

Article

The Impact of an 8-Weeks At-Home Physical Activity Plan on Academic Achievement at the Time of COVID-19 Lock-Down in Italian School

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Abstract: The purpose of this randomized controlled study was to investigate the efficacy of an 8-week exercise programme conducted in e-learning mode on high school students’ academic performance. The aim was to examine the changes in physical fitness and learning outcomes during the enforced period of lockdown caused by outbreak of the second wave of COVID-19 pandemic and the closure of schools in Italy. Thirty high-school students (14–15 years) were randomly assigned to an experimental group ($n = 15$) that performed an at-home workout programme (~60 min, twice a week), or a control group ($n = 15$) who received only a regular programme of theoretical lessons where no practice takes place. Both groups were synchronized in real-time with the physical education teacher. In order to assess students’ starting level and significant changes reached, at baseline and after training, a battery of standardized assessment motor tests (Standing long jump test, Harvard step test, sit and reach test, and butt kicks test), and an academic achievement test (Amos 8–15) were administered. In comparison to the control group at baseline and the end of the programme, the experimental group reported considerable improvements in motivation and concentration, significant anxiety reduction, and an increase in capacity to organize studying and to be more flexible. Moreover, it was possible to observe the efficacy of the workout to improve learning ability among practicing students ($p < 0.001$). No significant changes were found in the control group. The results suggest that a school-based exercise programme conducted online could be a powerful approach in order to achieve the best academic outcomes and for improving students’ physical fitness as well as their cognitive health.

Keywords: academic performance; physical activity; learning outcomes; e-learning; exercise



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1. Introduction

In recent years, the impact of daily physical activity upon academic performance is a concept that is gaining high importance, especially in the professional education system.

Physical activity is considered to be correlated with academic performance by many researchers. Multiple lines of empirical evidence [1–5] confirm that students performing additional physical activity present an improvement in cognitive functions and psychomotor development [6]. This growing body of research claims that physical activity may have a significant influence on academic performance across a multitude of cognitive, physiological, emotional, and learning factors, acting in a direct and indirect manner [3,7]. Engaging in high amounts of physical activity provides more effective brain activation when committing in cognitive tasks, higher inhibitory control, better working memory, and greater attention span [8].

Even a few minutes after the beginning of physical activity, students are more capable of hyper-focusing on classroom tasks, which may improve learning. As time passes, with

regular exercise, their better physical fitness could have a positive impact on academic results in certain fields, such as mathematics, reading, and writing [9,10]. It is hypothesised that this is mainly caused by a number of interacting neurobiological, psychological, and social mechanisms [11], such as increased hormones, increased self-esteem, and reduced stress and anxiety [12]. A higher level of physical activity might be able to supply new routes for faster and more pleasant learning of academic skills. Unfortunately, within the school context, even today instructional time dedicated for basic curricular subjects is increasingly extended to the disadvantage of physical education. It is often considered a secondary subject and is perceived by some teachers to be potential barrier to academic performance [4]. It is more and more common for, young people not to engage in any sport outside of school, meaning that it represents the only opportunity for children to participate in physical activity [13]. Consequently, the school should be a privileged place where the importance of physical activity is ceaselessly nurtured. Several reviews and reports in this area have been released over the last few years, largely concluding that a routine physical activity could be connected with enhanced cognitive benefits, classroom behavior, and academic performance among school age youth [14,15].

More attention should be paid to improved opportunities for physical activity, especially because the prevalence of weight gain is more related to physical inactivity than improper eating behavior alone [16]. Global estimates indicate that 27.5% of adults and 81% of adolescents fail to respect the 2010 World Health Organization (WHO) recommendations for physical activity. This circumstance of significantly decreased physical activity is all the more evident at an age range between 9 and 15 years [17]. The latest Guidelines on physical activity and sedentary behavior (2020), dictated by WHO [18], suggest practicing greater physical activity in terms of frequency, intensity and duration. Their aim is to offer significant physical and mental health benefits, in order to give greater value to a healthy weight and general well-being. It is widely acknowledged that physical activity during the span of life represents an important protective factor against numerous diseases. Children who properly engaged in the suggested level of physical activity build healthy bones and muscles, enhance muscular strength and endurance, reduce chronic disease risk factors, optimize self-esteem and their perceived sense of self-efficacy, and reduce stress and negative emotions [19].

Limited physical activity as a consequence of COVID-19 restrictions may be associated with unfavourable effects. Thus, maintaining a healthy lifestyle, which includes an adequate amount of physical exercise and a convenient alimentary regimen, should also be a priority, especially in a critical situation like this [20,21]. During quarantine, partaking in a regular physical activity routine at home, staying active, vigorous, and safe is essential for mental and physical health [22]. Furthermore, ensuring quality education and a quality lifestyle, also in terms of attention to health, is one of the most important objectives pursued by the UN 2030 Agenda for the realization of a sustainable society [23]. Schools and, in particular, physical education teachers need to become the main promoters of sustainability education, in order to obtain an integrated connection between health and physical education. In fact, students who engage in outdoor activity, learning about environmental aspects of personal safety, examining competition versus cooperation, in sport and in life, will be able to experience first-hand this transformative process necessary for achieving a better future [24].

Concerning that, previous studies have shown the connection between physical inactivity, improper diet, and consequently obesity [25]. There is ample evidence that the more time individuals spend in sedentary activities, the more likely they are to change their purchasing behavior concerning food, and they can significantly increase their weight [26]. Therefore, at a time in world history when people are called to answer difficult challenges and crucial responsibilities, overcoming interpersonal distance, concern, and reduction in physical activity has become an urgent necessity.

Since students are getting less and less active because of COVID-19 restrictions, it is of paramount importance to devise practical and efficient interventions to enhance

physical health, as well as cognitive health. On the other hand, Physical Education is the only school subject through which children can gain the necessary foundation to become physically active. The emergence of COVID-19 has severely changed the way of teaching physical education. In this respect, the main concern is about the practical and experiential nature of teaching and learning in Physical Education, which is addressed towards a much stronger online component. This new approach to learning will require new methods for student engagement, and both teachers and pupils will need to have positive behavior and the proper training to get ready to deal with this change as well as possible [27]. In fact, the most important international associations in the field, such as the European Physical Education Association (EUPEA) and International Motor Development Research Consortium (I-MDRC), insist that Physical Education curricular lessons must ensure the level and quality established prior to the crisis for all children with and without disabilities.

Therefore, to foster progression in this research field, the purpose of this study was to assess the impact of a Physical activity video classes programme on academic performance at the time when students must observe a forced rest because of COVID-19 confinement.

2. Method

2.1. Study Design

This research used a randomized controlled study design to examine the consequences of an 8-week exercise online programme on high-school students, forced to work from home due to the second wave of COVID-19 pandemic. The study was conducted online and included a series of supervised exercises performed for 8 weeks for the intervention group, and only a regular programme of theoretical lessons for the control group where no practice takes place. The evaluation regarded a total of 16 lessons during which participants were monitored at the 1st and 8th week. The acquisition of measurements was carried out 1 week before the beginning of intervention (pre-test) and at the end of it (post-test).

2.2. Participants

Thirty high-school students, aged 14–15 years (18 males and 12 females, age 14.53 ± 0.50 , mean \pm SD), were recruited to participate in the study.

Participation in the study was entirely on a voluntary basis and all students attending local high-school could access this study. Participant inclusion criteria were as follows: not having a health condition that could limit the ability to move, being able to performing a moderate-intensity aerobic exercise session, and abstaining from all physical activity not involving the study protocol during the full period of intervention. Exclusion criteria were the following: having an orthopedic condition limiting the ability to perform an exercises program, and not being able to abstain from all physical activities outside the study protocol during all of the intervention days. Forty-four subjects met the protocol selection criteria for participating in the program. Of those recruited, fourteen refused the invitation to participate in the study because they considered the program too demanding or due to their own personal reasons. Conversely, 30 subjects agreed to take part in the study and completed the protocol. Thus, the final sample selected was composed of 30 subjects, 12 females and 18 males, who carried out the assessments at baseline and at the end of the intervention. Each of them were randomly assigned to the experimental group or to the group receiving only theoretical physical education lessons, as the control. Consequently, the experimental group was composed of 7 males and 8 females, while the control group was composed of 10 males and 5 females. The selected subjects had the same socio-economic background, educational level, and similar lifestyle conditions. Moreover, they had at baseline similar results in the assessment motor tests and shared academic achievement level, in order to avoid negative affects on the final findings.

Attendees were sent an e-mail containing information about the study 7 days before the start of the programme. Written informed consent was secured from all participants' parents prior to study enrolment and all parents gave their approval for the performance of the practical classes by them carefully overseen. The researchers ensured the anonymity

of the participants. The study was conducted from October 2020 to December 2020, in accordance with the Declaration of Helsinki. The Department of Basic Medical Sciences, Neurosciences, and Sensory Organs—Sports Science Section—at the University of Bari “Aldo Moro” and the Department of Clinical and Experimental Medicine, at the University of Foggia, did not consider approval of the Ethics Committee necessary for this study because the research did not provide any clinical, health, or biological treatments.

2.3. Procedures

The intervention was administered online using the G-suite for Education platform, during normal school lessons, carried out through distance teaching (in synchronous mode). The measurements and tests were administered at school. It was possible because, despite the epidemiological emergency period, the Italian Ministry of Education allowed the activities to be carried out in person by summoning the students in small groups and in line with safety precautions.

All two groups attended an online classroom twice per week and received 60 min each day of supervised training (EG) or theoretical knowledge (CG), under carefully monitored and controlled conditions. Before study participation, the subjects were given a battery of standardized assessment motor tests and an academic achievement test. The test battery included the Standing long jump test, Harvard step test, sit and reach test, and butt kicks test. Concerning academic achievement, the test used was the Amos 8–15. Moreover, we examined associations between Body mass index (BMI) and lifestyle (active/sedentary).

Participants completed the tests immediately before and after the intervention, with the objective of ensuring pre- and post-testing data connection and to assess the impact of the intervention. The extrapolated data from initial and final tests were collected at the same time of day and under the same experimental conditions. The participants were divided into two groups and physical testing took 30 min for each of them. All students were tested individually and each motor task item was explained before starting. On the day of the first training session, a meeting was held in order to explain the content of the exercise program and verify the motivation of every single student. On the same occasion, it was communicated to participants that the control group would receive the study intervention in a delayed manner. However, despite the control group subjects abstaining from the physical activity program during the experimental period, they were constantly encouraged to remain active on their own in their daily life.

Moreover, students were urged not to ingest stimulating food or soft drinks before testing, but they were asked to continue with their normal intake of foods. They wore sports shoes and clothing suitable for physical activity during the whole intervention program. An experienced Physical Education teacher instructed, performed, and supervised the entire at-home workout program and all measurements for testing.

2.4. Measures

2.4.1. Motor Tests

The evaluation included four physical fitness tests as shown below:

1. Standing long jump test, a valid, reliable and easy to administer test used to assess explosive leg power [28].
2. Harvard Step test, a test used to measure endurance [29].
3. Sit and reach test, a common measure of flexibility of the lower back and hamstring muscles. It requires three measurements, and the score is the average reached by the three distances [30].
4. Butt kicks test, a test used to measure the athlete's speed of movement execution [31].

The physical fitness tests were conducted for both the EG and CG at the beginning and end of the intervention program.

2.4.2. Body Mass Index (BMI)

Body mass index (BMI) is a simple and practical method of screening used to determine weight categories (underweight, normal weight, overweight, and obese) and the level of fat accumulation that might cause health problems [32]. It is a worldwide measure expressed through the relationship between weight (kilograms) and height (meters). In children it is calculated in a similar manner as for adults, but rather than using fixed thresholds, it is converted to percentiles in order to extrapolate the approximate position of the child's BMI number compared to children of the same sex and age [33].

2.4.3. Amos 8–15 Questionnaire

The Amos 8–15 [34] is a test battery meant for the Italian cultural context. It is designed to assess study skills as well as motivational aspects of the students from 8 until 15 years of age. The test battery includes a series of objective tests and questionnaires that require students to analyze their approach to the study, use of strategies for the study, beliefs about oneself as student, and accidental attributions about both success and failure events. Specifically, it includes the following:

1. Study approach questionnaire (QAS);
2. Study strategies questionnaire (QS1 e QS2);
3. Convictions questionnaire (QC1I, QC2F, QC3O) and attributions questionnaire (QCA);
4. Objective study tests.

The operator can choose to use all of them, some specific ones, or just one. In this study, Authors decided to use the Study approach questionnaire (QAS), and the Objective study tests.

Study Approach Questionnaire (QAS)

The Study approach questionnaire is an invaluable tool that evaluates the different components of the student's study approach. It consists of 49 items divided into 7 areas (7 items for each area, 5 positive and 2 negative, except for the Anxiety Area that is composed of 2 positive and 5 negative). Those areas include 1. Motivation; 2. Organization; 3. Didactic material development; 4. Study flexibility; 5. Concentration; 6. Anxiety; 7. Attitude towards school.

The response scale involves a 3-point "Likert-type", ranging from 1 (disagree) to 3 (strongly agree). The score is calculated for each area separately. If a respondent's Study approach questionnaire score increased, it suggests they experienced an appropriate approach to the study. The time required to fulfill the test was between 15 and 20 min (it includes instruction and practice phases). The assessment protocol was administered before the beginning of the intervention and at the end of the exercise program, with the purpose of evaluating any changes.

Objective Study Tests

This is an assessment tool that checks the student's ability to understand and memorize. This test requires to learn a text for 30 min each one individually. Participants can use their usual study habits. At the end of the study phase, there was a 15-min break. Next, participants carried out 3 different tests:

1. Choice of titles: this measures the student's ability to identify the most important events in the text. They should select, from an 8-title list, the 3 most meaningful. The system for calculating the score uses 1 point for each valid title.
2. Open questions: the student is asked to answer 6 open questions about the text studied. The system for calculating the score uses 1 to 3 points to assess the accuracy of the response.
3. True/False questions: the student is asked to answer true or false to 12 questions. They evaluate the student's ability to understand and remember specific information.

The system for calculating the score uses 1 point for each correct answer, 0 points for an answer not given, and −1 for each incorrect answer.

The sum of the scores obtained for each test determines the overall final score. The time required to fulfill the test was between 75 and 90 min, (it includes instruction and practice phases). The assessment protocol was administered before the beginning of the intervention and at the end of the exercise program, with the purpose of evaluating any changes.

2.4.4. Grades

The school board allowed access to student's grades at the end of each term time. They were the results of tests and examinations prepared and administered according to the ministerial guidelines. The numeric scale of the grades ranged from 1 to 10.

2.4.5. Exercise Training Intervention

This eight-week training programme was conceived for students to boost strength, stay fit, and feel healthy. It is made up of bodyweight and cardiovascular moderate-intensity exercises to be completed each week. Consistency was the core of this approach. This workout was designed for beginners, but it could be modified for all fitness levels. No equipment or gym was required. Most body-weight exercises could be completed indoors within a confined space (i.e., burpees, air squats, and push-ups). The goal was to transition from a sedentary lifestyle to an active lifestyle, and to help students better overcome the periods of lockdown and restricted movement. It was also thought to remove problems that sometimes come along with resuming exercise activity. The intent was to build an exercise habit in order to improve cardiovascular health and muscular endurance by engaging in consistent practice. Every body-weight exercise involved utilized multiple muscle groups, got the heart rate pumping, and burned calories. The first week of the routine was a total-body workout to kick-start metabolism and perfect muscle moves. Over the following weeks, the complexity and resistance were increased and the routine was focused on strength and cardiovascular exercises. During weeks one and two, rest periods were granted ranging from 90 s and two minutes, between each set. Over the following weeks, rest periods were reduced to one minute. When training involved the use of dumbbells, these were replaced by water bottles or something else present in the house.

The workout routine started with a 10 min warm-up sequence. The purpose of the warm-up was to prepare the student mentally and physically for the conditioning exercises that followed and to reduce the risk of injury. The warm-up included the following exercises: marching in place, wide toe touch, leg swings, arm swings, half jacks, chest expansions, torso rotation, alt back expansions, shoulder rotations, hops on the spots, single-leg hops, hip rotations, walking jacks, hip circles, walking knee hugs, side shuffles, inchworms, light punches, and karaoke.

Later, the main workout exercises included 40 min of a sequence of movements that involved rotation, abduction, and extension of body parts. This training plan was aimed at improving the strength, resistance, and flexibility of the body. It was designed to improve musculoskeletal prowess, cardiovascular competence, as well as the development of different psychomotor abilities (Tables 1 and A1).

Each training session ended with a brief full-body cool-down exercises (10 min). It consisted in a sequence of static stretching exercises which included glute stretch, standing quad stretch, piriformis stretch, side bench stretch, arm-cross shoulder stretch, overhead triceps stretch, lower back stretch, abdominal stretch, and child's pose, lunge with spinal twist, 90/90 stretch, frog stretch, butterfly stretch, seated shoulder squeeze, lunging hip flexor stretch, lying pectoral stretch, knee to chest stretch, and seated neck release. It was important for muscle relaxation and the improvement of joint range of motion.

Table 1. Home workout plan: main exercises.

Week	Main Exercise
1	Complete 2 sets of 12 repetitions: Jumping rope, skaters, jumping jacks, standing x crunches, chair squats, knee push-ups, knee planks (hold for 20 s), standing shoulder presses, forward lunges, step-ups, sit-ups, donkey kicks.
2	Complete 2 sets of 12 repetitions: Lateral toe taps, mountain climbers, side reach jacks, reverse lunges, squats, bicep curls, plank and drag (hold for 20 s), tricep dips, hip bridges, russian twists, crunches, half burpees.
3	Complete 2 sets of 15 repetitions: High knees, criss-cross jacks, x hops, alternating lateral lunges, squat punches, full plank (hold for 30 s), push-ups and reach, single-arm rows, straight leg jackknives, single-leg glute bridges, overhead seated leg lifts, burpees.
4	Complete 2 sets of 15 repetitions: Lateral shuffle floor taps, bench runners, sit-outs, punch jacks & knee pumps, walking plank (hold for 30 s), triceps overhead extensions, T push-ups, raised-leg sit-ups & claps, half burpees & plank jacks, straight-leg sit-ups, walking lunges, sumo squats.
5	Complete 2 sets of 15 repetitions: Banded vertical jacks, fast-feet drops, knee pumps to overhead jacks, shoulder tap plank (hold for 40 s), alternate V-sits, Burpees 180° Jumps, leg lifts, diagonal squats, hip thrust single-arm reaches, hover leg extensions, walking push-ups, scissors.
6	Complete 3 sets of 15 repetitions: X mountain climbers, knee to elbow-toe touches, beast shoulder taps, dumbbell thrusters, lay-down push-ups, walkout burpees, wall hip thrusts, bicycle crunches, bottoms-up lunges, hip drive step-ups, rear-foot-elevated split squats, flutter kicks.
7	Complete 3 sets of 15 repetitions: Running in place, power skips, star jumps, drop squats, plyometric woodchoppers, x plank (hold for 50 s), hip thrusts, side step-ups, knee-tap burpees, bent-leg raises, heel taps, pike push-ups.
8	Complete 3 sets of 15 repetitions: Fast feet, broad jumps, spiderman burpees, side plank & hold (hold for 60 s), dumbbell seesaw presses, knee back to knee raises, reaching oblique crunches, marching hip lifts, single-leg sit-to-stands, dumbbell squatscleans, single-leg deadlifts, glute-bridges and hamstring rolls, ab rollbacks.

2.4.6. Statistical Analysis

The statistical analyses were carried out through SAS JMP Statistics (Version <15.1>, SAS Institute Inc. Cary, NC, USA, 2020). Data generated were shown as group mean values and standard deviations. They also were checked for assumptions of homogeneity of variances (i.e., Levene test). Using the Shapiro–Wilk test procedure the normality of all variables was tested. An independent sample *t*-test was performed to establish the baseline differences among the groups in all considered variables. A two-factor ANOVA analysis (group experimental/control) \times time (pre/post intervention), was effected to analyze the impact of the intervention program on all investigated factors. Likewise, a group-specific post hoc test (paired *t*-test) was used to pinpoint the significant levels of interaction reached. To estimate the magnitude of the variation among each group partial eta squared (η^2_p) was applied. The following criteria was used to interpret it: small ($\eta^2_p < 0.06$), medium ($0.06 \leq \eta^2_p < 0.14$), large ($\eta^2_p \geq 0.14$). Lastly, Cohen's *d* was useful to identified effect sizes (ES) for the pairwise comparisons. It was interpreted as small, moderate, and large effects defined as 0.20, 0.50, 0.80, respectively [35]. Statistical significance was set at $p \leq 0.05$.

Results

The training program was completed by all participants. They were given the treatment conditions as planned and none of them reported injuries. Both the two groups (EG and CG) shared the same characteristics at baseline, with regard to age and anthropometric and psychological measures ($p > 0.05$) (Table A2). Table 2 presents pre- and post-intervention results for all dependent measures.

Table 2. Changes in physical fitness and study abilities after an 8-week at-home workout plan.

	Experimental Group (<i>n</i> = 15)			Control Group (<i>n</i> = 15)		
	Baseline	Post-Test	Δ	Baseline	Post-Test	Δ
Motor Tests						
<i>Standing long jump test</i>	1.5 (0.11)	1.57 (0.10) †*	0.06 (0.03)	1.46 (0.09)	1.44 (0.09)	−0.01 (0.02)
<i>Harvard step test</i>	74 (4.14)	81.73 (5.36) †*	7.73 (3.41)	76.53 (3.29)	72.73 (6.09)	−3.8 (4.64)
<i>Sit and reach test</i>	18.93 (2.31)	23.33 (2.66) †*	4.4 (1.29)	18.8 (2.04)	17.06 (2.25)	−1.73 (1.86)
<i>Butt kicks test</i>	82.8 (11.71)	92.2 (12.32) †*	9.4 (4.82)	82.86 (11.55)	78.33 (9.61)	−4.53 (6.82)
Amos 8–15—QAS Questionnaire						
<i>Motivation</i>	15.6 (1.50)	18.66 (1.58) †*	3.06 (1.43)	15.33 (1.39)	14.53 (1.55)	−0.8 (1.26)
<i>Organisation</i>	15.2 (1.37)	18.2 (1.74) †*	3 (1.69)	15.26 (1.27)	14.8 (1.56)	−0.46 (1.24)
<i>Didactic material development</i>	15.66 (1.34)	15.46 (1.68)	−0.2 (1.47)	15.93 (1.53)	15.73 (2.25) 2.25	−0.2 (1.85)
<i>Study flexibility</i>	15.73 (1.62)	18.53 (1.76) †*	2.8 (1.82)	14.93 (1.16)	14.33 (1.34)	−0.6 (0.98)
<i>Concentration</i>	14.33 (1.54)	18.06 (1.83) †*	3.73 (1.70)	14.2 (1.65)	14.06 (1.33)	−0.13 (1.18)
<i>Anxiety</i>	18.26 (1.66)	15.06 (1.90) †*	−3.2 (1.52)	18.2 (1.56)	19.13 (1.35)	0.93 (1.22)
<i>Attitude towards school</i>	15.53 (1.59)	15.26 (1.86)	−0.26 (1.09)	15.93 (1.03)	15.46 (1.59)	−0.46 (1.35)
Amos 8–15—Objective Study Tests						
<i>BMI percentile median (QR) Ω</i>	74.00 (13.55)	67.86 (15.21) †*	−6.13 (5.12)	61.83 (20.61)	67.47 (16.52)	5.63 (5.82)

Note: values are presented as mean (± SD); Δ: pre- to post-training changes; † Significant ‘Group × Time’ interaction: significant effect of the intervention ($p < 0.001$). * Significantly different from pre-test ($p < 0.001$); Ω BMI percentile indicates the relative position of the child’s BMI number among children of the same sex and age.

Motor Tests

A two-factor repeated measures ANOVA found significant ‘Time x Group’ interaction for the all four Motor tests performed: Standing long jump test ($F_{1,28} = 54.25$, $p < 0.001$, $\eta^2_p = 0.66$, large effect size), Harvard Step test ($F_{1,28} = 60.03$, $p < 0.001$, $\eta^2_p = 0.68$, large effect size), Sit and Reach test ($F_{1,28} = 108.91$, $p < 0.001$, $\eta^2_p = 0.79$, large effect size), and Butt kicks test ($F_{1,28} = 41.71$, $p < 0.001$, $\eta^2_p = 0.59$, large effect size). Post hoc analysis revealed that the experimental group significantly increased test scores from pre- to post-test in the Standing long jump test ($t = 7.42$, $p < 0.001$, $d = 1.91$ large effect size), Harvard Step test ($t = 8.78$, $p < 0.001$, $d = 2.26$, large effect size), Sit and Reach test ($t = 13.12$, $p < 0.001$, $d = 3.38$, large effect size), and Butt kicks ($t = 7.54$, $p < 0.001$, $d = 1.94$, large effect size). No significant changes were found for the control group ($p > 0.05$).

BMI

A significant ‘Time x Group’ interaction was also found for Body Mass Index ($F_{1,28} = 34.53$, $p < 0.001$, $\eta^2_p = 0.55$, large effect size). Post hoc analysis revealed that the experimental group significantly decreased in BMI from pre- to post-test ($t = 4.63$, $p < 0.001$, $d = 1.19$ large effect size). No significant changes were found for the control group ($p > 0.05$).

Study Approach Questionnaire QAS

A significant ‘Time x Group’ interaction was also found for Motivation ($F_{1,28} = 61.16$, $p < 0.001$, $\eta^2_p = 0.68$, large effect size), Organization ($F_{1,28} = 40.88$, $p < 0.001$, $\eta^2_p = 0.59$, large effect size), Study flexibility ($F_{1,28} = 40.46$, $p < 0.001$, $\eta^2_p = 0.59$, large effect size), Concentration ($F_{1,28} = 30.09$, $p < 0.001$, $\eta^2_p = 0.51$, large effect size), and Anxiety ($F_{1,28} = 67.27$, $p < 0.001$, $\eta^2_p = 0.70$, large effect size). The post hoc analysis revealed that the experimental group significantly increased scores from pre- to post-test in Motivation ($t = 8.26$, $p < 0.001$, $d = 2.13$, large effect size), Organization ($t = 6.87$, $p < 0.001$, $d = 1.77$, large effect size), Study flexibility ($t = 5.95$, $p < 0.001$, $d = 1.53$, large effect size), and Concentration ($t = 8.45$, $p < 0.001$, $d = 2.18$, large effect size). In the same way, experimental group showed a significant decrease in Anxietyscore ($t = -8.14$, $p < 0.001$, $d = 2.10$, large effect size). After

8 weeks of the intervention program, there were no significant “Time x Group” interactions in Didactic material development and Attitude towards school ($p > 0.05$). No significant changes were found for the control group ($p > 0.05$).

Objective Study Tests

A two factor repeated measure ANOVA found significant “Time \times Group” interaction effects for Objective Study Tests ($F_{1,28} = 101.32$, $p < 0.001$, $\eta^2_p = 0.78$, large effect size). The post hoc analysis revealed that the experimental group significantly increased scores for Objective Study Tests ($t = 12.10$, $p < 0.001$, $d = 3.27$, large effect size) in the intervention group after 8 weeks, whereas no significant changes were found for the control group ($p > 0.05$).

3. Discussion

This study aimed to investigate the effects of a physical activity at-home program on academic achievement at the time of the COVID-19 lock-down. Two groups of students participated in 60 min of a workout program or physical education theoretical knowledge, respectively, and afterwards performed one standardized questionnaire of cognitive functioning. In this work, the results revealed that, after an 8-week workout program, students who practiced the exercise plan had markedly better academic performance than those not recruited in the experimental intervention program, as a result of greater levels of physical activity gained over the course of exercise sessions.

The first significant finding of this work involved the positive effect that the workout program had on motivation and concentration in the treatment group. This supports the idea that the rise in physical activity throughout school hours could lead arousal and reduce boredom, and at the same time contribute towards an augmented attention span and concentration [36,37]. Shephard and Lavalley (1994) [38] also argued that higher physical activity levels might be linked to the growth of self-esteem, which would enhance both classroom behavior and academic performance. Moreover, it was possible to observe significant anxiety reduction. This disclosure was in keeping with previous research indicating that exercise can decrease symptoms of stress and depression related to anxiety, raise enjoyment, and promote academic achievement [39]. By lowering this load, increased working memory become accessible, allowing students to execute school tasks. Conversely, it is considered that worries and negative emotions generated from anxiety are able to inhibit working memory, thus reducing the students’ resources helpful for learning [40]. Thus, regular exercise could decrease the symptoms and consequences of quarantine-induced anxiety and depression through its positive neuroprotective effects [41].

Another important finding which positively connects workout with academic achievement pertained to the increase in capacity to organize study and to be more flexible. This result stemmed from the advantages provided by exercise. In fact, a large body of research has demonstrated that people who consistently train show greater problem solving and decision-making capabilities [42,43].

Nevertheless, the greatest finding of this research was the demonstration of the efficacy of workouts to improve learning ability among students practicing. Compared with controls, the experimental group reported significant improvements in learning outcomes upon completion of an 8-week workout intervention. In line with previous literature, we suggest that this result was a consequence of a better concentration and attention span [44,45], better working memory [46], reduction of anxiety, greater motivation, higher capacity to organize the study and reduced off-task behaviors [47,48].

Interestingly, most research showed that exercise can improve children’s academic outcomes, because at the end of physical activity sessions they respond more rapidly and with higher accuracy to different cognitive tasks (i.e., on-task behavior, executive function skills, and academic achievement) [49–53]. Further, it has been shown that physical activity mediates improvements in academic performance because it can permit the allocation of neural resources underpinning performance on a working memory task [54,55]. Further-

more, a positive association between BMI and an active lifestyle was observed in this study. In fact, students who improved their body mass index were also those who reported best grades, enhancing at the same time their health. On the other hand, students following the theoretical lessons were those who showed an increase in BMI and, consequently, a worsening of physical conditions and school grades. Most probably, we assumed that it was due to a lack of physical activity and sedentary lifestyle leading to poor habits and improper eating behavior. This negative connection between physical inactivity, weight gain, and school failure are possibly clarified by lifestyle factors related to energy and metabolic balance, and to changes in health behaviors [56]. A range of studies [57–59] agreed that a sedentary lifestyle during childhood affects both physical and cognitive health.

Lastly, it was interesting to note that many students refused to be part of the study when invited to participate. Our main explanation is that the young generation prefers a different mode of interaction, by choosing to stay comfortably seated behind a screen instead of practicing physical exercises. This situation was further aggravated during the restriction period. With a view to overcoming the problem, schools experimented with an educational alliance with families and institutions in order to promote health through physical education, especially at this critical time [60]. In this regard, the active school model was revised and adjusted through the pursuit of an intersection between physical education, families, and community.

In connection with the issues raised, these results were consistent with previous research corroborating the existence of a positive relationship between an active lifestyle and academic performance [61–64]. Especially with the outbreak of the Coronavirus emergency and the closure of all schools, at-home exercises provided numerous advantages. Various researches in this field have demonstrated that enforced sedentary behavior brought both negative feelings and moods in healthy people within seven days [65]. Moreover, as pupils were ever more sedentary and less trained because of lockdown, introducing robust interventions to enhance metabolic, cardiovascular, and cognitive health was of fundamental importance. Thus, teachers and educators should cooperate in order to incorporate physical activity into children's daily routine and promote healthy movement practices in alignment with the global movement behavior guidelines [66]. In accordance with the latest scientific studies, physical activity is able to affect academic performance via different direct and indirect physiological, cognitive, emotional, and learning factors [67–70], thereby opportunities for children to maintain a steady pace of training should be provided by the school [56]. Esteban-Cornejo et al. (2020) [59] suggested the adoption of a school-based active approach, including more frequent Physical Education lessons, for the purpose of enhancing brain health, and executive function, as well as academic performance. In fact, the promotion of daily physical activity and favouring an active lifestyle have been shown to increase children's concentration and attention. Furthermore, leading an active lifestyle is a convenient and practical way to improve children's psychophysical well-being, classroom behavior, and academic outcomes. In relation to these arguments it is possible to establish that the findings of the research available support our idea, as pupils had considerably enhanced their psychophysical well-being and academic performance following the workout intervention.

Although the evidence concerning the significant connection between physical activity and school outcomes, in this study some limitations were present. The first is related to the small sample size ($n = 30$), generated by problems in recruiting motivated students to participate or difficulties associated with the use of the technological devices. Furthermore, the sample was drawn from a population of students at a local public school located in a small district. Thus, the results may not be generalizable to students from other schools or with other backgrounds. Nevertheless, this work represents a pilot study that had only the ambition to be an opening research for future study on this topic. Lastly, this study was conducted towards the end of the first quarter of school, thus it can be assumed that participants were a highly motivated group who wanted to improve their academic performance in view of the quarterly report card. This might have affected the final

results. Additional limitations concerned the fact that we did not evaluate the long-term effects of the workout on cognitive skills. Future study would need to investigate these opportunities with the aim of clarifying these variables. Nonetheless, the findings achieved could provide important indications for future research. Therefore, the strengths of this study were represented by the revolution that this simple and effective approach brings to academic performance as well as physical and cognitive health among school-aged youth. In fact, once past the first days of confusion, demotivation, and laziness, students were more involved with learning in lockdown, away from the 'chaos' of the classroom. Physical education practice through remote learning has proved to be engaging and it was a convenient way to get out of the daily routine. As the lockdown weeks passed, the pupils, encouraged by their steady sense of accomplishment and supported by the improvement of their regular academic rewards, became organized and punctual. Also, the pupils who previously needed to be constantly spurred to participate and join the class became those who interacted better. Thus, Educational Institutions must admit the significance of this advantageous intervention strategy, recognising that Physical Education may be an effective approach for health promotion among students. Against this background, most European countries have wondered about the ways of promoting of physical education. Concerning that, there has been resistance on a normative and organizational plane, above all linked to qualification of teachers [71], which becomes, now more than ever, an essential promotion strategy which shall be revised periodically. Fortunately, in some European countries the training of teachers has been implemented [27]. In addition, the increase in the number of hours dedicated to this subject, and building concrete and consistent programs with the growing need for movement of the new generations (also with a focus on attractive programs that combine physical activity with technologies—such as apps, video resources and exergames), represent all together the most effective way to promote physical education.

4. Conclusions

Lockdown to contain the spread of the second wave of COVID-19 pandemic has obliged Italian school education to face several challenges. The COVID-19 pandemic, as a result of its incomparable risk and one-of-kind response strategy, has had a negative and dramatic impact on youth's physical fitness as well as academic performance, particularly for those who have not practiced physical activity. With the second wave outbreak of the Coronavirus emergency and the closure of schools in Italy, to facilitate learning, lessons were organized remotely. Thanks to online physical education teaching, however, pupils were able to still attend their practice virtually and effectively to support their learning during the closure period.

As children were becoming increasingly sedentary and unfit during the closure period, it was important to be able to identify potentially effective interventions and low-cost strategies for improving metabolic, cardiovascular, and cognitive health for school-age children. A school-based physical activity programme conducted online could be a powerful approach, in order to achieve these aims. However, this work represents a pilot study that had only the ambition to be an opening research for future study on this topic. On the other hand, physical education in schools remains the most important way to promote the interpersonal relationship and educational process between teacher and pupil through the variations of both teaching styles and strategies.

Thus, several questions remain to be answered, for example to be able to establish the optimal type, intensity, and timing of school physical education, and how on-line different teaching approaches might influence the effects of the physical activity on cognitive learning. Therefore, it would be important that future study should focus on whether to offer students new strategies monitored for a longer time.

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Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

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Appendix A

Table A1. Home workout plan: main exercises.

Week	Main Exercise
1	Complete 2 sets of 12 repetitions: Jumping rope, skaters, jumping jacks, standing x crunches, chair squats, knee push-ups, knee planks (hold for 20 s), standing shoulder presses, forward lunges, step-ups, sit-ups, donkey kicks.
2	Complete 2 sets of 12 repetitions: Lateral toe taps, mountain climbers, side reach jacks, reverse lunges, squats, bicep curls, plank and drag (hold for 20 s), tricep dips, hip bridges, russian twists, crunches, half burpees.
3	Complete 2 sets of 15 repetitions: High knees, criss-cross jacks, x hops, alternating lateral lunges, squat punches, full plank (hold for 30 s), push-ups and reach, single-arm rows, straight leg jackknives, single-leg glute bridges, overhead seated leg lifts, burpees.
4	Complete 2 sets of 15 repetitions: Lateral shuffle floor taps, bench runners, sit-outs, punch jacks & knee pumps, walking plank (hold for 30 s), triceps overhead extensions, T push-ups, raised-leg sit-ups & claps, half burpees & plank jacks, straight-leg sit-ups, walking lunges, sumo squats.
5	Complete 2 sets of 15 repetitions: Banded vertical jacks, fast-feet drops, knee pumps to overhead jacks, shoulder tap plank (hold for 40 s), alternate V-sits, Burpees 180° Jumps, leg lifts, diagonal squats, hip thrust single-arm reaches, hover leg extensions, walking push-ups, scissors.
6	Complete 3 sets of 15 repetitions: X mountain climbers, knee to elbow-toe touches, beast shoulder taps, dumbbell thrusters, lay-down push-ups, walkout burpees, wall hip thrusts, bicycle crunches, bottoms-up lunges, hip drive step-ups, rear-foot-elevated split squats, flutter kicks.
7	Complete 3 sets of 15 repetitions: Running in place, power skips, star jumps, drop squats, plyometric woodchoppers, x plank (hold for 50 s), hip thrusts, side step-ups, knee-tap burpees, bent-leg raises, heel taps, pike push-ups.
8	Complete 3 sets of 15 repetitions: Fast feet, broad jumps, spiderman burpees, side plank & hold (hold for 60 s), dumbbell seesaw presses, knee back to knee raises, reaching oblique crunches, marching hip lifts, single-leg sit-to-stands, dumbbell squatscleans, single-leg deadlifts, glute-bridges and hamstring rolls, ab rollbacks.

Table A2. Changes in physical fitness and study abilities after an 8-week at-home workout plan.

	Experimental Group (<i>n</i> = 15)			Control Group (<i>n</i> = 15)		
	Baseline	Post-Test	Δ	Baseline	Post-Test	Δ
Motor Tests						
<i>Standing long jump test</i>	1.5 (0.11)	1.57 (0.10) †*	0.06 (0.03)	1.46 (0.09)	1.44 (0.09)	−0.01 (0.02)
<i>Harvard step test</i>	74 (4.14)	81.73 (5.36) †*	7.73 (3.41)	76.53 (3.29)	72.73 (6.09)	−3.8 (4.64)
<i>Sit and reach test</i>	18.93 (2.31)	23.33 (2.66) †*	4.4 (1.29)	18.8 (2.04)	17.06 (2.25)	−1.73 (1.86)
<i>Butt kicks test</i>	82.8 (11.71)	92.2 (12.32) †*	9.4 (4.82)	82.86 (11.55)	78.33 (9.61)	−4.53 (6.82)
Amos 8–15—QAS Questionnaire						
<i>Motivation</i>	15.6 (1.50)	18.66 (1.58) †*	3.06 (1.43)	15.33 (1.39)	14.53 (1.55)	−0.8 (1.26)
<i>Organisation</i>	15.2 (1.37)	18.2 (1.74) †*	3 (1.69)	15.26 (1.27)	14.8 (1.56)	−0.46 (1.24)
<i>Didactic material development</i>	15.66 (1.34)	15.46 (1.68)	−0.2 (1.47)	15.93 (1.53)	15.73 (2.25)	−0.2 (1.85)
<i>Study flexibility</i>	15.73 (1.62)	18.53 (1.76) †*	2.8 (1.82)	14.93 (1.16)	14.33 (1.34)	−0.6 (0.98)
<i>Concentration</i>	14.33 (1.54)	18.06 (1.83) †*	3.73 (1.70)	14.2 (1.65)	14.06 (1.33)	−0.13 (1.18)
<i>Anxiety</i>	18.26 (1.66)	15.06 (1.90) †*	−3.2 (1.52)	18.2 (1.56)	19.13 (1.35)	0.93 (1.22)
<i>Attitude towards school</i>	15.53 (1.59)	15.26 (1.86)	−0.26 (1.09)	15.93 (1.03)	15.46 (1.59)	−0.46 (1.35)
Amos 8–15—Objective Study Tests						
<i>BMI percentile median (QR) Ω</i>	74.00 (13.55)	67.86 (15.21) †*	−6.13 (5.12)	61.83 (20.61)	67.47 (16.52)	5.63 (5.82)

Note: values are presented as mean (±SD); Δ: pre- to post-training changes; † Significant 'Group × Time' interaction: significant effect of the intervention ($p < 0.001$). * Significantly different from pre-test ($p < 0.001$); Ω BMI percentile indicates the relative position of the child's BMI number among children of the same sex and age.

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