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Eight months of school-based soccer improves physical fitness and reduces aggression in high-school children

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ABSTRACT: School-based programmes have shown promising results in the reduction of aggressive behaviour, but the effectiveness of physical activity modalities among adolescents remains to be determined. The aim of this study was to determine the effects of a school-based soccer programme on physical fitness and aggression in adolescent students. One hundred and five high school students were randomized to a small-sided soccer training group (SG) or a control group (CG). In addition to the regular physical education classes performed as part of a curriculum, the SG completed eight months of small-sided soccer training twice a week after school. Aerobic fitness (YYIR1), vertical jump (VJ), backward overhead medicine ball throw (BOMBT), and Buss and Perry's aggression questionnaire were evaluated before and after eight months of training. Greater improvements were observed in the SG than in the CG in the BOMBT (%diff=4.3, η_p^2=.308) and YYIR1 tests (%diff=2.2, η_p^2=.159), and physical aggression subscale (%diff=-12.1, η_p^2=.144). Extra, school-based recreational soccer for adolescents was accompanied by a significant improvement in physical fitness, compared to physical education classes only. Moreover, the implementation of recreational soccer into regular physical education classes seems to be a potentially appropriate stimulus for reducing aggression in high-school students.

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INTRODUCTION

The most important motivational factors for physical activity among adolescents are motives related to health and enjoyment [1]. Recreational soccer provides fun and effective options to encourage adolescents to train at a workload that aims to enhance their fitness and health profile [2–4]. Soccer matches for youth are generally organized as small-sided games (SSGs) with fewer than six players per team on pitches of a reduced area [5]. In this context, SSGs are often used as a popular alternative for those seeking to improve their physical and metabolic fitness [3] while maintaining high involvement and motivation [5]. The importance of motivation and enjoyment for physical activity but also for school-based interventions in youth was recently confirmed [3].

Adolescence is a critical phase of human development, which includes a variety of health-related risk behaviours [6]. One of the recent issues and risk behaviours among modern high-school students is aggressive behaviour [7]. Nelson and Gordon-Larsen stated that participation in physical activity is associated with favourable adolescent risk behaviours [8]. In this context, we found opposite results concerning the impact of participation in physical education on the slope of aggressive behaviour in adolescents [9, 10]. However, extracurricular sports activities may contribute to encouraging more ethical and less delinquent behaviour in adolescents by promoting both physical and psychological advantages [9]. The child-centred approach is a proven approach that focuses on imparting the child with self-control, emotional, social, and problem-solving skills [11, 12]. Through interaction with peers during extracurricular sports activities, adolescents may develop self-control skills and reduce their aggressive behaviour [13]. Harwood et al. stated recently that troubled youth often do not cooperate with traditional psychologically oriented approaches [14].

Soccer is a popular, accessible, and easy-to-learn sport that offers children opportunities for enjoyable physical activity. Recreational soccer also has the potential to promote social interactions that may have an impact on perceived psychological status [15]. This was confirmed recently by Seabra et al., who found a positive influence of soccer on perceived psychological status [16, 17]. To the authors' knowledge, only two studies have examined the effects of a school-based intervention on aggression behaviour [11], with one focusing on adolescents [18]. Zivin et al. showed that traditional martial arts (Koga Ha Kosho Shorei Ryu Kempo) provided positive outcomes for violence and psychological risk factors in adolescents [18]. Shachar et al. also showed that after-school sports activities (e.g., soccer, basketball, volleyball, capoeira, martial arts) five times per week produce larger reductions in physical aggression, hostile thoughts, anger, and negative emotions in comparison to a standard physical education programme in children 8–12 years of age [11]. Nonetheless, there is a lack of longitudinal studies that could explore whether any of the specific components of aggression in adolescents could be impacted across time. Such an intervention could potentially help in the development of effective school-based interventions and preventive programmes.

The aim of this study was therefore to determine the effects of a school-based soccer programme on physical fitness and aggression in adolescent students. It was hypothesized that a school-based soccer programme would decrease aggression and improve physical fitness parameters in high-school students. Additionally, this study examined whether changes in physical fitness measures relate to changes in aggression measures.

MATERIALS AND METHODS

Subjects

One hundred and five high school students from twelve classes were cluster-randomized to recreational soccer training group (SG) (three classes: n=54 (14 girls), age=15.7±0.6 years [range: 14.86, 16.34]; Y-PHV, i.e., years to and from peak height velocity=0.3±0.9 years) and to the control group (CG) (three classes: n=51 (16 girls), age=15.8±0.5 years [range: 14.91, 16.33]; Y-PHV=0.4±0.7 years) that maintained their usual physical education activities (Table 1). The participants knew they could withdraw from the study at any time without any penalty. The study flow diagram is presented in Figure 1. No time-loss injuries were sustained during the soccer sessions. The participants underwent medical evaluation before the beginning of the study. For each participant, maturity was estimated by predicting age at peak height velocity (Y-PHV) [19] via a gender-specific equation that includes anthropometric measures (weight, height, leg length, and sitting height) [20], as it has been considered as the directive for assessing physical fitness in boys and girls aged 10–16 [21]. All participants were fully informed of the risks associated with the experimental procedures and agreed to participate in the study with the signed informed consent of their parents or guardians. The study was carried out in accordance with the Declaration of Helsinki and approved by the ethics committee of the Faculty of Sport and Physical Education at the University of Novi Sad.

Procedures

The study was carried out in the period from September 2014 to May 2015. In both groups, participants' baseline levels of physical fitness and aggression were assessed a week prior to the beginning of the intervention, following the familiarization sessions. During the familiarization sessions, the assessment protocols were introduced to all participants, and a small-sided recreational soccer intervention was introduced to the SG group. Both groups, SG and CG, attended regular physical education (PE) classes twice a week for eight months. In addition to PE classes, SG undertook two recreational soccer sessions after school. In total, the SG completed 64 soccer sessions after school: ~45-min SSG sessions per week, separated by at least 1 day. Finally, SG and CG participants' levels of physical fitness and aggression were retested after 32 weeks. Regarding compliance, the average number of sessions attended was >85% for both groups.

The test battery consisted of anthropometric measurements (height, mass, body mass index [BMI]), aggression, and several physical fitness tests. Experienced university staff performed all tests and assessments, with support from the physical education teachers. The tests were completed over two consecutive days, with the requirement that physical activity must not be performed a day before test day 1. Test day 1: assessment included body mass and weight, sit-ups, vertical jump, and backward overhead medicine ball throw.

TABLE 1. Sample general anthropometric characteristics.

Characteristics	Soccer group		Control group	
	Pre-training	Post-training	Pre-training	Post-training
BH (cm)	176.5±5.1	177.3±4.6	174.0±3.1	175.0±4.2
BW (kg)	66.4±7.5	65.2±5.8	65.1±6.9	66.3±6.6
BMI (kg/m^2)	21.0±3.5	20.2±2.7	20.7±3.2	20.8±3.5

Values are mean± SD. Abbreviations: BH - Body height; BW - Body weight; BMI – body mass index.

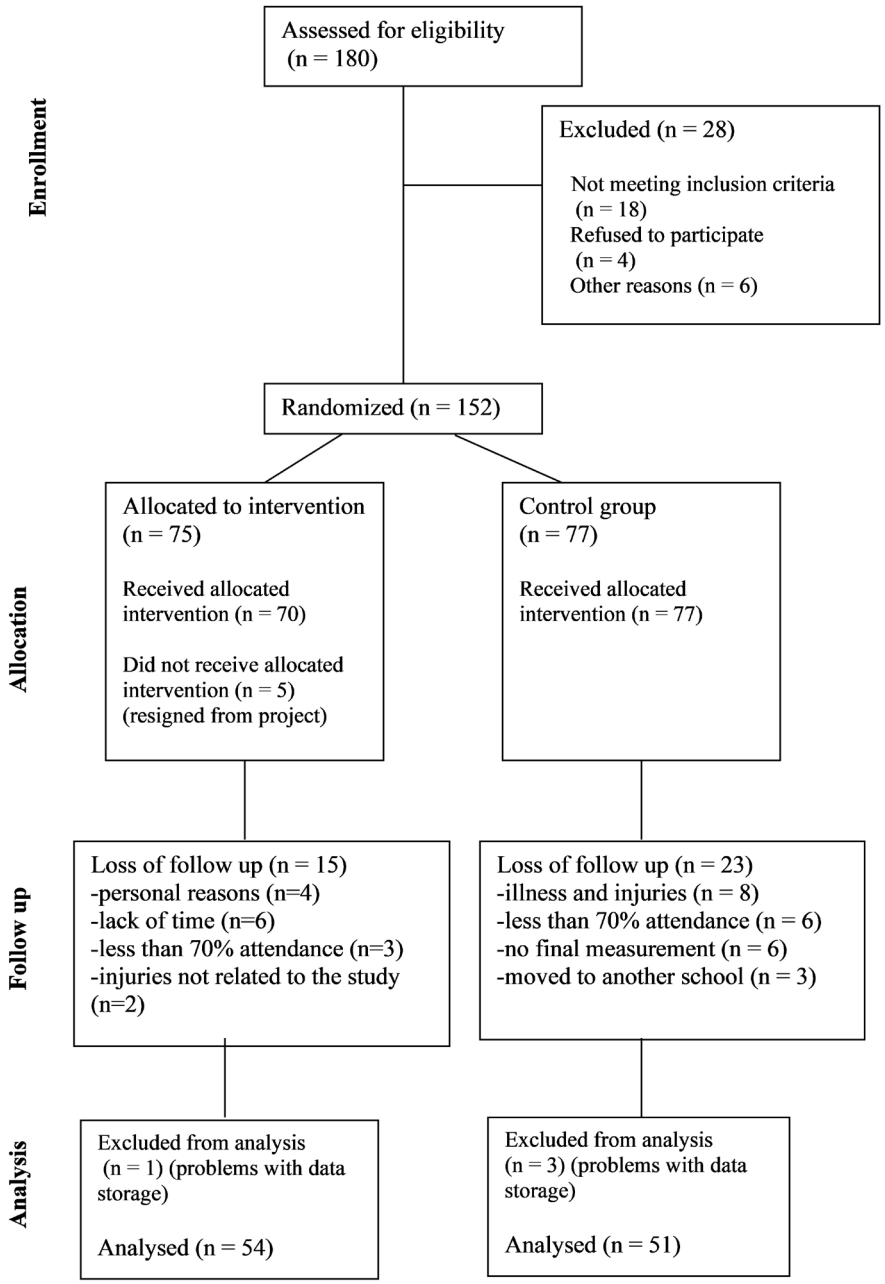

FIG. 1. Flow chart of participant enrolment, randomized group allocation, and final analysis.

Test day 2: Aggression Questionnaire followed by Yo-Yo intermittent recovery level 1 test. Before the assessment, the school children performed a standardized warm-up consisting of moderate-intensity jogging (4 minutes), static and dynamic stretching (4 minutes), and acceleration running (2 minutes).

In Serbia, it is compulsory for school children to have two PE classes of 45 min per week. PE classes involve learning techniques in ball games (volleyball, handball, basketball), instruction, and individual sporting activities common to many European countries (gymnastics, table tennis, athletics), excluding soccer. The duration of each type of physical activity was about one month. HR was monitored during SSG sessions and also during PE classes, and the average HR was recorded for the period of each physical activity.

Training programme

The content of the programme was inspired by and adapted from several protocols [22, 23]. The SSGs were played with varying rules, and mini-goals were used without goalkeepers on an indoor pitch

with the size adjusted to the relative pitch area (40 to 70 m^2 per player) (Table 2). Each session consisted of a warm-up lasting ~10 min (moderate-intensity jogging (4 minutes), static and dynamic stretching (4 minutes), and acceleration running (2 minutes)), ~30 min of soccer and ~5 min of cool-down. The intensity of training was monitored using individual HR monitors (Polar S-610; Polar Electro, Kempele, Finland) and supervised by trained staff. The same 10 players were monitored for every session for the first two weeks and the last two weeks of the training programme. HR was recorded at 5-s intervals and mean HR during the ~45-min soccer training sessions, including warm-up, was 154±12 bpm (85–89% of HRpeak). The exercise programme was performed for over 8 months, divided into two 40-month stages, to adjust the work intensity. In order to progressively increase the exercise intensity, the relative pitch area was increased from 40 m to 70 m per player [22]. Moreover, each time the ball went out of play, the teacher immediately fed in another ball, resulting in constant play flow and thus avoiding any notable decrease in the physical demands on the players.

Furthermore, during the games, the teachers tried to prevent and respond to aggressive behaviour in children before or instead of discipline. Intervention included sports activities specifically designed to explicitly impart children with self-control skills in order to reduce aggressive behaviour and improve interpersonal relationships with peers and adults [12, 24, 25]. In addition to the training programme, two days per month were devoted to an educational discussion focused on behavioural modelling, role-playing, and behavioural rehearsal with the techniques of social skills training to help children build social skills and positive relationships with peers [26].

Measurements

Backward overhead medicine ball throw (BOMBT). The participant held a 3-kg rubber medicine ball (Tigar, Pirot, Serbia) with arms straight in front of the body and, following a countermovement, flexed their hips and knees before extending forcefully backward to throw the ball over their head [27]. The medicine ball was lightly covered with gym chalk powder (magnesium carbonate) to serve as a drying agent for hands by absorbing sweat and ensuring a reliable and strong grip to prevent the ball slipping from the subject's hands. It also left a mark on the floor where the ball landed, ensuring precise measurement of the throwing distance. The score was measured from the front of the line to the point where the ball landed. The score for each throw was recorded to the nearest 5 cm. Three attempts were made with 1-minute rest intervals between each attempt. The best of the three attempts was adopted for further analysis. ICC and CV for measuring BOMBT were 0.832 and 3.84%, respectively.

Vertical jump. Vertical jump performance was measured using a wall tape [28]. The participant was instructed to reach above their head within normal extension limits to record standing reach. The same initial reach was used in both pre- and post-training measurements. The participant was then allowed three trial jumps to obtain their maximal vertical jump (in centimetres). The participant was allowed arm movement but not a preliminary step. ICC and CV for measuring vertical jump performance were 0.911 and 2.89%, respectively.

Yo-Yo Intermittent Recovery Level 1 test (YYIR1) was performed according to the guidelines established by Povoas et al. [29]. Yo-Yo Intermittent Recovery test performance and associated measured HRpeak are reliable for 9–16-year-old soccer players and non-sports-active boys [29]. Briefly, the Yo-Yo Intermittent Recovery test consists of repeated 2×20-m runs back and forth (180-degree turns) between the starting, turning, and finishing line at a progressively increased speed, controlled by beeps from an audio device. The total distance (in meters) was recorded for the analysis.

The *Aggression Questionnaire* was used to assess aggressive behaviour as a trait [30]. The Aggression Questionnaire is a 29-item instrument that assesses four dispositional expressions of aggression, namely physical aggression, verbal aggression, anger, and hostility. A five-point Likert scale was used: 5 points (from Extremely uncharacteristic of me=1 to Extremely characteristic of me=5) that provides a global measure of aggression and four subscales: Physical Aggression (PA, 9 items, e.g., "If somebody hits me, I hit back"), Verbal Aggression (VA, 5 items, e.g., "I often find myself disagreeing with people"), Anger (A, 7 items, e.g., "Some of my friends think I am a hothead"), and Hostility (H, 8 items, e.g., "I sometimes feel that people are laughing at me behind my back"). The reliability of the adolescent population was previously verified [31].

TABLE 2. Overview of soccer game format during experimental period.

SSG	Game duration (repetitions x time)	Duration of recovery between SSG (min)	Relative pitch area
4 vs. 4	4 x 5 min	3 min	40 m^2
3 vs. 3	4 x 5 min	3 min	50 m^2
4 vs. 4	4 x 5 min	3 min	60 m^2
3 vs. 3	4 x 5 min	3 min	70 m^2

Abbreviations: SSG – small-sided games; 4 vs. 4 – four players per team; 3 vs. 3 – three players per team.

Statistical analysis

Descriptive data were calculated for all variables. The assumption of normality was confirmed by the Shapiro-Wilk test. A 2x2 mixed ANOVA (group×time) was used to test for interactions, main effects and simple main effects for time (pre- vs post-training) and group (SG vs CG) on the physical fitness and aggression measures. The reliability of each test was assessed by calculating the intra-class correlations coefficient (ICC), according to the literature [32]. Also, to illustrate potential common aspects of trainability, we tested whether changes (%Δ pre-to-post) in physical fitness measures are related to changes in aggression measures, using Pearson's correlation coefficient. As a measure of effect size, partial eta squared (η_p^2) is reported, and defined as small (η_p^2=0.01), medium (η_p^2=0.06), and large (η_p^2=0.14), according to Cohen [33]. Statistical analyses were conducted in SPSS (SPSS, Version 18.0, Chicago, IL, U.S.A.). Statistical significance was established a priori at $p<0.05$.

RESULTS

The results are presented in Table 3. A 2x2 mixed ANOVA revealed a significant interaction between group and time for most physical fitness outcomes (Figure 2), except VJ performance (p=0.067). Although the interaction effect on the VJ performance was not significant, the simple main effect for time showed a significant increase of vertical jump height for 1.35 cm [95% CI: from 0.02 to 2.69] in the SG after 8 months ($F_{(1, 53)}$=4.117, p=0.047, η_p^2=.072), whereas the mean vertical jump height of the CG did not significantly change ($F_{(1, 50)}$=0.399, p=0.531, η_p^2=.008). However, SG performance notably increased in the BOMBT test by 0.48 m [95% CI: from 0.32 to 0.64] over the 8-month intervention, while CG performance in the BOMBT test significantly decreased by 0.18 m [95% CI: from 0.07 to 0.29] for the same period. Likewise, greater improvements of YYIR1 performance were seen in the SG as compared to the CG (33.33 m [95% CI: from 21.77 to 44.9] vs. 1.18 m [95% CI: from -7.57 to 9.9]).

Regarding 8-month changes in aggression measures, the only significant interaction between group and time was observed for physical aggression (Figure 2). Physical aggression was notably more reduced in the SG (-3.65 score [95% CI: from -4.91 to -2.39]) than in the CG (-0.75 [95% CI: from -1.28 to -0.22]) after 8 months. Nevertheless, the simple main effect for time indicated that hostility decreased to a similar extent in the SG (-2.06 score [95% CI: from -3.21 to -0.9]; $F_{(1, 53)}$=12.718, p<0.0005, η_p^2=.194) and the CG (-.98 score [95% CI: from -1.52 to -0.44]; $F_{(1, 53)}$=13.395, p<0.0005, η_p^2=.211) over the same period. However, verbal aggression and anger did not change in the SG (p=0.067, 0.101, respectively) or the CG (p=0.498, 0.247, respectively).

Pearson's correlation coefficient showed that most relationships between the relative changes from pre- to post-test in aggression measures and the relative changes from pre- to post-test in physical fitness measures were not significant. However, we observed significant correlations between lowering of physical aggression and improvements in the BOMBT (r=-0.357, p<0.001) and YYIR1 tests (r=-0.196, p=0.045). Also, there was observed significant correlation between lowering in hostility and improvements in the BOMBT test (r=-0.231, p<0.05).

DISCUSSION

The present 8-month study aimed to evaluate the fitness and aggression effects of prescribed additional playing SSGs on top of a curriculum involving PE classes twice a week, with intermittent classroom learning around social behaviours in high-school children. The results indicate that SG and CG significantly improved physical fitness, but playing small-sided soccer resulted in greater improvement in comparison with PE classes only. Moreover, both groups experienced a reduction in physical aggression and hostility over eight months, but the additional playing of SSGs induced a significantly greater decrease in physical aggression than PE classes only. Finally, correlation analysis showed that improvements in physical fitness

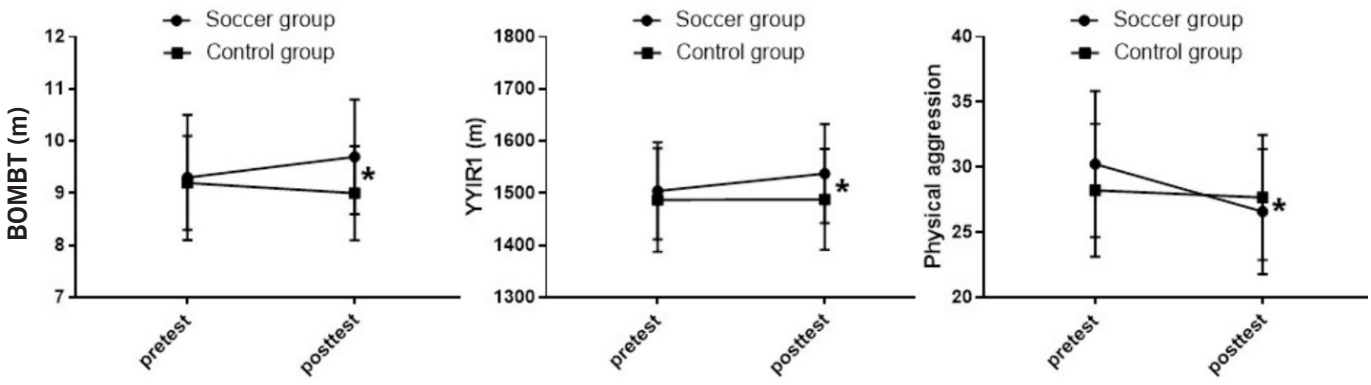

FIG. 2. Significant interaction between group and time on the backward overhead medicine ball throw test (BOMBT), the Yo-Yo Intermittent Recovery test Level 1 (YYIR1), and the Physical aggression subscale.

TABLE 3. Changes in physical fitness and aggression measures from pre- to post-test in SG and CG.

	Pre-test	Post-test	% Δ	A 2 x 2 mixed ANOVA outcome
				Physical fitness
				BOMBT (m)
SG	9.3±1.2	9.7±1.1	4.3*	the main effect of group: $F_{(1, 103)}$=3.984, p=0.049, η_p^2=0.037
CG	9.2±0.9	9.0±0.9	-2.2*	the main effect of time: $F_{(1, 103)}$=9.212, p=0.003, η_p^2=0.082
				the interaction effect: $F_{(1, 103)}$=45.849, p<0.0005, η_p^2=0.308
				VJ (cm)
SG	38.4±6.4	39.7±5.5	3.4*	the main effect of group: $F_{(1, 103)}$=1.505, p=0.223, η_p^2=0.014
CG	37.9±6.9	37.5±6.0	-1.1	the main effect of time: $F_{(1, 103)}$=0.853, p=0.358, η_p^2=0.008
				the interaction effect: $F_{(1, 103)}$=3.415, p=0.067, η_p^2=0.032
				YYIR1 (m)
SG	1504.4±93.1	1537.8±95.1	2.2*	the main effect of group: $F_{(1, 103)}$=3.312, p=0.072, η_p^2=0.031
CG	1487.1±99.2	1488.2±96.8	0.1	the main effect of time: $F_{(1, 103)}$=22.416, p<0.0005, η_p^2=0.179
				the interaction effect: $F_{(1, 103)}$=19.463, p<0.0005, η_p^2=0.159
				Aggression
				PA (score)
SG	30.24±5.6	26.59±4.8	-12*	the main effect of group: $F_{(1, 103)}$=3.201, p=0.077, η_p^2=0.03
CG	28.23± 5.1	27.68±4.8	-1.9*	the main effect of time: $F_{(1, 103)}$=39.742, p<0.0005, η_p^2=0.278
				the interaction effect: $F_{(1, 103)}$=17.353, p<0.0005, η_p^2=0.144
				VA (score)
SG	17.94± 3.1	17.05± 3.4	-5.0	the main effect of group: $F_{(1, 103)}$=1.419, p=0.236, η_p^2=0.014
CG	18.49± 4.4	18.33± 4.2	-0.9	the main effect of time: $F_{(1, 103)}$=3.738, p=0.056, η_p^2=0.035
				the interaction effect: $F_{(1, 103)}$=1.616, p=0.207, η_p^2=0.015
				Hostility (score)
SG	26.01±5.3	23.96±5.8	-7.9*	the main effect of group: $F_{(1, 103)}$=0.225, p=0.637, η_p^2=0.002
CG	26.00±6.2	25.01±6.0	-3.8*	the effect of time: $F_{(1, 103)}$=21.961, p<0.0005, η_p^2=0.176
				the interaction effect: $F_{(1, 103)}$=2.754, p=0.1, η_p^2=0.026
				Anger (score)
SG	18.16± 4.6	17.38± 4.5	-4.3	the main effect of group: $F_{(1, 103)}$=5.407, p=0.022, η_p^2=0.05
CG	19.86± 4.5	19.54± 4.4	-1.6	the effect of time: $F_{(1, 103)}$=4.075, p=0.046, η_p^2=0.038
				the interaction effect: $F_{(1, 103)}$=0.493, p=0.48, η_p^2=0.005

Values are mean±SD. Abbreviations: SG soccer group; CG control group; BOMBT – the backwards overhead medicine ball throw test; VJ – the vertical jump test; YYIR1 – the Yo-Yo intermittent recovery test level-1; PA – the Physical aggression subscale; VA – the Verbal aggression subscale; Hostility – the Hostility subscale; Anger – the Anger subscale; % Δ – percentage of change from pre- to post-test. *significant difference from pre- to post-test at p<0.05.

(BOMBT and YYIR1) might be related to changes in physical aggression.

Physical fitness represents a very important and useful health marker in adolescence [34]. In the current study, explosive leg power was improved by 4.3% (*large* ES) in BOMBT after eight months of recreational, small-sided soccer training, while in vertical jump, it was 3.5% (*small* ES) and without statistical significance. This could be expected, given that small-sided ball game activities include more than 100 fast runs and sprints per hour and more than 150 specific intense actions such as dribbles, tackles, jumps, and changes of direction [35]. A recent study confirmed that recreational football training had positive effects on countermovement jumping (17.0%; ES=0.76, moderate) in overweight and obese children [36]. Additionally, football training was at least as beneficial as a standard exercise programme in improving the vertical jump of overweight children [37]. However, Hammami et al. found limited effects on jump performance in untrained adolescents, following eight weeks of soccer training [38]. A possible explanation for this discrepancy could be found in the different duration of training periods across studies, as well as the difference in participants' characteristics. Moreover, different protocols being used to assess vertical jump ability could have significantly contributed to the mentioned discrepancy above.

Our results indicate that a school-based recreational soccer intervention is effective for improving aerobic fitness, as fitness improved by 2.2% (*large* ES). This is in line with previous studies performed on preadolescent and adolescent children [17, 36, 39, 40]. A recent

meta-analysis showed that the duration of school-based interventions significantly contributed to the effects of aerobic fitness; however, these effects appeared only in interventions lasting 13–24 weeks or 32 weeks or more [41]. This was confirmed in the present study, which lasted for 32 weeks. Additionally, our programme mainly consisted of SSGs (~75% of total time), which probably increased the exposure time to intensities that were compatible with aerobic fitness improvement [42]. These results support the evidence that there are considerable cardiovascular effects of school sports interventions with long-term health benefits when the intensity of exercise is controlled. It might also be speculated that bigger improvements occurred in the SG compared with the CG because the participants were more motivated when playing soccer compared to PE classes, due to the fact that participants usually found the soccer game enjoyable [43]. Minatto et al. concluded in their recent review that PE classes alone could not significantly improve aerobic fitness in adolescents [41]. Moreover, they stated that strategies combining additional physical exercise in or after school hours with theory-based programmes focused on behavioural change are more promising in promoting aerobic fitness. This was confirmed in our study, which was focused on educational discussion besides the afterschool SSG programme.

Exercise has been shown to be an effective coping mechanism for many individuals with aggressive tendencies [44]. In a school environment, extracurricular sports activities have been proposed as a mitigating factor for aggressive behaviour, because they can serve as an outlet for psychological stress [9, 45]. In this study, we observed a significant decrease in physical aggression among high-school students participating in the eight-month recreational soccer programme. Our results support the fact that those who are engaged in more formal sports and for a greater period of time have lower levels of aggression [46]. In that context, children who engaged in extracurricular sports activities five times per week reported larger increases in self-control skills and larger reductions in physical aggression, hostile thoughts, and anger in comparison to the control group [11]. Moreover, Pedersen and Seidman stated that recreational soccer has the potential to promote teamwork, sharing, and better interpersonal relationships with peers and adults, all of which provide opportunities to enhance perceived psychological status [15]. This was confirmed with several recent studies which found that recreational soccer programmes had positive effects on the psychological status of children [16, 43, 47–49]. The strength of our study is the use of a strategy that combines extracurricular recreational soccer with theory-based programmes focused on behavioural change. Our results along with the results from other studies could be a powerful argument for the use of recreational soccer by practitioners involved with young people to desirably impact aggressive tendencies. Further studies in the field are warranted.

We found that the decreases in physical aggression were related to improvements in explosive power (BOMBT: r=-.357) and aerobic fitness (YYIR1: r=-.196). Furthermore, with greater explosive power, hostile behaviour tended to be lower (r=-.231). To the author's knowledge, in adolescents, changes in aggressive behaviour have not yet been related to changes in physical fitness, but rather to participation in PE or sports activities [9, 44]. Future studies should investigate the true relationship between aggressive behaviour and physical fitness by assessing their different components using reliable tests. The focus of future studies should be exploring the effects of different exercise parameters (methods, duration, frequency, intensity) on changes in aggressive behaviour and physical fitness.

Among the present study's limitations, the overall physical activity of the students was not determined before and during the eight-month intervention period. A further limitation of the study was that we did not monitor or control for dietary intake, as a possible mediator of training gains, nor did we attempt to contextualize aggression (e.g. passive vs. reactive). The major strength of the study, in our opinion, is that it was the first to investigate the effects on aggression parameters of school-based interventions comprising SSGs in 15-year-old children. Nevertheless, this obviously does not imply that PE curricula should include only soccer training and play. Moreover, during informal discussions, we found that our students showed greater motivation during recreational soccer than in the more traditional classes they were used to performing before the intervention. In this context, we can speculate that adding SSG as part of the school curriculum might improve motivation and adherence to exercise, which, in turn, may elicit other physical and psychological health benefits over time.

CONCLUSIONS

The results of this study showed that the implementation of recreational soccer into regular PE classes seems to provide an appropriate stimulus for reducing aggression and improving physical fitness in high school students compared with normal PE classes. Compared to PE classes, recreational soccer with intermittent classroom activities provides an enjoyable, more intensive but non-competitive option with better peer interaction. The findings significantly contribute to the understanding of possible mechanisms underlying the associations between adolescents' aggression and sport activities, with particular implications for the roles of self-control and motivation. Moreover, due to the availability of sports in the school setting, implementing such a programme can be more cost-effective than deploying individual interventions with specialized professionals. Overall, this speaks in favour of promoting recreational soccer in schools to maintain a high level of physical fitness while lowering the students' aggression.

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Competing interests

No potential conflicts of interest were reported by the authors.

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