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Article

Classroom active breaks: a feasibility study in Southern Italy

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Summary

Though classroom time has been identified as a contributing factor to sedentary behavior, school has been recognized as the main educational setting providing physical activity (PA) opportunities. The purpose of this study was to develop and evaluate the feasibility of a classroom-based intervention which integrates PA during the school time, and assess its potential effect on reducing inactivity in primary school children. The intervention was performed in a sample of 47 children attending a primary school in the south of Italy and it was structured in two sessions of classroom active breaks (CABs) in three school days a week, shared with and supervised by the teachers. CABs showed an overall potential positive effect on the reduction of inactivity of ~12 min and an equivalent increase in PA levels, of which 5 min were of moderate/vigorous intensity. Girls showed lower time spent in light and moderate PA and higher amount of inactivity than boys and responded better to the intervention. The satisfaction of children and teachers was high. CABs program is a safe tool to reduce inactivity and increase moderate/vigorous PA. Designing structured exercise breaks adapted in a flexible way to meet the needs of the school curriculum program may increase the feasibility of such PA program in the schools.

Key words: children, physical activity, sedentary behavior, school

INTRODUCTION

Sedentary behavior among children and adolescents is associated with cardio-metabolic risk factors, obesity and type 2 diabetes (Fröberg and Raustorp, 2014; Saunders *et al.*, 2014; Cliff *et al.*, 2016). Therefore public health guidelines (Who, 2010) recommend that children aged 5–17 years should limit sedentary behavior and accumulate at least 60 min of moderate to vigorous physical activity (MVPA) every day. Remarkably, only 15% of schoolchildren aged 8–9 years fulfill these recommendations in Italy (Lauria *et al.*, 2016). Considering that children spend many hours at school, the classroom is the ideal setting to educate them on reducing inactivity. However, the

emphasis on the academic content renders school one of the dominating environment of sedentary behavior and class time a significant sedentary period of the day (Holt *et al.*, 2013).

Previously, school-based intervention programs have been developed to integrate physical activity (PA) into academic lesson content (Mahar *et al.*, 2006; Donnelly *et al.*, 2009; Grieco *et al.*, 2009; Bartholomew and Jowers, 2011; Donnelly and Lambourne, 2011; Vazou *et al.*, 2012; Martin and Murtagh, 2015a; Drummy *et al.*, 2016; Norris *et al.*, 2016; Watson *et al.*, 2017). Integration involves PA at any level of intensity, incorporated within the general education classrooms through the standard classroom time. Three main approaches have been used to include movement during the school time: incorporating PA as part of the academic lessons (e.g. students need to jump the answers to addition problems in a math lesson), scheduling short (5–15 min) PA breaks between lessons (e.g. having students follow a sequence of exercises) or including PA into the main transition periods (e.g. having students hop around the classroom before getting in line to go to lunch). The teacher is a key figure, having the duty of managing, demonstrating and monitoring PA sessions. Teachers may have several options to integrate movement into the academic lesson, using existing prepackaged programs, video exercise guides and/or creating and implementing their own strategies (IOM, 2013). There are several examples of 'ready-to-use' guides and programs designed to make PA 'breaks' between lessons (Katz *et al.*, 2010; Whitt-Glover *et al.*, 2011; Murtagh *et al.*, 2013). The purpose of these programs was to increase PA in children during the school time through an innovative tool represented by classroom PA breaks. However, studies demonstrating the feasibility and effectiveness of these programs are limited in number (Drummy *et al.*, 2016). To the authors' knowledge, the majority of the studies examining the effects of classroom activity programs have been mainly conducted in the USA (Katz *et al.*, 2010; Whitt-Glover *et al.*, 2011; Murtagh *et al.*, 2013). These studies showed the positive effects of classroom-based interventions not only on PA levels but also on behavior and physical fitness of children.

No univocal result regarding gender differences in the adherence to school-based prevention programs has been reported in the literature (Kropski *et al.*, 2008; Metcalf *et al.*, 2012). For instance, the systematic review by Kropski *et al.* (Kropski *et al.*, 2008) suggested that girls may respond better to educational components based on the social learning theory, while boys may be more influenced by structural and environmental changes facilitating increased PA and improved diet. However, the meta-analysis by Metcalf *et al.* reported that the differences in changes of PA between intervention designed to increase the PA and control groups were slightly higher in girls, although not significant. As for the specific effect of school activity breaks, two studies reported no significant dissimilarities between boys and girls (Murtagh *et al.*, 2013; Drummy *et al.*, 2016).

In Italy, about a quarter of children do not practice leisure time PA for more than a day per week and ~30% of them are overweight or obese, with higher rates in southern regions (Lauria *et al.*, 2016). Since physical education in primary-school in Italy is entrusted to generalist teachers and the time devoted to physical education is highly variable (European Commission/EACEA/Eurydice, 2013), children spend much time sitting down at school, which highlights the need for PA interventions in this setting.

Therefore, the aim of this study was to evaluate the feasibility and the effectiveness in reducing inactivity of a classroom-based PA intervention performed in children attending a primary school of south Italy (Lauria *et al.*, 2016).

MATERIALS and METHODS

Participants

This was a non-randomized feasibility study conducted in the primary school 'Istituto Comprensivo Piano di Sorrento' (Naples, Campania region, Italy) from March to June 2017. This school, included in the District of the Local Health Unit (ASL) Napoli 3 Sud, adhered to the regional project '*Crescere Felix*', aimed at promoting health nutrition and lifestyle in third grade school-children (primary school runs from 1 to 5 grades in the Italian context). The school authority and the teachers of the third classes were informed regarding the aims of the study, which consisted in incorporating classroom PA sessions between lessons to reduce inactivity in the third grade school-children (aged ~8 to 9 years). Only classes whose teachers agreed to participate were enrolled in the study. The parents or guardians of children involved were fully informed about the objectives and methods of the study and signed a consent form. Study procedures were carried out according to the guidelines laid down in the Declaration of Helsinki and approved by the scholastic institution board.

Children in the third grade classes were informed about the program and all were invited to participate to avoid discrimination. However, physical limitations or diagnosed developmental disabilities were considered as exclusion criteria when the data were analysed.

Procedure

The PA intervention was developed on the basis of previous literature (Murtagh *et al.*, 2013; Drummy *et al.*, 2016) by the research team and was structured in classroom active breaks (CABs). The initial program was organized in four exercise sessions scheduled during the school days, with the exception of the gym class day (namely four days/week). Each exercise session lasted 5 min and was composed of four exercises, based on fundamental movement skills and gross motor coordination, which differed for each session at a set time:

1st session 8:40 = Stretching
2nd session 9:40 = Running and jump
3rd session 11:40 = Upper limb exercises
4th session 12:40 = Lower limb exercises.

All teachers of the third classes attended a 1-day training program to understand the aims of the CABs and the way to perform the exercise sessions. A researcher showed in details each single exercise and provided the teachers both printed and digital materials, containing information about the proper performance of the tasks. Teachers were asked to provide any comment about feasibility. In particular they expressed difficulties about the high number of daily exercise sessions, which probably would have subtracted time to the academic curriculum, and the type of some exercises regarding the lower limbs (such as leaps), which were deemed unsafe for the little space. Therefore, the original CABs program was reduced to two sessions in three school days/week and exercises were limited to low-impact upper and lower limb exercises in the first session, and running and jumping on the spot in the second session.

The CABs program started on 1 February 2017 and ended on 30 April 2017. On the first day of intervention a researcher (CM) supported the teacher performing all the exercises together with the school-children. Furthermore, during the following weeks, a researcher periodically encouraged and supported teachers and school-children for a successful implementation of the CABs program. Teachers were in touch with the research group at any time using e-mail or contact numbers. Each session was performed and supervised by the teacher classroom. School children performed the CABs standing behind their school desk.

Inactivity and PA levels were assessed using the ActiGraph GT1M (ActiGraph LLC, Pensacola, Florida). The ActiGraph accelerometer has documented evidence of reliability and validity for measuring PA in studies involving children (Trost *et al.*, 2002; Rowlands *et al.*, 2007; Mcclain *et al.*, 2008; Dollman *et al.*, 2009). The accelerometer attached to an elastic belt was worn around the waist during the school day time and initialized to register counts (from 8:40 to 12:30 am for ~230 min) in two occasions: the first on a usual day before starting the CABs intervention (T0) and the second at the end of the program, after 3 months (T1) of 'training'. Accelerometer data were collected in 15 s epochs (time intervals); this period has been shown to have the best specificity and sensitivity for use with children (Trost *et al.*, 2002; Rowlands *et al.*, 2007). Data were expressed as mean activity counts. In addition, the activity levels were categorized using the Evenson's cut points (Evenson *et al.*, 2008) [Sedentary 0–100 counts per minute (CPM), Light 101–2295 CPM, Moderate 2296–4011 CPM, Vigorous >4012 CPM] as these provide the most acceptable classification accuracy for use with children (Trost *et al.*, 2011).

A questionnaire composed by 11 'yes or no' questions was administered to the school-children at the end of the intervention to explore their satisfaction of the CABs program. In addition, one 5-point Likert scale question (1 corresponding to 'very difficult' and 5 to 'very easy') was administered to assess the difficulty perception of CABs exercises. Only children whose complete accelerometer and questionnaires data were obtained were included in the analyses. At the end of the program teachers' opinion regarding the CABs program was assessed by a self-administered anonymous questionnaire composed by three open-ended questions on utility, feasibility and children compliance.

Data analysis

Data are presented as mean ± standard deviation for continuous variables (age, activity counts and time spent in different PA intensity levels) or frequency for categorical variables (gender, percent time spent in different PA intensity levels, percent of affirmative responses to the satisfaction questionnaire); the significance level was assumed at $p < 0.05$. The internal consistency of the satisfaction questionnaire was assessed by the Cronbach's alpha test, which provided a value of 0.68. Analyses were conducted using the IBM SPSS Statistics for Windows, Version 24.0 (Armonk, NY: IBM Corp). Independent-sample Student's *t*-test was performed to compare activity data between genders, while paired *t*-test was used to compare before-and-after observations on the same subjects.

RESULTS

There were 5 third grade classes in the school: based on the teachers consent, three classes with 70 children agreed to participate and two classes with 35 children did not. One teacher for class supervised the program. Subsequently based on either the parents' consent to wear the accelerometer or the exclusion criteria, the

number of the enrolled children was 53 (26 boys and 27 girls) out of 70 (75.7%); furthermore five children were excluded from the analyses because they were absent on the second assessment day and one for technical dysfunction of the accelerometer. Therefore only 47 children (24 males, 23 females), mean age 8.4 ± 0.3 years (range: 7.9–8.9 years) with complete data set were finally analysed. Age did not differ between boys and girls (8.5 ± 0.3 versus 8.3 ± 0.3 years, respectively).

The mean activity counts registered by accelerometer were compared between the two CABs sessions. Values during the first break session were significantly lower than those recorded during the second break session (356.8 ± 111.8 versus 1132.1 ± 451.4, respectively; $p < 0.001$): mean activity counts measured during the first break session corresponded to light PA, while the counts measured during the second session corresponded to vigorous PA. There were no differences, in term of counts, between boys and girls performing either CABs sessions. Significantly higher mean activity counts were registered during the school day at T1 with respect to a usual day at T0 (Table 1). The intervention substantially reduced the inactivity time and increased the MVPA levels, with no significant change in light PA.

Similar results were found by stratifying the sample by gender (Table 1). However, girls diverged from boys in that they significantly reduced inactivity and increased also light PA ($p < 0.05$). Comparisons at T0 further revealed significant gender differences, in that girls showed higher amount of inactivity and lower time spent in light and moderate PA than boys. These differences disappeared at T1 (Table 1).

Figure 1 shows the percentage of inactivity and time spent in the different PA intensity levels on the day with or without the CABs intervention. At T0 children spent 72% of the school time in inactivity, which decreased in favor of a consensual increase in MVPA after 3 months.

Children's satisfaction about the CABs program is shown in Figure 2. Almost the entire sample desired to repeat the experience in the future and almost the 80% of subjects appreciated the CABs program and asked to increase the activity sessions. Only 13% of students felt tired and 4% felt bored or losing time for study.

According to the open-ended questions, teachers unanimously considered the intervention and the related methodology interesting, easy to perform, well-accepted by children and effective. However, all teachers were still concerned that CABs might subtract time to other educational activities. Teachers suggested the program might have been repeated in the next year, extended to higher grades and also exported to other schools. Furthermore, they suggested to introduce the CABs program at the beginning of the school year to better incorporate the intervention with all the other school activities.

DISCUSSION

This study showed that it is possible to implement a CABs program in the primary school, taking into account the academic requirements and the time available to the teachers. This intervention, characterized by two daily PA breaks for three times a week, showed potential positive effects on the reduction of inactivity of ∼12 min and an equivalent increase in PA levels, of whom 5 min in MVPA, particularly in girls.

While in the US programs based on CABs are considered an auspicious strategy for schools to obtain health-related and educational objectives, hence they are recommended by various national organizations (Physical Activity Guidelines for Americans Midcourse Report

Table 1: Changes in mean activity counts (15 s epoch), inactivity and physical activity time before and after the classroom physical activity break intervention in the whole sample and by gender

	Whole sample ($n = 47$)			Boys ($n = 24$)			Girls ($n = 23$)		
	T0	T1	p	T0	T1	p	T0	T1	p
Activity counts (mean)	41.5 ± 21.7	82.9 ± 82.9	<0.001	50.7 ± 23.0*	86.4 ± 29.1	<0.001	31.9 ± 15.6	79.4 ± 19.8	<0.001
Inactivity (min)	177.5 ± 21.4	165.0 ± 23.8	<0.01	167.1 ± 21.2*	158.9 ± 27.7	0.254	188.3 ± 15.8	171.4 ± 17.4	0.001
Light PA (min)	50.9 ± 19.9	58.1 ± 22.3	0.102	60.5 ± 19.5*	63.8 ± 25.7	0.621	40.9 ± 15.1	52.2 ± 16.6	0.020
Moderate PA (min)	2.1 ± 1.9	4.0 ± 2.5	<0.001	2.8 ± 2.2*	4.7 ± 3.1	0.018	1.4 ± 1.3	3.4 ± 1.4	<0.001
Vigorous PA (min)	0.5 ± 0.8	3.8 ± 1.3	<0.001	0.6 ± 0.7	3.6 ± 1.3	<0.001	0.4 ± 0.8	3.9 ± 1.3	<0.001

*$p < 0.05$ comparison between boys and girls.

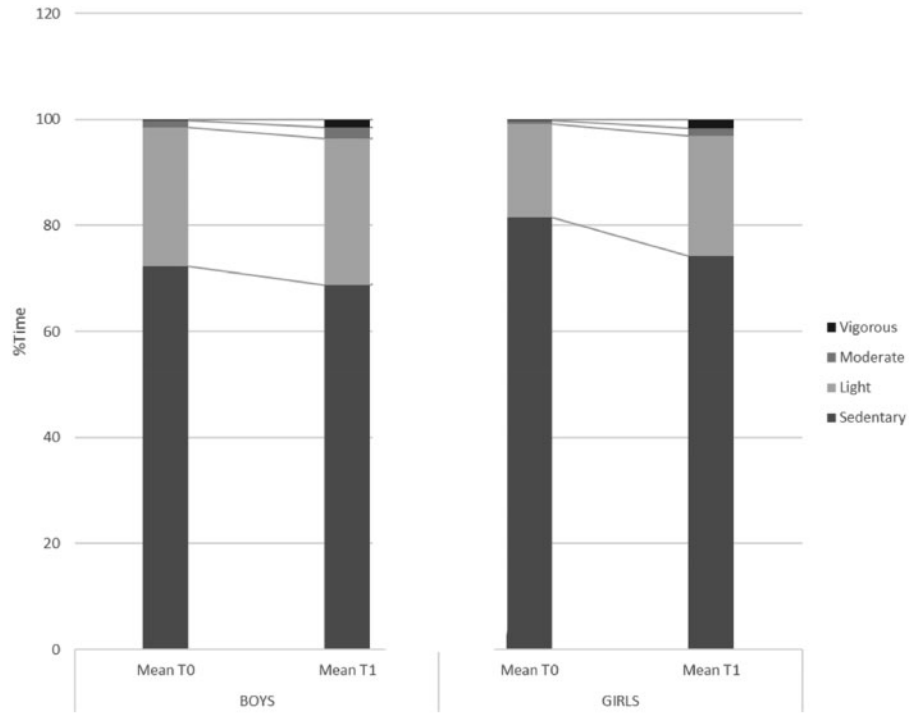

Fig. 1: Mean percent of the school day time spent in inactivity and time spent in the different PA intensity levels on the day with or without the classroom physical activity break intervention by gender.

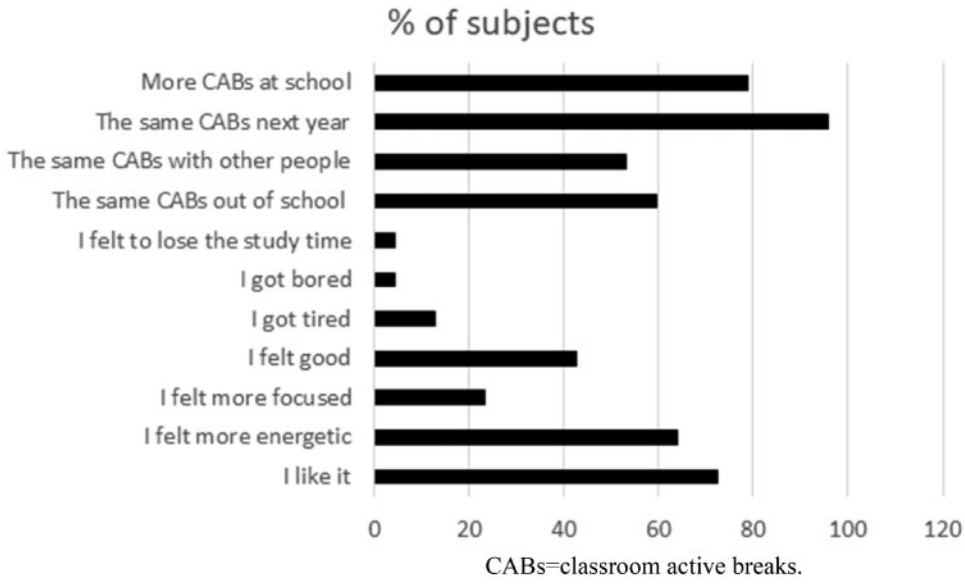

Fig. 2: Percent of affirmative responses to the classroom physical activity breaks' satisfaction questionnaire.

Subcommittee of the President's Council on Fitness, Sports & Nutrition, 2012; IOM, 2013; Centers for Disease Control and Prevention, 2016), in Italy it is very far to be integrated in the academic curriculum. This study is the first evaluating the feasibility of movement integration during the school time through short PA breaks between lessons in primary school-children in Southern Italy. The purpose of this study was not to use

prepackaged exercise programs, as other studies did (Donnelly *et al.*, 2009; Donnelly and Lambourne, 2011; Carlson *et al.*, 2015), but to design structured exercise breaks adapted in a flexible way, after discussion with the teachers, to meet the requirements of the school curriculum program.

Previous programs requiring teachers to integrate short PA period into their lesson have been shown to be effective in improving children's classroom behavior (Whitt-Glover *et al.*, 2011; Howie *et al.*, 2014; Ma *et al.*, 2014; Carlson *et al.*, 2015), academic achievement (Uhrich and Swalm, 2007; Donnelly and Lambourne, 2011, Howie *et al.*, 2014, Mullender-Wijnsma *et al.*, 2016) and cognitive function (Donnelly and Lambourne, 2011, Janssen *et al.*, 2014; Ma *et al.*, 2015). Different standing programs included active break durations between 10 and 15 min (Hill *et al.*, 2010; Whitt-Glover *et al.*, 2011; Janssen *et al.*, 2014; Wilson *et al.*, 2016), however, numerous factors were associated with their real application, for example teachers claimed the need to consider time and space constraints (Webster *et al.*, 2013; McMullen *et al.*, 2014). Only one study (Watson *et al.*, 2017) involved classroom teachers in the development of the active break intervention, with important implications for the sustainability and feasibility of such programs. For this reason, to increase the applicability in the real-world, we shared the program with the teachers and modified the original activity sessions to face the barriers associated with the effective time management and safety in the limited available classroom's space. Furthermore, we included open-ended questions about teachers' satisfaction with the CABs.

In our study the two daily activity breaks measured by accelerometer were quite different in intensity, since the first session corresponded to light PA, while the second session corresponded to vigorous PA; in this way the students were allowed to gradually adapt to the exercise intensity. The results of this study highlighted the potential of the program to reduce the inactivity at school and slightly increase MVPA levels. To the authors knowledge, only one study evaluated the effect of a PA break intervention at school, on both inactivity and light, moderate and vigorous PA levels (Martin and Murtagh, 2015b), other studies did not measure the inactivity time (Donnelly *et al.*, 2009; Donnelly and Lambourne, 2011; Carlson *et al.*, 2015; Riley *et al.*, 2015; Drummy *et al.*, 2016; Norris *et al.*, 2016; Watson *et al.*, 2017) and five studies considered only the MVPA levels (Donnelly *et al.*, 2009; Donnelly and Lambourne, 2011; Carlson *et al.*, 2015; Drummy *et al.*, 2016; Watson *et al.*, 2017), hence allowing only partial evaluation. Moreover, we observed significant gender differences before the start of the intervention, since boys were more active than girls, showing higher levels of light and moderate PA and lower levels of inactivity. Generally, boys are described to be physically more active than girls, and more restless if they have to sit for long periods (Pellegrini, 1995). However, after the CABs intervention, girls showed higher compliance to the exercises, reducing their inactivity time and increasing light PA. Generally, boys are described to be physically more active than girls, and at the same time more restless if they have to sit for long periods (Pellegrini, 1995). Indeed, the greater response showed by girls in this study might be ascribed to their lower baseline PA levels than boys, which probably provided a higher potential for improvement. Further analyses are needed to explore these findings in depth.

A promising element of the intervention is the children's enjoyment to participate in such programs (Allender *et al.*, 2006). In this study, children expressed a positive evaluation toward CABs, claiming that they felt 'more energetic', 'more focused' and they liked it, in agreement with others similar studies (Howie *et al.*, 2014; Martin and Murtagh, 2015b; Riley *et al.*, 2015; Norris *et al.*, 2016).

The positive findings of this feasibility study support the implementation of the CABs program in the whole school setting. The program was designed for third grade school-children, but it can be easily extended to the fourth and fifth grades, when gross motor coordination and coordination abilities progressively improve.

Strength and limitations

The strength of this study relies upon the use of accelerometers, which allowed us to objectively measure inactivity and different PA levels. This study contains also some limits considering that students worn the accelerometers only for two occasions and only during the school time, allowing a partial evaluation of the efficacy of the intervention. Moreover, we did not randomize the sample due to the paucity of the population neither included a control group since the purpose was to evaluate the feasibility of the program in preparation for a future randomized controlled trial. Lastly, the resistance showed by the teachers about the risk that PA would subtract time to other educational activities should be considered for future implementation of CABs, which should be better structured into the school curriculum to improve teachers' acceptance.

CONCLUSIONS

In conclusion, we demonstrated that the CABs program is a safe tool to reduce inactivity and increase MVPA.

With adequate motivation, proper training and support of educational materials, it does not require specialized teachers. It can be performed just behind the desk, overcoming structural problems. Designing structured exercise breaks adapted in a flexible way to meet the needs of the school curriculum program may increase the feasibility of such PA program in the schools. Further studies are needed to evaluate the educational effects of this program on the general household activities or cognitive function, academic achievement or classroom behavior.

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