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Benefits of multi-sports physical education in the elementary school context

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Abstract

Objective: In many countries, physical education (PE) is taught by classroom teachers (generalists) during the formative years of elementary school. The purpose of this study was to evaluate the physical and psychological outcomes of multi-sports PE taught by qualified PE teachers (specialists) and how they contribute to children's physical and mental health development.

Design: Experimental study with non-random assignment.

Setting: Four elementary schools in Italy (Rome) stratified by urban district.

Method: One hundred and twenty-five upper elementary school children (10-11 years) were assigned to an eight month multi-sports or traditional PE programme taught by a PE specialist or a generalist, respectively. Pre- and post-intervention tests assessed children's fitness (aerobic fitness, abdominal strength and endurance, and hamstring flexibility) and coordination (kinesthetic discrimination ability, response orientation ability), goal (task and ego) orientation, perceived physical ability and social self-efficacy. Multivariate and univariate analyses of variance were performed on physical and psychological test measures.

Results: The results demonstrated that the multi-sports approach to PE induced more pronounced improvements in aerobic fitness and kinesthetic discrimination ability, as well as small but significant improvements in task orientation, ego orientation and social self-efficacy, when compared to traditional PE taught by a generalist.

Conclusions: A multi-sports approach to elementary school PE contributes to the development of children's physical fitness and goal orientations, which support engagement in physical activity. These findings highlight the role of qualified PE specialists and multi-sport, skill-based curricula to obtain positive physical and psychological outcomes that may facilitate the development of a healthy child.

Keywords

Fitness, coordination, goal orientations, self-perceptions, child health

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Introduction

The promotion of regular physical activity (PA) for children and adolescents is an important aim of the World Health Organization[1] and a primary goal for physical educators.[2] The results of tracking studies suggest that the promotion of PA during the growing years contributes to the development of healthy lifestyles and is therefore of great importance for the promotion of public health.[3] However, epidemiological reports indicate that the PA levels of contemporary youth are low and may already have started declining by age six.[3,4] As a consequence, secular declines have been observed in school age youth not only in measures of aerobic fitness and muscle strength,[5,6] but also in fundamental motor skills, starting as early as preschool age. This is particularly evident in those skills more strongly associated with coordinative development and PA habits rather than body building and power.[7]

PA guidelines for youth, targeted to counteract these trends, are mainly focused on the quantity (i.e. intensity, duration and frequency) of regular PA needed to enhance physical fitness in school-age youth.[8] Such general recommendations are helpful but not sufficient, since longitudinal studies indicate that components of physical fitness which are sensitive to the quantity of PA practiced are transitory and only weakly correlated with PA adherence across the lifespan.[9] Conversely, fundamental motor skill proficiency developed in childhood seems to have a strong influence on subsequent fitness during adolescence.[10] Therefore, PA programmes for children should target the development of motor skill proficiency to promote continued engagement in PA.[11] Since a lack of early exposure to qualitatively diversified motor activities is considered a determinant of the observed secular decline in children's motor skill proficiency,[7] the quality of movement experiences needs to be considered in childhood. In fact, children who are not exposed to a variety of opportunities to enhance motor skills and physical ability perceptions early in life might not be able to break through a hypothetical 'proficiency barrier' later in life.

In the framework of a developmental model of socialization into sport, Kirk[12] highlighted that the elementary school years should be sampling years during which children participate in a wide variety of sport activities centred on deliberate play, skill-building and enjoyment. While youth sport can offer many benefits, participation in sports practice does not ensure that youth meet the recommended health-related goals of PA programmes.[13] Elementary PE programmes represent the most appropriate context in which all children may experience a variety of skill-enhancing, multi-sport activities focusing on active participation, health promotion and personal development, but the limited knowledge and abilities of generalists to achieve these goals represent a notable barrier.

In elementary PE research, enhancing the quality of PE content and instruction within the curricular time seems to induce physical fitness benefits mediated by increments in physically active time during PE.[14] The manipulation of PE instruction has also been targeted to assess the motivational outcomes in order to understand how to help young people develop and maintain PA participation motivation. A large body of research in PE was inspired by the early work of Duda and colleagues[15] on task and ego goal orientations. Task orientation leads individuals to focus on mastery development through effort and persistence, while ego orientation leads to a focus on outperforming others in order to demonstrate their own competence. The coupling of a high ego- and a low task-orientation seems to be mainly associated with maladaptive responses already at elementary school age.[16] Intervention studies in PE have obtained positive effects on children's motivation by generating a task-oriented motivational climate[17] and by adopting more pupil-centred teaching styles focused on assimilation, discovery and production, rather than teacher-centred styles.[18,19]

Combining the emerging relationship between motor skill competence and PA habits in youth,[11] the necessity to deliver to children meaningful content in well-designed PA, and Kirk's[12] call for offering early multi-sports sampling opportunities in elementary school, additional research is needed to examine the effects on children of quality PA centred on multi-skill promotion through multi-sports sampling taught by specialists within the elementary school context. Therefore the purpose of this study was to assess the effects of a multi-sport or a traditional PE programme, taught by PE specialists or classroom generalists respectively, on children's motor skill performances, goal dispositions and self-perceptions. It was hypothesized that (1) offering children multi-sports sampling opportunities would optimize the development of motor skill proficiency and (2) using appropriate instruction to give them choices, including productive teaching styles and cooperative discovery learning, should foster their task orientation,[18] as well as the positive self-perceptions which are related to task orientation.[19]

Method

Participants

During the 2008/2009 school year, 125 healthy elementary school students aged 10-11 years from four schools in Rome, Italy participated in this study with the written, informed consent of their parents. The study was approved by a recognized institutional review board. The sample was stratified by urban district. Within each school, gender-matched classes were selected according to teacher and class availability and assigned to an experimental PE programme taught by a PE specialist (experimental group, $n = 63$) or to a traditional PE programme taught by a generalist (control group, $n = 62$).

Generalists and PE specialists participated in the study. They had a similar number of years of past teaching experience (24 ± 6 years for specialist teachers and 21 ± 9 years for generalist teachers, with 18 and 16 years of specific experience in teaching elementary PE, respectively). The generalists had a basic qualification for elementary school teaching but had never participated in specific teacher training for PE, whereas the specialists were licensed to teach PE. All students participated in PE for one hour once a week, corresponding to the curricular PE time in Italian elementary schools, and the intervention duration was eight months. The teacher-student ratio was about 1:20.

Instruments

Physical assessment. Pre- and post-intervention tests, validated for the age of interest, assessed students' physical fitness[20] and coordinative abilities.[21] Physical fitness tests included: (1) 20m shuttle run test to assess aerobic fitness; (2) curl-up test to assess abdominal strength and endurance; (3) sit and reach test to assess hamstring flexibility. Coordinative ability tests included: (1) backwards ball throw and (2) low jump test to assess the kinesthetic discrimination ability; (3) hanging target throw test and (4) orientation shuttle run test to assess the response orientation ability ([22] for a detailed description).

Psychological assessment. Pre- and post-intervention tests assessed students' goal orientations in PE, perceived physical ability, and perceived social self-efficacy. For each test, a validated version in Italian with satisfactory psychometric properties was used. The tests used were: (1) the Italian version[23] of Walling and Duda's Task and Ego Orientation in PE Questionnaire[24] comprising task and

ego orientation scales; (2) the Italian version[25] of the Physical Self-Efficacy subscale of Ryckman et al.'s Perceived Physical Ability Scale;[26] (3) the Social self-efficacy scale of the Italian Children's Perceived Self-Efficacy Questionnaire.[27]

Procedure

The experimental and the traditional PE programme had the following similarities and differences. Both the two generalists and the two PE specialists taught PE according to the age-related PE goals defined in the Italian curriculum for elementary schools.[28] However, the generalists did not receive any particular instruction by the researchers, whereas the specialists were provided with guidelines for the experimental multi-sports intervention. The intervention, centred on experiences joining multiple sports in varied ways, was structured in four didactic modules lasting eight weeks each. The modules consisted of (1) pre-tumbling, (2) rhythmic gymnastics, (3) ball mini-games and (4) dexterity circuits, and were adapted from an experimental programme previously applied to middle school students.[22] Since the intervention outcomes may depend on both the PE content and the delivery skills of the teachers, the teaching behaviors were video-recorded during two PE lessons chosen by each teacher to address concerns about the characteristics of their individual teaching styles.

Statistical analysis

Regarding physical fitness and motor coordination, pre- and post-intervention measures obtained with each test were jointly submitted to a 2 x 2 x 2 multivariate analysis of variance (MANOVA) with group (experimental vs. control) and gender (males vs. females) as between-participants factors and testing time (pre- vs, post-intervention) as within-participants factors. In the case of significant results in the MANOVA, univariate analyses (ANOVAs) were performed separately for each dependent variable. Post-hoc analyses of significant interactions were performed by means of planned pairwise comparisons. Effect size and observed power were computed for ANOVA results of interest.

Regarding goal orientations and self-perceptions, only the data of 104 children (49 belonging to the experimental group and 55 to the control group) were used for analysis because of the missing responses of 21 children in one or more items of the employed questionnaires. Scores of task and ego orientation, perceived physical ability and social self-efficacy were submitted to the same MANOVA and ANOVA models described for the analysis of physical fitness and motor coordination measures.

To evaluate the reliability of observational data on teaching styles, two independent observers analyzed all videos two times each, one week apart, coding events every 20 seconds to compute percentages of events belonging to different teaching styles according to Mosston's spectrum.[29]

Results

Physical fitness and motor coordination

According to the aim of the study, only main effects for testing time (pre- vs. post-intervention) and significant interactions involving group (experimental vs. control) will be reported. The MANOVA

showed a significant main effect for testing time, Wilks $\lambda = .39$, $F(1,114) = 26.13$, $p < .001$, and a significant Group x Testing Time interaction, Wilks $\lambda = .80$, $F(1,114) = 4.13$, $p < .001$.

ANOVAs revealed the main effects for testing time, indicating significant enhancements from pre-test to post-test for all measures except for the low jump test (Table 1). The Group x Testing Time interaction was significant only for the 20m shuttle run test, $F(1,121) = 12.42$, $p = .001$, $\eta_p^2 = .09$, $(1-\beta) = .94$, and for the backwards ball throw test, $F(1,121) = 8.52$, $p = .004$, $\eta_p^2 = .07$, $(1-\beta) = .83$. The experimental group had a lower performance in the shuttle run test at pre-intervention time and a more pronounced performance increment from pre- to post-intervention time, $t(1, 62) = -10.87$, $p < .001$, than the control group, $t(1, 61) = -5.27$, $p < .001$ (Figure 1), as well as a significant increment in the backwards ball throw test, $t(1, 62) = -4.55$, $p < .001$, that was absent in the control group ($p = .802$) (Figure 2).

Given the group differences in shuttle run test performance at pre-intervention time, further analyses were conducted to evaluate whether the intervention outcomes were biased by such baseline differences. Lower performance improvements after the intervention may be expected for students who performed better at baseline. To this aim, differences between pre- and post-intervention shuttle run performances (Δ shuttle run) were calculated and entered in 2 (groups) x 2 (genders) analysis of covariance (ANCOVA) with the pre-intervention performance level as a covariate. The difference between groups in Δ shuttle run still remained significant, $F(1,121) = 9.65$, $p = .002$, $\eta_p^2 = .07$, $(1-\beta) = .87$, whereas the covariate was only marginally significant ($p = .061$), indicating that baseline differences did not account for the differential intervention effects.

Table 1. Pre- and post-intervention performances (mean values ± SD) in the employed motor and psychological tests and statistics for the Testing Time (pre vs. post) effect. Data are collapsed across experimental and control group.

Physical fitness and motor coordination tests	Pre	Post	ANOVA results
20m shuttle run (stages)	4.8 ± 2.7	5.9 ± 2.7	$F(1,121) = 128.83$, $p < .001$, $\eta_p^2 = .52$, $(1-\beta) = 1.0$
Curl up (number)	16.7 ± 5.0	17.7 ± 5.2	$F(1,121) = 10.44$, $p = .002$, $\eta_p^2 = .08$, $(1-\beta) = .89$
Sit and reach (cm)	15.9 ± 7.2	16.71 ± 7.4	$F(1,121) = 9.06$, $p = .003$, $\eta_p^2 = .07$, $(1-\beta) = .85$
Backwards ball throw (score)	4.9 ± 2.8	6.0 ± 3.3	$F(1,121) = 10.94$, $p = .001$, $\eta_p^2 = .08$, $(1-\beta) = .91$
Low jump (cm)	8.8 ± 6.4	8.9 ± 6.4	n.s.
Hanging target throw (score)	4.9 ± 2.8	5.8 ± 2.9	$F(1,121) = 11.09$, $p = .001$, $\eta_p^2 = .08$, $(1-\beta) = .91$
Orientation shuttle run (s)	11.5 ± 2.3	10.4 ± 1.8	$F(1,121) = 30.76$, $p < .001$, $\eta_p^2 = .20$, $(1-\beta) = 1.0$
Goal orientations and self-perceptions tests			
Task orientation (score)	24.0 ± 3.7	24.9 ± 4.1	n.s.
Ego orientation (score)	13.9 ± 5.3	15.2 ± 5.1	$F(1,97) = 11.59$, $p = .001$, $\eta_p^2 = .10$, $(1-\beta) = .92$
Social self-efficacy (score)	53.6 ± 6.3	54.8 ± 6.0	n.s. ($p = .052$)
Perceived physical ability (score)	38.6 ± 5.6	40.4 ± 5.1	$F(1,97) = 16.81$, $p < .001$, $\eta_p^2 = .14$, $(1-\beta) = .98$

ANOVA: univariate analyses; s: seconds.

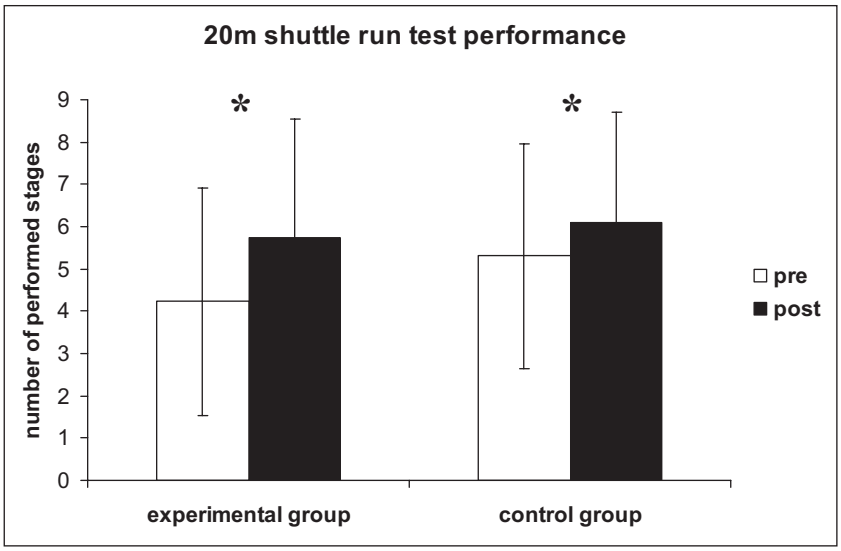

Figure 1. Stages performed (±*SD*) in the 20m shuttle run test, assessing aerobic fitness, before (pre) and after (post) the intervention period by children participating in the multi-sports PE programme (experimental group), or traditional PE programme (control group) (* = $p < .05$).

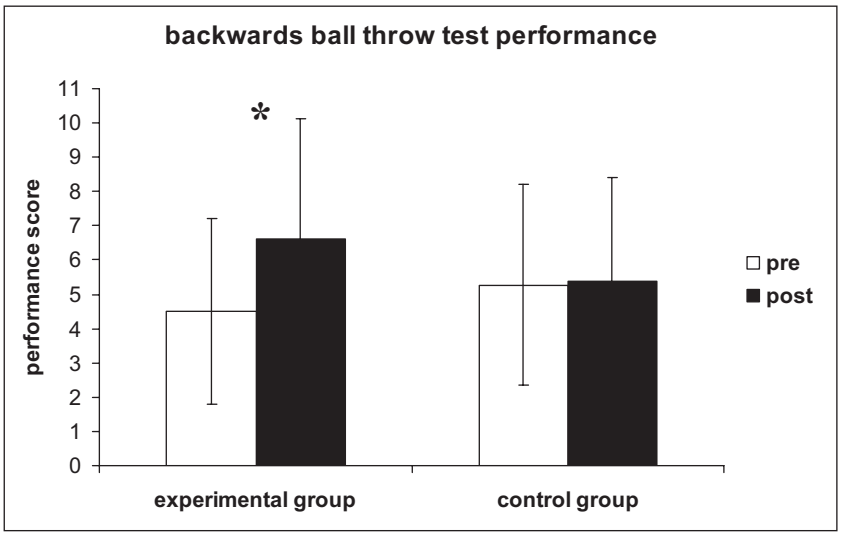

Figure 2. Performance scoring (±SD) in the backwards ball throw test, assessing kinesthetic discrimination ability, before (pre) and after (post) the intervention period of children participating in the multi-sports PE programme (experimental group), or traditional PE programme (control group) (* = $p < .05$).

Goal orientations and self-perceptions

The MANOVA showed a significant main effect for testing time (Wilks $\lambda = .78$, $F(1,97) = 6.97$, $p < .001$, and a significant Group x Testing Time interaction, Wilks $\lambda = .82$, $F(1,97) = 5.46$, $p < .001$. ANOVAs revealed significant enhancements from pre-test to post-test for ego orientation and

perceived physical ability scores (Table 1). The Group x Testing Time interaction was significant for all psychological variables except for perceived physical ability; task orientation, $F(1,97) = 7.21$, $p = .008$, $\eta_p^2 = .07$, $(1-\beta) = .76$; ego orientation, $F(1,97) = 5.90$, $p = .017$, $\eta_p^2 = .06$, $(1-\beta) = .67$; and social self-efficacy, $F(1,97) = 6.19$, $p = .014$, $\eta_p^2 = .06$, $(1-\beta) = .69$. After the intervention, only the experimental group had an increment in task orientation, $t(1, 48) = -2.52$, $p = .015$ (Figure 3, left), ego orientation, $t(1, 48) = -4.20$, $p < .001$ (Figure 3, right), and social self-efficacy, $t(1, 48) = -3.61$, $p = .001$ (Figure 4), that was absent in the control group ($p = .216$, .481, .747, respectively).

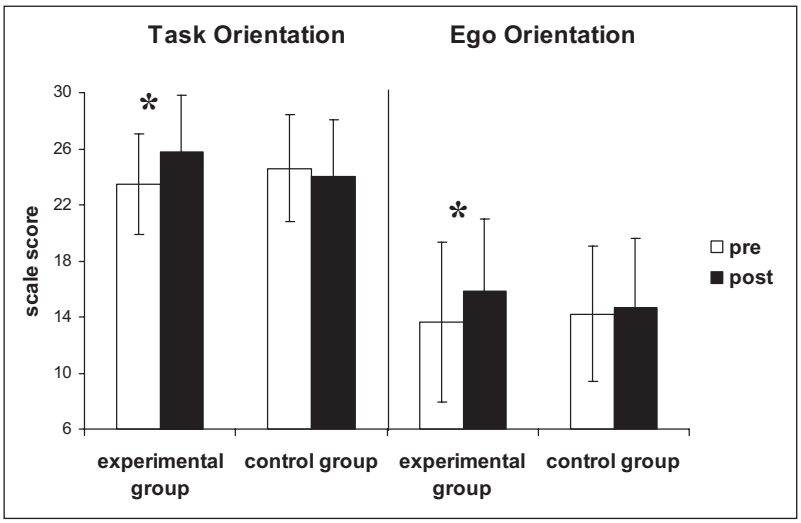

Figure 3. Scoring (±SD) in task (a) and ego (b) orientation before (pre) and after (post) the intervention period of children participating in the multi-sports PE programme (experimental group), or traditional PE programme (control group) (* = $p < .05$).

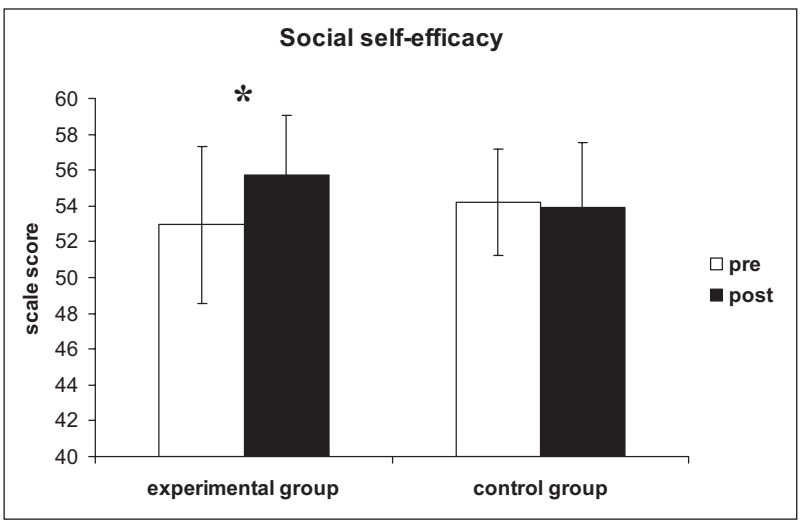

Figure 4. Scoring (±SD) in social self-efficacy before (pre) and after (post) the intervention period of children participating in the multi-sports PE programme (experimental group), or traditional PE programme (control group) (* = $p < .05$).

Teaching styles. A satisfactory intra- and inter-observer agreement, indicated by a percentage of agreement [Agreements/(Agreements + Disagreements) x 100] ≥ .80, was reached. PE specialists, when compared to generalists, used more differentiated reproductive and productive styles.[29] Within the multi-sports activities, pupils were allowed to choose between multiple levels of performance based on perceived ability (inclusion style) and to engage not only in the individual reproduction of movement patterns (command and individual practice style), but also in the autonomous or cooperative search for different movement task solutions (divergent discovery style). In contrast, generalists limited their spectrum to a frequent use of two reproductive styles (command and individual practice) and a less frequent use of only one productive style (guided discovery).

Discussion

The increasing initiatives for elementary PE enhancement with specialist teachers targeted to promote healthy development in many European and American countries call for more scientific evaluations to gain the greatest benefit from these investments and to inform policy development.[30,31] The present study aimed to compare the physical and psychological outcomes of elementary school PE curricula taught by specialists and generalists, and was centred on multi-sports sampling or traditional PE, respectively. The multi-sports approach to PE quality enhancement was chosen according to Kirk's[12] claim that elementary school children should be 'samplers' of multi-sports activities to enhance motor skills and perceptions of motor competence, which are essential to regular participation in health-related PA.

The present results support the view that regular participation in school-based PA has the potential to enhance a child's physical, emotional, social and cognitive well-being.[32] Also, they add the novel indication that providing children with a wide range of multi-sports experiences in elementary PE may have positive outcomes on children's physical fitness, motor coordination, goal orientations, and social self-efficacy. These physical and psychological benefits might represent intermediate outcomes that mediate the effects of early quality PA experiences on actual and later PA participation.[33] Therefore in addition to the recommendation of 60 minutes or more of Moderate to Vigorous Physical Activity (MVPA), derived from research examining the 'dose-response' relationship,[8] also the 'quality-response' relationship should be considered when designing specialist-led PE interventions for children in elementary school.

The focus on variability of practice through the multi-sports approach to PE has led to positive outcomes on kinesthetic discrimination performance (Figure 2) and on aerobic fitness which improved in both groups, but more pronouncedly in the multi-sport intervention (Figure 1). Exercise intensity levels were not measured in this study; however, the higher improvement in aerobic fitness in children participating in the multi-sport PE intervention supports the premise that specialist-led interventions may substantially increase the time elementary school children engage in meaningful MVPA and that repeated bouts of skill-based training as in the multi-sports approach to PE can enhance measures of aerobic fitness.[34,35] Although the control group started with a higher baseline level of aerobic fitness, the differential intervention effect cannot be entirely explained by a ceiling effect, because it still remained significant after controlling for the potential covariation of pre-intervention performance levels.

The experimental intervention also contributed to reinforcing children's task orientation, ego orientation and social self-efficacy (Figures 3 and 4). Beyond the expected enhancement of children's self-efficacy beliefs and task orientation, the parallel enhancement of ego orientation is consistent with a goal profile in PE labeled 'competitive achiever' that joins high levels of task,

ego, and social goals, emphasizing mastery, competition and socialization.[36] Sport-based PE programmes join playful cooperative activities and simulation of competitive features of sport which may influence motivation,[37] probably encouraging the development of both mastery and performance goal orientations. Particularly, the employed multi-sports programme offers PE teachers the opportunity to promote children's mastery of multifaceted tasks, accommodating individual skill differences and exploring different interaction patterns.

The geographical concentration of the elementary schools in only one town, although stratified per urban district, limits the generalizability of the findings to other contexts. Also, participants and classes were not randomly assigned to the experimental or control condition due to constraints with teacher availability and school-related administrative concerns. Finally, PE content and teachers' delivery skills could not be decoupled, only PE specialists having specialized skills to deliver multi-sports quality PA experiences. Differences in delivery were controlled only as concerns the teaching styles employed. Further studies are needed to control the role played by the other characteristics and pedagogical skills of the teachers.

In conclusion, a multi-sports approach to elementary school PE seems to be a feasible intervention that can contribute to the development of children's physical and psychological prerequisites for lifetime PA adherence, provided the programme is taught by a PE specialist. Future research should investigate the effects of specialist-led PE on children's school-relevant cognition. The multi-sports approach may be particularly appropriate since it integrates different skill-based activities with highly variable cognitive and social interaction demands, which seem to positively influence memory performances of school-age youth.[38]

These results have health education implications. If it is the intention of all personnel involved in healthy youth development – from policy makers to school administrators and PE teachers – to have a positive impact on lifelong PA adherence, then there should be concerted efforts to promote the development of the physical and psychological characteristics predicting participation in PE and later PA habits.[11,28] Notwithstanding notable efforts to counteract children's inactivity and promote PA among school-age youth,[1] the answers coming from the educational and competitive sport systems still largely diverge. The first Youth Olympic Games were introduced in 2010 with the declared motivation to contribute to solving the universal problem of increasing sedentariness and obesity in youths. Nevertheless, a performance-oriented approach to youth sport, stressing competitiveness and early specialization for talent identification, highlights the low capacity of the competitive sport system to implement educational policies of early multi-sports diversification.

Given the leading role attributed to schools for PA promotion in children,[39] the educational and health-promoting opportunities offered by youth sport are not being adequately exploited by the competitive sport system, and should be more properly conveyed by the educational system into school-based policies. Evidence presented here suggests that a multi-sports approach to elementary PE, centred on the role of specialist PE teachers in sport education programmes,[40] may represent an effective means to contribute to the ideal convergence of education and sport for promoting young people's participation in health-related PA and sports.

Conflict of interest statement

None declared.

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