

STUDY PROTOCOL

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Effect of the PROFIT-BR exercise program on physical fitness of children: a protocol study

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Abstract

Background Considering that school environments are important and have the potential to promote an active lifestyle with direct impacts on physical, motor, cognitive, affective, and psychological aspects, the objective of this study was to evaluate the effect of a physical exercise program in the school context.

Methods A parallel, two-arm experimental research project carried out over 19 weeks, with two non-consecutive weekly classes of 60 min, with the inclusion of PROFIT-BR in the initial 15 min of the class followed by 40 min based on specific physical education skills on indicators of physical fitness in children. Estimates of excess weight and visceral fat will be measured and assessed by body mass index and waist-to-height ratio, respectively, and cardiorespiratory fitness by performance in the six-minute run/walk test. Flexibility will be assessed by the sit and reach test; and muscle strength measured by the number of sit-ups in one minute. The 2 kg medicine ball throw and the horizontal jump will be used to measure upper and lower limb power, respectively, the square test used as a measure of agility, and the 20-meter run test used to measure speed. To analyze the differences between baseline and post-intervention values, repeated measures ANOVA adjusted for somatic maturation will be used. The magnitude of the effect size will be estimated by “partial eta squared”. Statistical analyses will be carried out using SPSS version 24.0 software and a 5% probability of error in the analyses will be accepted.

Discussion The main theoretical assumption of the proposal is the cause-and-effect relationship between the regular practice of physical exercise in childhood and adolescence and several parameters of health and motor performance. The elaborated program has a lot of applicability because it was wondering from the perspective of the school, in terms of materials, space, and objectives of physical education.

Keywords Physical education, School, Exercise training, Children, Adolescent

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Introduction

School is one of the potential environments for promoting physical activity in children and adolescents. However, evaluations of physical education classes in Brazil have shown low active participation of students and a high rate of school dropout in this curricular component [1]. Furthermore, despite the increased extracurricular sports observed after a decade of mega-events in Brazil (2007–2017), only 30–40% practice sports regularly [2].

In such a way that, in this same period, approximately 50% of Brazilian children and adolescents presented an expectation of “weak and reasonable” skill-related physical fitness [3], and were classified as having inadequate levels of health-related physical fitness [4], a situation that continued over the following years [5]. Even with an adverse scenario, school environments are important and potential to promote an active lifestyle through the practice and policies to encourage healthy behavior.

In this way, the inclusion in physical education (PE) classes of exercises that guarantee efforts whose duration and intensity are favorable to the improvement of physical fitness components can be a promising strategy for health promotion [6]. Low levels of muscle fitness imply physical, psychosocial, emotional, and behavioral risk factors, in addition to boosting physical inactivity and increasing time spent in sedentary behavior [7, 8].

Evidence has highlighted that participation in physical exercises purposely designed to improve physical fitness components during childhood and adolescence has a positive association between motor competence and physical activity [9], muscle health and fitness [10], the perception of competence [11], and weight control [12]. Faigenbaum & MacDonald [7] point out that adequate levels of muscle fitness are necessary for participation in play and games, as well as sports participation. That is, children and adolescents who have low physical fitness lack a fundamental basis for performing different skills, which leads to a low perception of motor competence and, consequently, non-engagement in physical activity and physical exercise.

In this sense, after a review [13], it was shown that programs that seek to improve “fundamental movement skills” should offer physical exercise of moderate to vigorous intensity in a way regular 2–3 times a week to first build a foundation by developing motor competence and then build on those skills to enrich sport-specific skill sets. Thus, as more children and adolescents become involved in physical exercise programs for school physical education, it is important to establish safe and effective guidelines by which exercise can improve the health, fitness, and sports performance of younger populations.

The present study consists of research, developed within the scope of physical education and a research group that develops investigations with an

epistemological approach, of interventions in physical education and modulation in sports performance in Brazil, to propose, starting from a diagnosis of the problem situation, a systematized, viable and easy-to-apply strategy, with a minimum of sophisticated and easily accessible materials, helping physical education teachers through a method. Given the above, this study aimed to present the theoretical basis used to develop a physical exercise program protocol (PROFIT-BR) to assist physical education teachers in different contexts.

Methods

This study outlines the methodology for a parallel, two-arm experimental research project. The research will be conducted with students who are currently enrolled in 1st to 5th-grade classes at an elementary school located in a Southern city in Brazil. The study protocol was reported following SPIRIT [14] recommendations, was registered (CAAE 12221918.8.0000.5347), and approved by the Research Ethics Committee of the Federal University of Rio Grande do Sul under opinion 3.460.288.

This will be a quasi-experimental study carried out with a convenience sample. The school was selected due to a pre-existing agreement with the University, based on mandatory internships in the undergraduate curriculum in Physical Education. All 300 children aged six to 11, from the 1st to 5th grade of primary school in the morning and afternoon shifts, will be included in the study voluntarily. Considering that the study will take place during Physical Education classes, those children and/or guardians who do not wish to participate in the study will be exempt from taking measurements, tests, and evaluations. As an exclusion criterion, those with less than 75% attendance in classes will be subsequently excluded from data analysis.

To this end, meetings were held between the members of the research group and their coordinators, and posteriorly, a visit was made to a specialized training center that offers functional training for children and adolescents. During these meetings surveys were made of dissertations and theses with physical exercise programs in physical education, tracing the timeline and its positive points in the perspective of building a method.

Physical Education teachers will execute two similar course plans throughout the academic year (19 weeks), containing the same teaching units. The general structure of the classes will be similar, except for the inclusion of 15 min of functional exercises in the PROFIT-BR group (intervention). Comparative students continued with Physical Education classes taught by regular teachers with content not structurally planned to improve physical fitness.

The intervention group, with the inclusion of PROFIT-BR, will be all classes from the 1st to the 5th grade

classes in the morning shift. It was planned and will be conducted by a group of researchers and qualified physical education teachers. Sessions will be applied twice a week during Physical Education lessons, lasting 60 min each throughout the school year (19 weeks). The physical education sessions will be organized into 5 stages (with PROFIT-BR being the main differential): 10 min of commuting to the sports court and warm-up; 15 min of circuit training (PROFIT-BR); 10 min of gymnastics components and rhythmic activities; 15 min of motor skills and pre-sports games; and 5 min of rest activities and feedback (Supplementary material 1).

The warm-up consisted of aerobic recreational activities. The PROFIT-BR was thought the “fundamental movement skills” [15] in Physical Education classes lasting approximately 15 min through functional exercises with natural movements such as jumping, running, squatting, turning, and pushing whose objective was to develop strength, coordination, speed and agility, and fatigue resistance, and thought from the theoretical basis of neuromuscular integrative training [13, 16, 17]. PROFIT-BR was structured to allow children to master “fundamental movement skills” while participating in an engaging program that includes variety, progression, and adequate recovery intervals [13, 16, 17]. To this end, the 19-week program was structured in preparation, base, construction, and peak (Supplementary material 2).

The PROFIT-BR (macrocycle) was structured in three moments (mesocycle): general preparation; specific preparation; and complex period. Objectives (micro cycles) were proposed for each of these moments, that is, the general preparation was subdivided into preparation, which aims to adapt the body to PROFIT-BR, and base, which seeks to establish strength, speed, agility, and fatigue resistance. The specific preparation (construction) aims to increase the intensity and limits established in the base. The complex period (peak) aims to consolidate all conditioning acquired throughout the program.

Over the three weeks of preparation, emphasis is placed on the proper posture of the proposed basic movements through educational exercises and simple movements. The base has two objectives, two weeks progressing to intermediate exercises and movements (requiring greater body control than the previous moment), and five weeks with progression to more complex exercises and movements, aiming at the transition to the construction. Lasting four weeks, the construction aims to evolve into complex exercises and movements designed to keep the average heart rate at its upper limit. After 14 weeks of preparation, base, and construction, five weeks of the peak will begin, to consolidate conditioning through exercises and complex movements of vigorous intensity.

Based on international literature for resistance training [13, 16] and World Health Organization guidelines

[18] for physical activity in children and adolescents, strength and condition exercises of moderate to vigorous intensity that generate impact should be performed 2–3 times a week on non-consecutive days. Bearing in mind that the specific tasks of the Physical Education teacher go beyond body and motor training and based on previous evidence, PROFIT-BR is proposed with a duration of approximately 15 min [17, 19]. In addition, aerobic training does not seem to be a priority in prepubertal children, instead, strategies that prioritize interval training of moderate to vigorous intensity and that allow children to adapt to their execution pace without losing sight of movement techniques tend to improve their mechanical efficiency and, consequently, reduce the metabolic cost of the activity [20, 21]. From this perspective, we propose 60 s of execution of the proposed exercises with 30 s of passive rest between stations. Finally, the four-station were proposed as they were able to work on the six essential components proposed by integrative training (dynamic stability, strength, plyometrics, coordination, speed and agility, and fatigue resistance, and it was a strategy to organize the students in blocks as a single teacher must handle classes with 20–30 students. Before the intervention, the cardiorespiratory fitness test was performed and, according to the observed performance, the participants were divided into four groups with similar conditioning characteristics to compose the stations. During classes, the participants should reach at least 75% of their maximum heart rate (indicating moderate-to-vigorous intensity), which was controlled via one participant from each group wearing a portable heart rate monitor (Polar Team2 Pro, Polar, Finland). Participants will be split into groups of approximately five/six people with similar performance in the cardiorespiratory fitness test, and each week a different participant would use the heart rate monitor. Part of the components of gymnastics and rhythmic activities will be carried out for the development of motor skills. The exercises consisted of throws, jumps, kicks, etc. Finally, the pre-sports games consisted of handball, volleyball, frisbee, and wrestling, among others (Supplementary material 3).

PROFIT-BR starts after a five-minute warm-up (plays and active games chosen by the students themselves) and is structured in two blocks: Block 1 – dynamic stretching; Block 2 – “fundamental movement skills” and physical conditioning. After warming up, students perform four dynamic stretches, one for the hamstrings, another for the adductors, followed by the quadriceps, and with the CORE (trunk). After stretching, students are equally divided into each of the four fixed stations: (1) lower limbs; (2) speed; (3) upper limbs; (4); agility. They are then instructed to perform the highest number of repetitions for 60 s at each station, with a 30-second interval

between them, completing two consecutive laps in the circuit (Supplementary material 4).

All children from the 1st to 5th-grade classes of the afternoon shift will be part of the control group. The methodology for applying the content, as well as its selection, will be carried out by the schoolteacher at the beginning of the school year. The content taught over the 19 weeks will be pre-sports games of handball, volleyball, frisbee, and wrestling, among others, and their gymnastic components, motor skills, and rhythmic activities. The skills emphasized over the 19 weeks will be knowledge of one's own body and body perception; knowledge of one's own body and perception of the surroundings; basic motor skills for locomotion and stability; manipulative basic motor skills; gymnastics - acrobatics; motor games.

The physical fitness tests will be carried out following the protocols described in the Manual of Measurements, Tests, and Evaluations version 2021 proposed by Projeto Esporte Brasil – PROESP-BR [22], during Physical Education classes on the school's sports court. Each of the tests has its validation procedure described in a study carried out with more than 90,000 children and adolescents [23]. Physical fitness will be assessed by a team of at least ten experienced members divided into stations/tests. All students who will be evaluated follow the same order, starting with anthropometric measurements and ending with cardiorespiratory fitness.

There will be a joint warm-up before each assessment section (there are prescribed warm-up activities within the PROESP-BR guideline). Assessments will be conducted with a maximum of 30 participants per section, and will be used four classes/sections to carry out the assessments: (1) body mass measurements (weight); stature (height); sitting height (is not part of the PROESP-BR guideline); arm-span, waist circumference, and the sit-and-reach test; (2) agility test; medicine ball throw; horizontal jump and 20-m speed test; (3) abdominal strength test; (4) and six-minute run/walk test.

Estimates of excess weight and visceral fat will be assessed by body mass index and waist-to-height ratio, respectively, and cardiorespiratory fitness by performance in the six-minute run/walk test. The sit-and-reach test will assess flexibility; the number of sit-ups will measure abdominal strength in one minute. The medicine ball throw and the horizontal jump will be used to measure the power of the upper and lower limbs, respectively, the agility test will be taken as a measure of agility, and the 20-meter run will be used to measure the speed.

Somatic maturation will be determined according to the procedures described by Mirwald, Baxter-Jones [24], which consists of determining the status of somatic maturation by identifying the distance, in years, that the individual is concerning the peak growth velocity. The student's physical activity (PA) level will be measured

using an Actigraph brand accelerometer (wGT3X-BT), placed on the waist, and encouraged to use it for seven consecutive days, throughout the day, and considered acceptable for monitoring purposes analysis usage for five days (including at least one weekend day), with at least 10 h/day of usage time. Moderate to vigorous intensity PA values will be those above 574 counts proposed by Evenson, Catellier [25].

To operationalize the study, the following steps will be carried out: (1) Initially, contact will be made with the municipal department of education of Porto Alegre and the school administration teams to present the study proposal and request authorization to carry it out; (2) After obtaining the necessary authorizations, the physical education teachers linked to the 1st to 5th-year classes will be contacted, and the objectives and procedures of the study will be presented to them; (3) Fathers, mothers and/or legal guardians of the children will be invited to attend the school so that the entire project can be presented and any doubts regarding it clarified. At this same meeting, those who voluntarily want to participate in the study will be given the terms of consent and free informed assent to be read, which will be signed by the fathers, mothers, and/or guardians and also by the children; (4) Each of the school's shifts has a physical education teacher responsible for the discipline of all classes from the 1st to the 5th year. These steps ensure that the study is properly presented to relevant authorities and educators and can be conducted with the necessary permissions and cooperation.

Statistical procedures.

A descriptive analysis will be carried out using the average, minimum, maximum and standard deviation values to characterize the research subjects and presented through the absolute and relative frequency of physical fitness related to health and motor performance. The health assessment will be carried out based on previous studies [26–29] in which they established cut-off points or critical values that, stratified by age and sex, classify Brazilian children and adolescents as belonging to the “health risk zone” or “healthy zone”. The assessment of motor performance [3] will be carried out based on the profile of the Brazilian population stratified by sex and age using five performance expectations (percentiles): “weak” (<P40); “reasonable” (P40-59); “good” (P60-79); “very good” (P80-98); “excellence” ($P > 98$). We will use the “Paired t-test” to calculate the difference between paired observations (before and after). To analyze the differences/effects between baseline and post-intervention values, repeated measures ANOVA adjusted for somatic maturation will be used. The magnitude of the effect size will be estimated by “partial eta squared” and classified according to Cohen [30] and Maroco [31] as small ($\eta^2 p < 0.05$), medium ($\eta^2 p \geq 0.06 \leq 0.25$), high

($\eta^2p \geq 0.26 \leq 0.5$) and very high ($\eta^2p > 0.5$). Statistical analyses will be carried out using SPSS software version 24.0 and a 5% probability of error in the analyses will be accepted.

Discussion

The present study aimed to present the theoretical basis used to elaborate a physical exercise program protocol (PROFIT-BR) to assist physical education teachers in different contexts. The elaborated program has a lot of applicability because it was thinking from the perspective of the school, in terms of materials, space, and objectives of physical education. The main theoretical assumption of the proposal is the cause-and-effect relationship between the regular practice of physical exercise in childhood and adolescence and several parameters of health and motor performance.

A meta-analysis study [6] indicated that both the increase in the number of physical education classes and the improvement in the quality of classes are associated with positive effects on several health indicators. This study also indicated that the inclusion of physical exercise circuits seems to be the strategy that most promotes a positive effect on health. Brazil recently summarized recommendations for Brazilian physical education [32], included in the Physical Activity Guide for the Brazilian Population. These recommendations are supported by positive evidence from physical education classes [32] on physical and motor health, fundamental motor skills, motivation, and autonomy, affectivity, reduction of anxiety and depression, socio-environmental health, with an emphasis on empathy and cooperation, making friends and prosocial behavior.

In such a way that evidence-based recommendations [13, 33, 34] suggest that initially (prepubescent children) priority should be given to fundamental exercises starting with moderate ranges of motion and progressing to full ranges. Programs should include exercises that work the main muscle groups seeking symmetry and balance with moderate execution speed (emphasis on controlled movement) and volume of 1–2 sets. Rest intervals can vary between 1 and 3 min, and must adapt to the characteristics of the group, according to the initial level of physical fitness and stages (objectives). With a weekly frequency of 2–3 non-consecutive days, the main adaptations are neuromuscular. It is worth mentioning that technique and postural control are the priority, but that training does not become rigid and monotonous, children must be free to try new movements pleasantly. As they enter puberty (adolescence) all these recommendations can (and should) progress both in quantitative and qualitative terms. The programs are developed aiming at the integral formation of the student according to their

specificities, physical, motor, cognitive, psychological, fantasies, and desires.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13102-024-00990-7>.

Supplementary Material 1

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Author contributions

Pedretti A, participated in the think of PROFIT-BR: periodization and prescription of exercises, conception, and writing of the manuscript. Gaya A, the idealizer in the insertion of 15 min of functional training in physical education, a proposal linked to his CNPq Productivity Project, participated in the conception of the manuscript and critical review of the content. Mello J, participated in the conception and writing of the manuscript and critical review of the content. Gaya AR, participated in the conception of the manuscript and critical review of the content.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

The study protocol was registered (CAAE 12221918.8.0000.5347), and approved by the Research Ethics Committee of the Federal University of Rio Grande do Sul under opinion 3.460.288. All children and their legal representatives completed written assent and consent forms, respectively.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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