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Original Article

EFFECTS OF TWO PHYSICAL EDUCATION PROGRAMS ON CHILDREN'S HEALTH-RELATED PHYSICAL FITNESS ACCORDING TO SEX

EFEITOS DE DOIS PROGRAMAS DE EDUCAÇÃO FÍSICA NA APTIDÃO FÍSICA RELACIONADA À SAÚDE DE CRIANÇAS DE ACORDO COM SEXO

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ABSTRACT
This quasi-experimental study evaluated the effects of two physical exercise programs offered in the context of physical education classes on physical fitness indicators. The convenience sample consisted of 91 students aged 9-12 years who formed the group's Body Training (GBT; 45 students) and Physical Education (PE; 45 students). Body mass index (BMI), cardiorespiratory fitness (CRF), flexibility, and abdominal muscle strength (LMS) were measured. The "Paired t-test" and repeated measures ANOVA were used. The size of the effect was estimated by the "partial squared eta", stratified by sex, with a 5% probability of an error being accepted. The results showed in boys a very high effect in the PFC group on CRF, flexibility, and FML and a high effect in the PEF group on flexibility and FML. In girls, a very high effect in the GBT group on CRF, flexibility, and FML, and the PE group greatly affected flexibility and FML and had a high effect on CRF. There was no effect on BMI in either group. We emphasize that this single weekly meeting (15 minutes of GBT) was able to have a very high and high effect on fitness in favor of the GBT in both genders.
Keywords: Physical Education. School. Physical Fitness. Children. Exercise Training.

RESUMO
Este estudo quase-experimental avaliou os efeitos de dois programas de exercício físico, ofertado no contexto das aulas de Educação Física escolar, sobre indicadores de aptidão física. A amostra por conveniência foi composta por 91 alunos com idades entre 9-12 anos que formaram os grupos Formação Corporal (PFC; 45 alunos) e Educação Física (PEF; 45 alunos). Foi mensurado o índice de massa corporal (IMC), aptidão cardiorrespiratória (ApC), flexibilidade e força muscular localizada (FML). Recorreu-se ao "Teste t pareado" e ANOVA de medidas repetidas. O tamanho do efeito foi estimado pelo "eta ao quadrado parcial", estratificado por sexo, sendo aceito a probabilidade de 5% de erro. Os resultados mostraram nos meninos efeito muito elevado no grupo PFC na ApC, flexibilidade e FML e efeito elevado no grupo PEF na flexibilidade e FML. Nas meninas efeito muito elevado no grupo PFC na ApC, flexibilidade e FML e no grupo PEF efeito muito elevado na flexibilidade e FML e de efeito elevado na ApC. Não houve efeito no IMC em ambos os grupos. Ressaltamos que este único encontro semanal (15 minutos de PFC) foi capaz de apresentar efeito muito elevado e elevado na aptidão física a favor do PFC em ambos os sexos.
Palavras-chave: Educação física. Escola. Aptidão física. Criança. Exercício Físico.

Introduction

There is strong evidence of the relationship between higher levels of physical fitness, the reduction of risk indicators for cardiovascular, musculoskeletal, and mental health, and better school performance in children and adolescents[1,2]. On the other hand, the multiple damages to health resulting from a sedentary or physically inactive way of life[3,4].

The World Health Organization recommendations for physical activity advise that children and adolescents should accumulate at least 60 minutes of moderate-vigorous activity daily, including aerobic exercise for the cardiovascular system and vigorous-intensity exercise, at least three times a week for the musculoskeletal system[5].

However, the practice of physical activities of the Brazilian children and adolescents is far from the recommendations of the World Health Organization. It is observed that the National Human Development Report of Brazil[6] indicates that only 0.55% of Brazilian

schools are identified as active schools, that is, schools that have a culture and infrastructure focused on the practice of physical activity and sports. Likewise, the report points out that 90% of Brazilian schools, public and private, present precarious conditions for the promotion of physical activity and sports. Added to this is the fact that school Physical Education (PE) programs usually do not reach the desired standards of moderate and intense activities that can improve physical fitness[7].

Kremer et al.[8] when investigating PE classes at school, point out that moderate or vigorous physical activities made up only 33% of the total time of all classes observed. This means that in the remaining time students were standing, sitting, lying down or just walking slowly, although we must consider moments of reflection and/or feedback as appropriate. Hino et al.[9] showed a similar situation. Most of the time, 45.5% of students remained to stand, followed by 26.3% of the class walking, 17.9% sitting, and a smaller part of the time being very active (8.67%) and 1, 5% lying down. Santos et al.[10] describe similar results: 41% of the class time the students remain standing (still); 27% walking, 20% sitting; and only 9% running. In this context, there is an evident need to include physical and sports activities in PE classes with duration and intensity that facilitate the adoption of behaviors aimed at the development of physical fitness[11, 12].

The occurrence of interventions with the aim of promoting physical activity in school PE has discreetly increased[13-15]. However, it is assumed that it will only be possible to increase and qualify the population's involvement with physical and sports activities within the scope of health promotion if there is a differentiated approach, which emphasizes the physical fitness development[6]. In this ways, Faigenbaum et al.[16] proposed the inclusion of 15 minutes of body training with functional exercises in the PE classes at school for children. This program ran twice a week for eight weeks. Their results demonstrated that girls were more sensitive than boys were to the effects of training on physical fitness outcomes, and that longer-term studies are needed to explore gender-specific effects. Considering the above, we planned this study[17] with the objective of evaluating the effects of two physical exercise programs, offered in the context of school PE classes, on physical fitness indicators in schoolchildren aged 9-12 years according to sex.

Methods

Design and sample

This is a study with a quasi-experimental design and a quantitative approach carried out in a public school in Tramandaí, Brazil. The population included all students in the four fourth-grade classes at the school (n = 100) and included for analysis those who completed baseline and post-intervention assessments. The convenience sample (Table 1) consisted of 91 students (57 boys and 34 girls) aged 9-12 years. By drawing lots, two classes were part of the Body-Training group (BTG), and two classes were part of the Physical Education group (PEG). The Research Ethics Committee of the Universidade Federal do Rio Grande do Sul, under opinion 1,445,846, approved the research project.

Table 1. Sample characterization through the mean and standard deviation of both groups stratified by sex at baseline.

	Body Training		**Physical Education**	
	Boys (n=28)	Girls (n=18)	Boys (n=29)	Girls (n=16)
	Mean (±SD)	Mean (±SD)	Mean (±SD)	Mean (±SD)
Age	10 (±1)	10 (±1)	10 (±1)	10 (±1)
Weight	40 (±12)	34 (±9)	42 (±15)	34 (±12)
Height	139 (±8)	137 (±8)	141 (±6)	135 (±6)
BMI	21 (±6)	18 (±3)	21 (±6)	18 (±5)
CRF	696 (±187)	593 (±122)	720 (±148)	620 (±176)
Flexibility	26 (±7)	29 (±7)	30 (±8)	28 (±8)
AMS	27 (±11)	21 (±7)	27 (±10)	20 (±7)

Note: n number of cases; SD standard deviation; BMI Body Mass Index; CRF cardiorespiratory fitness; AMS abdominal muscle strength

Source: authors

Data collection procedure

Physical fitness tests were performed in accordance with the protocols described in the Manual of measurements, tests and evaluations of Projeto Esporte Brasil[18] during Physical Education classes on the school's sports court. We measured the excess weight estimate assessed by body mass index (BMI), cardiorespiratory fitness by performance in the six-minute run/walk test, flexibility through the sit-and-reach test, and abdominal muscle strength by sit-ups test in one minute.

Pedagogical interventions

Two Physical Education teachers from the Municipal School of Tramandaí carried out two similar course plans throughout the school year (14 weeks), containing the same didactic units. The general structure of the classes was similar, except for the insertion of 15 minutes of functional exercises in the classes of the BTG. Classes in the PEG, and in the BTG, were held weekly during a single meeting lasting approximately 120 minutes.

Physical Education

Physical Education classes followed the curricular components suggested by the Municipal Department of Education and were structured with the focus on physical fitness aimed at health promotion. The activities were organized aiming at the development of fundamental and specialized motor skills, conditional and coordinative motor skills, and the basic and specific foundations through sports games. Four didactic units were worked on throughout the school year: experiences in individual sports (athletics); collective (futsal, volleyball, handball, and basketball); and radicals (parkour, skateboard, and slackline).

Body training

We conceptualize body-training activities as those that include functional exercises performed in school Physical Education classes lasting approximately 15 minutes. The exercises were performed with fundamental movements such as jumping, running, pulling, squatting, turning and pushing, whose objective is to develop strength, balance, flexibility, resistance, speed and agility with one's own body weight[19, 20]. Therefore, resistance runs and sprints, exercises with flexion and extension of lower and upper limbs, and abdominal and plyometric exercises were performed. The activities were distributed in four stations: (1) Races; (2) Upper Limbs; (3) Lower limbs; and (4) Sit-ups.

For this, the 14 weeks of intervention were structured in preparation, which aimed to adapt the body to the BTG, and base, which sought to establish strength, speed, agility, and endurance. The construction aimed to increase the intensity and limits established at the base. The peak, on the other hand, aimed to consolidate all the conditioning acquired throughout the program. Throughout the preparation, emphasis was given to the proper posture of the proposed basic movements through educational exercises. At the base, it evolved into intermediate exercises and movements (requiring greater body control than the previous moment), and progression to more complex exercises and movements, aiming at the transition to construction. The construction aimed to evolve into complex exercises and movements. At the peak, with the aim of consolidating conditioning through complex exercises and movements, encouraging children to perform as many repetitions as possible.

Statistics procedures

Descriptive statistics (mean and standard deviation) were calculated at baseline and post-intervention. The "Paired t test" was used to calculate the difference between paired observations (before and after). To analyze the effects between baseline and post-intervention values, repeated measures ANOVA was used. The magnitude of the effect size was estimated by the "partial squared eta" and classified according to Cohen (1988)[21] as: small ($\eta^2_p \leq 0.05$), medium ($\eta^2_p \geq 0.06 \leq 0.25$), large ($\eta^2_p \geq 0.26 \leq 0.5$) e very large ($\eta^2_p > 0.5$). Statistical analyses were performed stratified by sex in SPSS version 24.0 software, with a 5% probability of error in the analyses.

Results

Table 2 shows baseline and post-intervention physical fitness values, delta, significance level and effect size, by sex. In boys, it is possible to affirm that the applied pedagogical practices generated a statistically significant difference in the outcome variables and with a very high effect in the BTG on Cardiorespiratory fitness ($p \leq 0.01$; $\eta^2_p = 0.65$), flexibility ($p \leq 0.01$; $\eta^2_p = 0.78$) and abdominal muscle strength ($p \leq 0.01$; $\eta^2_p = 0.68$). A large effect on Flexibility of PEG ($p \leq 0.01$; $\eta^2_p = 0.35$) and abdominal muscle strength ($p \leq 0.01$; $\eta^2_p = 0.34$), in cardiorespiratory fitness the effect was medium ($p \leq 0.01$; $\eta^2_p = 0.24$).

In girls, the applied pedagogical practices generated a statistically significant difference in the outcome variables and a very large effect in the BTG on cardiorespiratory fitness ($p \leq 0.01$; $\eta^2_p = 0.75$), flexibility ($p \leq 0.01$; $\eta^2_p = 0.73$) and abdominal muscle strength ($p \leq 0.01$; $\eta^2_p = 0.74$). In PEG a very large effect was observed on flexibility ($p \leq 0.01$; $\eta^2_p = 0.61$) and abdominal muscle strength ($p \leq 0.01$; $\eta^2_p = 0.51$) and a large effect on cardiorespiratory fitness ($p \leq 0.01$; $\eta^2_p = 0.40$). About BMI, in both boys and girls in both groups we do not find any significate differences.

Table 2. Changes in physical fitness from baseline to the end of the intervention between the body training and physical education groups, by sex

BOYS	**Baseline**	**Post-intervention**	**Delta**	***p-value***	η^2_p
BMI					
Body training	21 (±6)	20 (±6)	-1	0.22	0.05
Physical education	21 (±6)	21 (±6)	0	0.40	0.03
CRF					
Body training	696 (±187)	814 (±195)	118	≤0.01	0.65
Physical education	720 (±148)	769 (±151)	49	≤0.01	0.24
Flexibility					
Body training	26 (±7)	34 (±8)	8	≤0.01	0.78
Physical education	30 (±8)	34 (±10)	4	≤0.01	0.35
AMS					
Body training	27 (±11)	32 (±12)	5	≤0.01	0.68
Physical education	27 (±10)	29 (±11)	2	≤0.01	0.34
GIRLS	**Baseline**	**Post-intervention**	**Delta**	***p-value***	η^2_p
BMI					
Body training	18 (±3)	18 (±3)	0	0.84	0.01
Physical education	18 (±5)	18 (±5)	0	0.29	0.07
CRF					
Body training	593 (±122)	753 (±178)	160	≤0.01	0.75
Physical education	620 (±176)	686 (±179)	66	≤0.01	0.40
Flexibility					
Body training	29 (±7)	36 (±7)	7	≤0.01	0.73
Physical education	28 (±8)	35 (±9)	7	≤0.01	0.61
AMS					
Body training	21 (±7)	26 (±9)	5	≤0.01	0.74
Physical education	20 (±7)	23 (±6)	2	≤0.01	0.51

Note: BMI body mass index; CRF cardiorespiratory fitness; AMS abdominal muscle strength; η^2_p "partial eta square"
Source: authors

Discussion

This study evaluated the effects of two physical exercise programs, offered in the context of school Physical Education classes, on physical fitness indicators in schoolchildren aged 9-12 years, according to gender. The primary evidence indicates that Body Training (BTG) in Physical Education classes, effectively, had positive effects on cardiorespiratory fitness, flexibility, and abdominal muscle strength in both sexes. Although some systematic review studies have shown the positive effect of different models of Physical Education classes[22, 23], few effective interventions were organized with a weekly class[24] like the present study.

To estimate sex-specific effects Faigenbaum et al.[16] evaluated the physical fitness of 40 children (7.6 ± 0.3 years old) after eight weeks of integrative training during the Physical Education class. Among seven-year-olds, girls were more sensitive than boys to the effects of integrative neuromuscular training performed twice a week on cardiorespiratory fitness, localized muscle strength, and lower-limb power. Such as Jarani et al.[25] when showing that functional exercises and games through circuits effectively improve physical fitness parameters in children, without changing the frequency and duration of Physical Education classes, and those boys had superior benefits in improving cardiorespiratory fitness. Our

results showed a very high effect on the outcomes evaluated for both boys and girls who participated in the BTG.

Regarding cardiorespiratory fitness, which is the physical fitness component best described in the literature that influences the general health of children and adolescents[1], we found a statistically significant difference with a very large effect in boys and girls participating in the BTG. The magnitude of this effect is likely to translate into overall health benefits (such as decreased cardiovascular risk) and underlines the potential of BTG to improve various health-related outcomes in children[15, 26, 27].

In accordance with our findings, Ardoy et al.[28] show that in addition to the increase in weekly sessions (increase in volume), the implementation of intensity is also important, showing that the increase in volume and intensity has a greater effect compared to the effect of volume increase or effect of increasing intensity in 67 Spanish children over 16 weeks of intervention. In addition, Lämmle et al.[29] demonstrated that guidance on the benefits of physical activity and healthy eating together with two daily moments of physical activity, totaling ten to 15 minutes per session over a school year, was able to significantly impact the cardiorespiratory fitness of 957 German children in their longitudinal, cluster-randomized study including intervention and control groups.

If on the one hand, cardiorespiratory fitness is associated with cardiovascular health, flexibility and abdominal muscle strength seem to be more related to musculoskeletal health in children and adolescents, that is, children who have low fitness in these variables possibly have low back pain[30]. We emphasize that the BTG had a very large effect on flexibility and abdominal muscle strength in both boys and girls. Although the level of flexibility at baseline was lower in the BTG than in the PEG, possibly generating a greater effect in the BTG than in the PEG, we emphasize that both groups had a positive and statistically significant effect after the intervention, which were beneficial and important for musculoskeletal health. Our findings are important since low back pain is a condition that can affect up to 20% of adolescents and up to 84% of people at some point in their lives[31]. And according to the "American College of Physicians Clinical Practice Guideline", the Back pain is very common and is associated with a higher occurrence of disability than any other condition.[32].

In addition, Farias[33] proposed ten classes on physical activity and 22 classes on recreational activities such as running, jumping and throwing for 57 students from a public school in the municipality of Santa Mariana, Brazil. With two weekly 50-minute classes for 16 weeks, he showed a significant increase in flexibility ($p \leq 0.01$). Eather et al.[27] proposed a multicomponent intervention during Physical Education three times a week for eight weeks and showed a large effect on flexibility and abdominal muscle strength. Whereas multi-component school interventions that involve a collaborative approach to improve physical activity and fitness have been shown to be more effective[34]. And Faigenbaum et al.[26] when proposed a circuit with 6-7 stations in order to improve muscle fitness and fundamental motor skills for eight weeks showed an effect on flexibility and localized muscle strength.

The BTG proposed in our study comprises an increase in volume and intensity, with a quality practice within Physical Education, offering a greater range of opportunities for physical activities, games and sports aimed at physical fitness. One of the important outcomes of this school-based program is its potential influence on children's physical fitness. Furthermore, the proposed program is a proposal that does not aim to compete with the other contents and competencies of the school Physical Education[35].

Our proposal presents positive results even corresponding to a small percentage of the total time of the Physical Education class (15 minutes). Other national[36] and international[23] studies have indicated that in one, two or three weekly classes, a short period of class with structured physical exercise (between 12 and 20 minutes) can have positive effects on several health variables[37]. The studies reinforce the BTG proposal as they indicate

that general strengthening, speed, agility and stretching activities, when worked together, can be an important strategy for Physical Education classes.

As a future perspective to confirm our results, it is relevant to consider overcoming the limitations of the present study, such as evaluating the physical activity level of schoolchildren, preferably by accelerometry, bringing relevant information about the practice of physical activity in addition to school PE. In addition, the literature emphasizes that to effectively impact on BMI, proposals with nutritional guidance through activities in class to understand food groups, portions, and daily recommendations of macronutrients, calories, and hydration, for example, are of paramount relevance. Other important methodological issues are the control of exercise intensity with some objective or subjective measure, in addition to the inclusion of a comparison group (control or with another practice/class model). Finally, we recommend that the BTG be performed two or three times a week during school Physical Education classes, according to national recommendations[38].

Conclusion

This methodological proposal in school Physical Education is an important addition to the current evidence of different effective approaches to improve health-related physical fitness in elementary school children. The Body Training Program inserted in the Physical Education classes a single weekly meeting lasting 120 minutes, in contrast to most Brazilian schools that have two to three weekly meetings lasting 45 to 50 minutes, was able to present promote physical fitness. To positively interfere in the development of these physical abilities, especially in aspects related to health, Physical Education classes must be developed with activities that increase the intensity, for that, exercise circuits and games oriented to Physical Education programs must be stimulated.

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