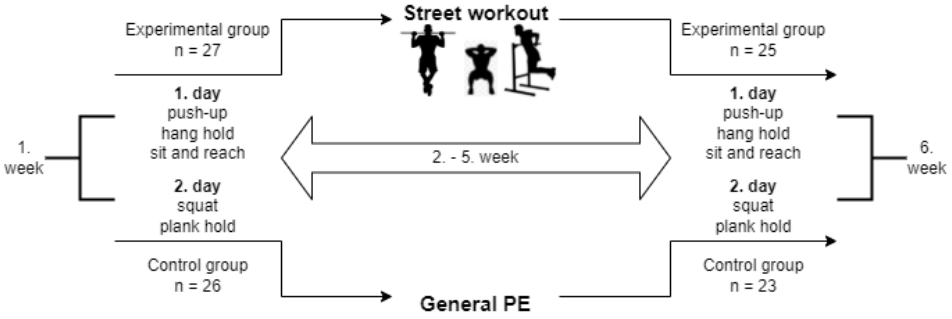

Fig 1. Research design

Test protocol

The individual tests were chosen to analyse, in a complex way, pull and push strength, trunk strength and also lower body strength. Standardised tests were not used. Instead, such tests were used which are related to Street Workout and which are appropriate for the given age group. The strength tests were complemented with a flexibility test. Cardiorespiratory fitness, as a vital part of physical fitness and health, was not tested because the study did not aim to affect it and an assumption was made that a longer intervention would be necessary to affect it (Dobbins et al., 2013).

Following tests were used:

Push-up — performing one set of maximum repetitions of inclined push-ups with hands on a 40 cm high bench, touching the bench with chest on each repetition

Squat — performing maximum repetitions of deep squats (under parallel) per minute

Hang hold — performing maximum passive hold on a bar with both hands without touching the ground

Plank hold — performing maximum hold in plank position (front hold on forearms)

Sit and reach test — from a seated position, lean forward with arms in front of the body, trying to reach as far as possible

A general warm-up (8 min) was performed before the testing. The pupils were actively encouraged as they were taking their tests, a motivational atmosphere was created. First, they tried the test and then they had two attempts to perform it. The testing was done within two school classes. On the first day, push-up, hang hold and sit and reach was performed, on the second day, it was squat and plank hold. A break between the attempts or the tests was at least 5 minutes.

Procedure

In the first week, the participants were divided into the groups, introduced to the study and they took the pre-test. In the second to the fifth week, the intervention took place in the experimental group. In the sixth week, a post-test and evaluation were done in both groups.

The program consisted of bodyweight exercises which comprise a part of Street Workout. They were exercises, such as pull-ups, levers, hanging leg raises, various forms of push-ups, squats, lunges, etc. No difficult coordination exercises were included. The exercises were not performed in typical sets and repetitions fashion, but rather within a specific time period (1–3 minutes) in which the participants practised correct technique and did "working" sets. Despite that, the number of repetitions was lower (<15) and the holds were shorter, up to 20 seconds. The composition of the PE classes was adapted to the intervention, with the Street Workout exercises comprising the main part of the class (20–25 minutes). Each class consisted of a common warm-up, the main part and a cool down. Then, for the rest of the class, usual (ball) games were played. The control group had normal PE classes as per the educational programme. Topics of the classes changed and had no special aim— they consisted mostly of athletics, gymnastics and sports games.

Statistical analysis

An IBM SPSS statistics programme was used for statistical processing (descriptive, correlation analysis, effect size) of the data. The data is presented as an average ± SD (standard deviation). Before the statistical testing, to assess statistical significance, data normality was evaluated using two tools: histogram and Shapiro wilk test. In case the normality was confirmed, parametric tests were used, specifically two-sample t-test for paired samples (with the premise of an F-test of equality of variances) - for testing between pre- and post-test. In the case the data was not normally distributed, non-parametric Wilcoxon signed-rank test was used. To assess statistical significance of the difference between experimental and control group, Cohen's d with the scale of <0.20 = trivial, 0.20– 0.49 = small, 0.50–0.79 = medium, ≥ 0.80 = large was used (Cohen, 1992). The significance was tested at a significance level of $\alpha > 0.05$.

Results

The starting values are comparable in both groups, only the plank hold time differs significantly. The experimental group showed progress in all tests, with the changes being statistically significant (p=0.05) (Table 1.). The greatest improvement was achieved in the push-up and hang hold tests (33.4 % a 24.6 %). The flexibility test shows very little change, even though it is still statistically significant. The results of the plank hold test showed statistically significant improvement in both groups, however, it is important to point out individual positive and negative fluctuations in the results of both pre-test and post-test.

The control group showed generally very small to insignificant improvements. The push-up test was the only one that showed worse results (by 1.4 reps), even though it was not statistically significant. The plank hold test was the only one where the control group showed a significant improvement (19.1 sec).

Table 1. Pre-test and post-test results, groups comparison.

	Experimental group				
	Push-up	**Squat**	**Hang**	**Plank**	**Sit and Reach**
pre-test	26.64	47.73	40.68	113.18	32.41
SD	15.09	9.73	22.64	104.85	6.80
post-test	35.55	51.36	50.68	151.77	33.45
SD	21.22	8.95	24.10	136.19	7.22
difference	8.91	3.64	10.00	38.59	1.05
% difference	33.4%	7.6%	24.6%	34.1%	3.2%

p value	0.0001	0.0003	0.0001	0.0172	0.0166
			Control group		
pre-test	26.05	46.21	45.16	70.84	34.00
SD	14.67	10.29	25.29	38.76	5.74
post-test	24.68	47.42	45.26	89.89	34.53
SD	13.18	7.30	25.44	39.56	4.46
difference	-1.37	1.21	0.11	19.05	0.53
% difference	-5.3%	2.6%	0.2%	26.9%	1.5%
p value	0.2154	0.4790	0.9667	0.0133	0.3098
effect size	1.356	0.426	1.036	0.361	0.259

The experimental group showed better results in all the tests. When comparing the groups, a large size effect was found in push-ups (ES=1.356) and hang hold (ES=1.036). Although the experimental group improved more also in other tests, the effect size was statistically small. A positive trend can be observed in squats when taking into account standard deviation and individual subjects' analysis.

Discussion

A workout programme focused on Street Workout proved effective regarding strength parameters progress. In school programmes, interventions lasting for at least 6 weeks have proven effective so far (Moreira et al., 2012, Dobbins et al., 2013). However, as shown in a study by Lloyd et al. (2012), as for prepubescents, improvement can be achieved in as little as 4 weeks. It seems that juvenile organisms have a very good potential for quick neuromuscular adaptability which manifests in the improvement of strength and speed parameters (Wright et al., 2015). The results generally confirm the fact that short-term school programmes with a focus on strength training can be expected to lead to significant improvement of strength parameters (Radnor et al, 2017). As shown by the results of the control group, a goal-directed intervention is necessary to see an improvement in the short term. If it be to the contrary, no progress can be expected and it is even possible to see a greater number of worse results (Kriemler et al, 2011).

No clear conclusion can be made regarding the flexibility test, but it is important to note that its specific development was not included in the intervention. Even though the improvements seen were statistically significant, they were very small in absolute numbers. If stretching exercises had been a part of the intervention, we could have expected a more significant improvement (Kamandulis et al., 2013).

The authors know of only one other similar study dedicated to Street Workout within a school programme (Santos et al., 2015). The experimental group consisted of 12-year-old children and the programme was 12 weeks long. Although the results were heterogeneous, there was progress in tests of push-ups and sit-ups. Flexibility was not evaluated and so far it is not clear if Street Workout without specific stretching exercises can develop this ability. If stretching was implemented, a positive effect would have likely occurred (Moreira et al, 2012). Also, a different organization of training sessions was used, with elements of "bodybuilding" methods and with a focus on an exact number of sets and repetitions. For the given age group, it might seem more appropriate from a pedagogical point of view to use an organization with a playful form and with room for children's active, independent approach (choosing their own tempo, exercises, rest periods, etc.)

Street Workout focuses mainly on upper body strength. This was confirmed by the results of the experimental group where the greatest improvement was seen in exercises based on the muscles of the trunk and arms (push-up, hang hold, plank hold). In case of optimal composition of exercises, lower-body muscles are engaged too. This was proven by the improvement in the squat test. Strengthening all the big muscle groups using functional movements should be the goal of proper physical fitness development. In more advanced or competitive forms of Street Workout, these elements are given less priority, but that is not a part of a school curriculum.

Short school programmes have, besides other things, benefits in terms of didactics. It is much easier to keep the children motivated for several weeks than for months and it is also possible to realize multiple projects within a year. It is likely that the observed changes are not affected by biological maturation and the results depend more on the children themselves (Folgado et al., 2021). When teachers focus on "modern" sports in their selection of activities, it is easier to get the children interested. In the case of Street Workout, extracurricular activities which are not significantly dependent on material and financial conditions are also supported. Attractivity, effectivity and connection to common life constitute important aspects of PE (Beni et al., 2017).

It is important to point out that this was supposed to be a "real" intervention that could be replicated in classic school PE. It would be possible to dedicate even more time to the selected exercises and thus achieve better results. However, that would shift away from an optimal composition of a PE class. The classes should constantly bring joy and excitement and therefore they should be diverse, with a clear organisation (Cairney et

al., 2012). Because of this, various games and similar activities were also part of the classes. It was another aspect of the study—to verify the effectivity of real intervention.

Limitations of the study can be seen in the size of the sample, but the conditions were typical—a teacher working with a class. Also, a common phenomenon in children are individual fluctuations in performance. Internal motivation and external factors (teacher, classmates, the atmosphere in the class, etc.) also play a significant role and can interfere with the results (Ommundsen & Kval∅, 2007). This trend was noticed especially in the plank hold test. Despite that, a clear trend in progress of both groups was seen.

Conclusion

Street Workout is a relatively new and modern sports discipline, and it is popular with the young generation. The study has shown that it can be very well implemented in a real school PE curriculum. After a 4-week intervention, the experimental group improved mainly in upper-body strength tests. With an optimal training plan, the lower body muscles are not neglected either. A meaningful influence on flexibility development was not confirmed. Statistically significant differences compared to the control group were also confirmed. With controlled short-term interventions, physical fitness can be developed well, and varied PE classes can be created at the same time. Therefore, Street Workout could be an interesting alternative to gymnastics and a useful tool to develop the strength of prepubescent individuals.

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