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ORIGINAL

EFFECTS OF ACTIVE BREAKS ON THE PRIMARY STUDENTS' PHYSICAL ACTIVITY

EFECTOS DE LOS DESCANSOS ACTIVOS EN LA ACTIVIDAD FÍSICA DE ESTUDIANTES DE PRIMARIA

Méndez-Giménez, A.[1]; Pallasá-Manteca, M.[2]; Cecchini, J.A.[3]

[1] Senior lecturer. Faculty of Teacher Training and Education. University of Oviedo (Spain) mendezantonio@uniovi.es

[2] PhD in Education Sciences. Department of Education Sciences. University of Oviedo (Spain) Teacher in Primary Education (Oviedo). Spain. mipallateca@gmail.com

[3] Professor. Faculty of Teacher Training and Education. University of Oviedo (Spain) cecchini@uniovi.es

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Spanish-English translator: Antonio Méndez-Giménez, mendezantonio@uniovi.es, University of Oviedo

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ABSTRACT

The objective were twofold: a) to examine the impact of active breaks (AB) on 2nd of primary students' physical activity (PA) during their lessons, recess, and after school, and b) to analyze possible compensations during the day. 46 schoolchildren (28 girls) aged between 7-8 years participated. A quasi-experimental design was carried out with pretest and posttest measurements. The experimental group (*n*=22) received an AB program developed by the teachers and students. PA was recorded using accelerometers. The repeated measures ANOVAs found significant effects in MVPA and very vigorous in favor of the

experimental group. The increase was 71’23”/week (14’17”/day) of MVPA and 10’03”/week (2’01”/day) of very vigorous PA. In the experiental group, there was a decrease (6’54”/sem) in MVPA during their recess. Nevertheless, the sedentary activity time during classes was reduced by 73’30”/week. In conclussion, involving both parties in the design of AB can be effective in increasing students' PA.

KEYWORDS: physically active lessons, active breaks, brain breaks, integrating movement, physical activity.

RESUMEN

Los objetivos fueron examinar el impacto de los descansos activos (DA) en la actividad física (AF) de estudiantes de 2º de primaria durante las clases, el recreo y el horario extraescolar, y analizar posibles compensaciones durante el día. Participaron 46 escolares (28 niñas) de 7-8 años. Se realizó un diseño cuasi-experimental con medidas pretest y postest. El grupo experimental (*n*=22) recibió un programa diseñado por docentes y estudiantes. La AF se registró mediante acelerometría. Las ANOVAs de medidas repetidas mostraron efectos significativas en AFMV y AF muy vigorosa a favor del grupo experimental. El grupo experimental incrementó 14’17”/día de AFMV y 2’01”/día de AF muy vigorosa. En este grupo también se produjo un descenso de AFMV durante los recreos de 6’54”/sem y se redujo el tiempo de actividad sedentaria durante las clases en 73’30”/sem. Implicar al docente y alumnado en el diseño de DA puede aumentar la AF del alumnado.

PALABRAS CLAVE: clases físicamente activas, descansos activos, integrar movimiento, actividad física.

INTRODUCTION

Physical inactivity is the fourth most important mortality risk factor in the world, after hypertension, tobacco and excess blood glucose (WHO, 2010). It is associated with an increased risk of type 2 diabetes mellitus, cardiovascular disease, obesity, metabolic syndrome, and other chronic diseases (Ciccia et al., 2017). The WHO (2010) recommends that children from 5 to 17 years of age engage in at least 60 minutes a day of moderate and vigorous physical activity (MVPA), mainly of an aerobic nature, of strength and flexibility. Recent WHO recommendations (2020) insist that children and adolescents of this age group should incorporate intense aerobic activities, as well as those that strengthen muscles and bones, at least three days a week. These minimum levels of physical activity (PA) can be reached at one time or in a summative way throughout the day, being possible to combine different periods of PA to benefit from the healthy effects. There is increasing evidence that sedentary behavior (spending a lot of time in low-energy cost activities: 1-1.5 METs, sitting or lying down) and physical inactivity (not meeting the recommendations for moderate physical activity: 3-5.9 METs and vigorosa, ≥ 6 MET), represent two independent risk factors that

predispose to harmful health outcomes (Cristi-Montero, & Rodríguez, 2014; Wing et al. 2015). In this way, high volumes of sedentary time have a negative impact on health, especially cardio-metabolic, regardless of PA (Leiva et al., 2017; van der Ploeg, & Hillsdon, 2017).

To maximize benefits, health programs that aim to solve the inactivity crisis should increase PA and decrease sedentary behaviors, especially in the pediatric population (Katzmarzyk et al., 2009; Tremblay et al., 2011). A comprehensive public health recommendation could be to establish a healthy balance between sitting, standing, and light intensity PA (LPA) and MVPA throughout the day (van der Ploeg, & Hillsdon, 2017). Furthermore, Van der Ploeg and Hillsdon (2017) pointed out the convenience of considering all the behaviors of the spectrum of energy expenditure, not only the upper end practiced less frequently (MVPA), despite being identified as the one with the greatest gains for health.

It is surprising that essentially sedentary classroom classes predominate in schools in the Spanish educational system.This structure means that schoolchildren adopt a mandatory and prolonged sitting position around 5 hours a day in class, to which study time is accumulated in after-school hours (Whitt-Glover et al., 2009). Additionally, changes in children's lifestyle and the growing increase in sedentary leisure (e.g., watching TV, playing video games) cause truly alarming levels of sedentary lifestyle (around 6-8 hours a day; Katzmarzyk et al. , 2009). There is evidence that, regardless of PA levels, sedentary behaviors of 8 hours or more sitting / day are associated with an increased risk of cardio-metabolic disease, mortality from different causes, and a variety of physiological and psychological problems in the adult population (Chau et al., 2013; Katzmarzyk et al., 2009).

However, the educational context offers a unique and underused opportunity to provide enough PA to all schoolchildren for long periods of time (Donnelly, & Lambourne, 2011; Rasberry et al., 2011). Along with physical education (PE) lessons, schools can develop programs of various kinds to accumulate the recommended amount of MVPA, for example, through active recess, extracurricular activities, active transport or integrating movement in the classroom (Méndez-Giménez, 2020).

One strategy for integrating movement in class is active breaks (AB), also known as brain breaks. AB use PA as a recovery of academic load, without necessarily connecting with the curricular content (Webster et al., 2015). They consist of independent PA programs designed as 1-10 min pauses to refresh the brain, either during academic lessons or during transitions (Katz et al., 2010; Murtagh et al., 2013; Ruiz-Ariza et al., 2021; Watson et al., 2019). Whitt-Glover et al. (2011) found significant increases in light PA (51%), moderate PA (16%) in 3rd to 5th grade children from eight primary schools in which the Instant Recess program was applied. Likewise, the results of the study by Katz et al. (2010), carried out with a sample of 1214 students, revealed significant increases in their physical condition when The Activity Bursts in the Classroom for Fitness program was applied. The

West & Shores study (2014) found that the group of students who received an AB program (HOPSports®) obtained higher levels of MVPA than the control group (traditional lessons). Along the same lines, the research by Emeljanovas et al. (2018) revealed significant improvements in the AB experimental group (HOPSports®) on the perceptions and attitudes towards PA of 1st to 4th grade students. Several AB programs have found higher levels of MVPA compared to a control group (Daly-Smith et al., 2018; Drummy et al., 2016; Erwin et al., 2011; Masini et al., 2020; West, & Shores, 2014). These ABs are generally based on commercially available audiovisual products.

Carlson et al. (2015) found that students who received an AB program in the classroom were more likely to obtain 30 min / day of MVPA during their stay in school. Implementation was negatively associated with lack of student effort, and MVPA was negatively associated with distracted students in the classroom. Students who received between 3-4 opportunities for PA (AB in classroom, recess, PE…) had 5 minutes or more per class/day of MVPA than students without those opportunities. Goh et al. (2019) examined the differences in PA levels between boys and girls in grades 3-5 in a US school, and between weight categories after participating in a PA curricular intervention in the classroom. Results indicated that boys' PA levels were higher than girls'. Additionally, healthy weight students exhibited the greatest gain.

On the other hand, the increase in PA at certain times of the day can lead to compensatory decreases at others. Wilson et al. (2017) explored the evidence for possible compensatory declines in response to 10-min AB performed outdoors during a three-day intervention. ABs increased MVPA in school by 5'48" (p <.0001), and although vigorous PA increased significantly during the full day (11'12" *vs* 8'54 ", p = .0006), MVPA throughout the day was similar between the intervention and control conditions (77'12" vs 77'24" / day, p > .05). However, the ABs in that study were provided by an investigator (not teachers), on a grass field (outside, not in class), and through various motor games. Several studies have suggested that the type of intervention and the involvement of teachers can be key elements in the impact of these programs (Masini et al., 2020; Watson et al., 2019). Involving teachers in the production of the videos that make up the AB program could strengthen the involvement of both the teachers themselves and the students during the intervention.

OBJECTIVES

Taking these antecedents into account, a study was designed to analyze the impact of an AB program on students' PA levels in class, recess and after-school hours, as well as to verify possible differences regarding sex. It was hypothesized that the application of AB during class could contribute to an increase in MVPA during the day without total compensation at other times of the day, as well as to a decrease in sedentary behavior in class. Differences based on sex were not predicted.

MATERIAL AND METHODS

Participants

The study was carried out in an state school from a city in the north of Spain. It was selected for its receptivity and collaboration in this research. The selected school was on line 2, had a continuous school day, and a class schedule from 9 am to 2 pm, with a half-hour recess from 11.45 am to 12.15 pm. The paarticipantes were 2nd year primary school students from two natural groups (N = 51 participants). These groups were selected due to the affinity and approval of the teaching staff and parentes to collaborate in the research. As an inclusion criterion, it was established that the participants had attended 90% of the classes and that accelerometers records were available at least 90% of the time. Consequently, 5 participants were excluded, 2 because their parents did not give consent, 2 because of failures in the recording of the accelerometers, and 1 because there were no records available during the pretest. A sample of 46 participants (18 boys and 28 girls) took part in the study, aged between 7 and 8 years (M = 7.22; SD = .42). The control group (CG) consisted of 24 participants (9 boys and 15 girls) and the experimental group (ExpG) of 22 participants (9 boys and 13 girls).

Research design

A quasi-experimental design was carried out randomly assigning the control group and the experimental group. But here was no randomization of students to the groups. The study ran over two weeks. During the first one, accelerometers were provided to all participants. In the second week, the AB program was applied to the experimental group and the accelerometers were put back in both groups. The ABs took place during the ordinary classes of the subjects with the greatest curricular weight (language, mathematics, natural sciences, social sciences, *science* in english, and foreign language). The program consisted of the application of a total of 26 ABs throughout a week (approximately 5 per day). The duration of each ranged from 2-5 minutes. The accumulated time of the ABs was 18’30”/day.

Procedure

Both the principal, parents and tutors, as well as the School Council of the center gave their consent. Likewise, the research was carried out in accordance with the standards of the Ethics Committee of a University in the North of Spain. At all times the voluntary nature of participation was respected, both by families and by the center's teaching staff.

The project was developed throughout the 2018/19 school year and comprised two phases: a) *Preparation of audiovisual material (videos) for breaks*. After receiving specific training courses, the center's teaching staff (14 women and 4 men) and a coordinator (one of the main researchers) generated *ad hoc* audiovisual resources

that sought to promote PA in classroom lessons (Pallasá-Manteca, & Méndez-Giménez, 2018). The teacher training courses consisted of 12 hours (distributed from October to December 2018) on software for video editing, preparation of audiovisual material "beta version", literacy and film language, and another 12 hours (from January to March 2019) for the design, planning and preparation of audiovisual materials. At the same time, the students of the experimental group were involved in tasks of making photographs, designing and filming choreographies, and composing rhythms and melodies. These tasks were developed during the tutoring sessions and plastic education lessons (photos or storyboards), language (lyrics), music (melodies and rhythm activities), and physical education (preparation of choreographies ...), as well as during recess (e.g., filming choreographies, student work meetings, organization of material ...) The material produced was part of a digital folder (made up of 16 videos) that included all the files for the practice of the ABs. This folder was available only for the use of the teaching staff of the experimental group. b) *Research study*. It took place during the months of April and May 2019. The ABs consisted of the viewing of 9 of the edited videos and the reproduction (by the students) of the movements and gestures proposed to the rhythm of the music during the language sessions, mathematics, natural sciences, social sciences, *science* and foreign language. The videos consisted of more or less structured choreographies with rhythmic movements of the legs, arms and the body, both in place and in movement (joging, jumps and turns).

Instruments

Anthropometry. The weight was obtained using a TEFAL® portable digital scale (precision of .05 kg). For this, the students, barefoot and without heavy clothing, were called individually to be weighed, always under the supervision of the expert teacher. For its part, height was measured using a rigid height rod available in the center with a precision of 0.1 cm. The two measurements were used to calculate the Body Mass Index or Quetelet Index: [BMI = mass / height^2 (kg / m^2)].

Physical activity. ActiGraph-GT3X® accelerometers (Acti Graph TM, LLC, Fort Walton Beach, FL, USA) were used to objectively measure the PA levels of the schoolchildren. The PA levels of the schoolchildren in both groups were measured both during the previous week (pretest) and one week later, during the application of the AB program (posttest). A member of the research team put the accelerometers on the student`s waist the Monday before the start of lessons (9,00 a.m.) and collected them on Friday at the end of the school day (2,00 p.m.). The accelerometer was located just above the right hip and under clothing by an elastic belt. They were instructed to wear it at all times except for showering or bathing. They were encouraged to leave it on at night if it did not bother them to avoid forgetting the next day. The data were collected through the triaxial function and times of 10 s. Periods where 10-minute bands of continuous zeros were counted were excluded. The cut-off points adjusted to the child's age of Freedson et al. (2005) to categorize the intensity of PA in children as sedentary (SED = 0-149

cpm; counts per minute), light (LPA = 150-499 cpm), moderate (MPA = 500-3999 cpm), vigorous (VPA = 4000-7599 cpm), and very vigorous (VVPA> 7600 cpm). Outcome variables include time in minutes, and percentage of time spent on SED, LPA, MPA, VPA, MVPA, and VVPA activity.

Data Analysis

To download and analyze the data from the accelerometers, Actilife 6.7.2 software was used. The results were exported to Excel sheets. The weight and height of each child were entered in the pretest and posttest measurements and the BMI was calculated. A Student's *t* test was run for independent samples in order to compare the BMI means between both groups. Filters were created in Actilife to select the data from the accelerometers related to the class (Monday to Friday, from 9:00 a.m. to 11:45 a.m. and from 12,45 to 2:00 p.m.), recess (11,45 - 12 , 3pm) and after-school hours schedule (2pm - 10pm). The data were analyzed with the SPSS program for Windows (IBM®, v. 22.0). To evaluate the effects of ABs on the children's PA levels during classes, recess and the rest of the day, repeated measures ANOVAs were used, with time (pretest-posttest), in minutes, as within-subject factor and the group (intervention, control) as a between subjects factor. To investigate the differences between men and women, sex was included as a second factor between subjects (time x group x sex). The level of statistical significance was set at p <.05. The effect size (np 2) was calculated. Cohen classifies the effect size as small (η_p^2 =.20), medium (η_p^2 = .50), or large (η_p^2 = .80). To verify the normality of the data distribution, the Shapiro Wilk test (<50 participants per group) was requested. The assumption of homogeneity of covariance was examined using Box's *M* test.

RESULTS

The BMI was calculated for the entire sample and each treatment group: BMI Total Sample (M = 17.13; SD = 2.37); BMI Control group (M = 16.69; SD = 2.48); BMI Experimental group (M = 17.61; SD = 2.22).

A Student's *t* test was run for independent samples in order to compare the BMI means between both groups. The results did not show significant differences between groups for BMI [F (1, 44) = .263, p = .611]. On the other hand, the analyzes showed a normal distribution. The result of Box's *M* test revealed that the homogeneity of covariance idea was satisfied, p <.05).

Tables 1, 3, and 4 show the descriptive statistics (means and standardized deviations) of each of the dependent variables for both groups during classes, recesses and after-school hours, respectively. The Table 2 shows the tests of within-subject effects on the variables studied during class, recess, and after-school hours. The total sum of MVPA in the three periods contemplated in the study showed that the students of both groups complied with the PA

recommendations of the WHO (2020) both in the pretest (CG = 777'55"; ExpG = 747'59") as in the posttest (CG = 760'56"; ExpG = 771'52").

In relation to the in class analysis (table 1), main effects were found over time between the experimental and control groups in all the variables under study (see table 2). In the experimental group, the time in SED activity in class between pretest and posttest decreased 73'30"/ week (from 75.04% to 70.50%), while the times in the rest of the spectrum of PA levels increased significantly: LPA (21'36"/ week), MPA (44'12"/ week), VPA (17'30"/ week), MVPA (71'24"/ week), and VVPA (10'05"/ week).

Table 1. *PA levels (minutes and percentage) during classes (9-11.45 - 12.15-14.00 h) for the control and experimental group.*

	Pretest				Post-test			
	Control		Experimental		Control		Experimental	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Sedentary	1014.87	98.24	1025.42	80.83	1004.28[b]	106.29	951.50[a]	85.02
% in Sedentary	75.30	7.36	75.96	5.99	75.04	7.50	70.50	6.29
Light	132.48	36.96	133.42	31.38	118.77[a]	29.34	135.58[b]	29.75
% in Light	9.82	2.73	9.88	2.32	8.86	2.11	10.05	2.21
Moderate	183.38	60.48	178.19	50.02	189.76[a]	54.20	222.40[b]	50.20
% in Moderate	13.60	4.47	13.20	3.71	14.16	3.94	16.48	3.72
Vigorous	14.44	13.08	11.54	4.41	23.03[a]	28.34	29.04[b]	10.62
% in Vigorous	1.07	.97	.85	.33	1.72	2.10	2.15	.79
Total MVPA	200.54	73.10	191.16	52.96	215.69[a]	82.66	262.55[b]	59.34
% in MVPA	14.87	5.40	14.16	3.92	16.09	6.05	19.45	4.40
Very Vigorous	2.72	3.17	1.43	1.11	2.90[a]	5.40	11.11[b]	5.88
% in Very Vigorous	.20	.24	.11	.08	.22	.40	.82	.44
Average MVPA/day	39.87	14.78	38.49	10.38	43.45[a]	16.35	52.51[b]	11.87

Note: In the same row, different superscripts indicate main effects over time between groups. The decimals in the different levels of PA are the effect of the calculation, taking them as integer numbers, not as part of the sexagesimal system.

Table 2. *Tests of within-subject effects for the variables studied in class, recess and after-school hours.*

		Class				Recess				After-school			
	gl	*F*	*Sig.*	η_p^2	P[a]	*F*	*Sig.*	η_p^2	P[a]	*F*	*Sig.*	η_p^2	P[a]
Sedentary /TIME	1	16.115	.000	.277	.975	.600	.443	.014	.118	4.774	.035	.102	.569
TIME*GROUP	1	9.972	.003	.192	.870	6.946	.012	.142	.731	.073	.789	.002	.058
Error	42												
Light / TIME	1	3.035	.089	.067	.398	2.642	.112	.059	.355	7.712	.008	.155	.774
TIME*GROUP	1	4.829	.034	.103	.574	1.311	.259	.030	.201	.778	.383	.018	.139
Error	42												
Moderate / TIME	1	25.132	.000	.374	.998	1.239	.272	.029	.193	4.563	.039	.098	.551
TIME*GROUP	1	15.413	.000	.268	.970	7.911	.007	.159	.785	.021	.884	.001	.052
Error	42												
Vigorous / TIME	1	51.660	.000	.552	1.000	130.69	.000	.757	1.00	.689	.411	.016	.128
TIME*GROUP	1	4.767	.035	.102	.569	.584	.449	.014	.116	4.072	.051	.088	.505
Error	42												
Very Vigorous/ TIME	1	48.243	.000	.535	1.000	.617	.437	.014	.120	.357	.554	.008	.090
TIME*GROUP	1	43.678	.000	.510	1.000	1.489	.229	.034	.222	.058	.810	.001	.056
Error	42												
Total MVPA/ TIME	1	50.898	.000	.548	1.000	.415	.523	.010	.096	4.104	.049	.089	.508
TIME*GROUP	1	21.607	.000	.340	.995	6.399	.015	.132	.695	.029	.866	.001	.053
Error	42												

a. It was calculated using alpha = .05; P = Power

In relation to the recess analysis (table 3), main effects were found over time between the experimental and control groups in the SED, MPA, and MVPA variables (see table 2). In the experimental group, sedentary activity increased and MPA and MVPA (6'54") decreased between pretest and posttest. Finally, in relation to the after-school hours analysis (table 4), no main effects were found over time between the groups (table 2).

Table 3. *PA levels (minutes and percentage) in recess (11.45 - 12.15 h) for the control and experimental group*

	Pretest				Posttest			
	Control		Experimental		Control		Experimental	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Sedentary	62.32	21.71	49.64	18.93	57.95[a]	21.46	58.42[b]	19.27
% in Sedentary	41.55	14.47	33.10	12.62	38.88	14.09	38.95	12.85
Light	19.36	4.33	22.29	4.89	18.88	4.27	20.41	4.47
% in Light	12.91	2.89	14.86	3.26	12.71	2.88	13.61	2.98
Moderate	58.04	15.64	65.78	15.05	61.20[b]	16.21	57.78[a]	14.72
% in Moderate	38.69	10.42	43.85	10.03	41.18	10.80	38.52	9.81
Vigorous	9.17	8.00	10.86	6.18	9.88	6.97	11.21	4.95
% in Vigorous	6.12	5.33	7.24	4.12	6.67	4.68	7.48	3.30
Very Vigorous	1.10	2.18	1.43	2.76	.83	1.03	2.17	1.69
% in Very Vigorous	.74	1.45	.96	1.84	.56	.69	1.45	1.13
Total MVPA	68.32	20.35	78.07	17.14	71.92[b]	20.82	71.17[a]	17.14
% in MVPA	45.55	13.57	52.05	11.43	48.41	13.95	47.44	11.43
Average MVPA/day	13.66	4.07	15.61	3.43	14.52	4.1840	14.23	3.43

Note: In the same row, different superscripts indicate main effects over time between groups. The decimals in the different levels of PA are the effect of the calculation, taking them as integer numbers, not as part of the sexagesimal system.

Table 4. *PA levels (minutes and percentage) in after-school hours (2:00 pm - 10:00 pm) for the control and experimental group*

	Pretest				Posttest			
	Control		Experimental		Control		Experimental	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Sedentary	1233.82	189.08	1289.27	135.95	1274.87	170.73	1337.88	185.47
% in Sedentary	63.30	9.65	66.12	6.97	66.03	7.92	68.61	9.51
Light	205.87	51.21	185.97	35.77	181.64	47.97	173.98	49.68
% in Light	10.57	2.63	9.54	1.83	9.41	2.41	8.92	2.55
Moderate	449.22	123.72	423.52	98.15	411.02	95.77	393.30	133.03
% in Moderate	23.06	6.38	21.72	5.03	21.33	4.91	20.17	6.82
Vigorous	52.72	35.00	45.00	18.76	54.35	40.05	38.58	18.11
% in Vigorous	2.71	1.80	2.31	.96	2.82	2.05	1.98	.93
Very Vigorous	7.11	6.55	6.23	6.31	7.96	8.41	6.27	5.46
% in Very Vigorous	.37	.34	.32	.32	.41	.43	.32	.28
Total MVPA	509.06	147.31	474.76	109.39	473.33	122.49	438.14	145.84
% in MVPA	26.13	7.61	24.35	5.61	24.56	6.26	22.47	7.48
Average MVPA/day	103.44	33.44	94.95	21.88	95.50	24.33	87.63	29.17

Nota: The decimals in the different levels of PA are the effect of the calculation, taking them as integer numbers, not as part of the sexagesimal system.

The effect sizes in class comparisons are small, except for those referring to higher intensity PA, which are medium. In the recess comparisons, the effect size is small,

except for vigorous PA, which is large. Regarding after-school hours, the effect sizes are small.

No differences were found by sex in any of the PA levels [(Sedentary activity, *F* = .021, *Sig*. = .88; LPA, *F* = .022, *Sig*. = .88; MPA, *F* = .002, *Sig*. = .96; VPA, *F* = .246, *Sig*. = .12, MVPA, *F* = .117, *Sig*. = .73; VVPA, *F* = .34, *Sig*. = .56)].

DISCUSSION

In the present study, the increase in MVPA during classes due to the AB program (71'24"/ week) was accompanied by a partial decrease in MVPA during recess (6'54"/ week); however, no compensations were found in after-school hours with respect to the control group. Although in this section the data revealed a significant decrease over time of the MVPA in both groups, the analysis did not show an effect derived from the treatment. Speculating on the reasons for this decline is not easy, although it could be due to a weather change between pre-post weeks (e.g., rain or bad weather) typical of the geographic region where the study was carried out. Consequently, the results support the validity of the program and confirm the hypothesis of not finding relevant compensatory decreases after a higher level of school PA. These data contrast with those of previous studies (Wilkin et al., 2006) that point to the idea that PA could be centrally regulated and be resistant to change (activitystat hypothesis) and diverge from those that have found total compensations of MVPA during the day (Wilson et al., 2017). We think that the type of intervention could play a determining role in these results. Although in the study by Wilson et al. (2017) an external researcher applied the AB program (10 min, outside the classroom) during the intervention, in the present research it was the teachers themselves who implemented the AB program and were involved both in the design of the videos and in its production, even involving the students in the creation of choreographies. Likewise, the teachers decided the best time to apply these ABs taking into account the mental fatigue and the behavior of the students. Understanding the teachers' perspective toward ways to integrate movement into the classroom is critical to the effective planning and development of these programs. The study by Webster et al. (2017) pointed out the advisability of addressing challenges and barriers (e.g., the belief about the lack of time to develop the curriculum or support with current and ideal resources). In the present study, the freedom granted to teachers to make decisions about what, how and when could strengthen the project, leading teachers to assume it as their own (and not by imposition). These results are consistent with the research that indicates teachers as fundamental elements in the staging of school-based programs (Webster et al., 2017; Whitt-Glover et al., 2011).

Additionally, the levels of sedentary behaviors in the experimental group decreased 73’44”/ week between pretest and posttest during classes, while the LPA increased 21'36”/ week. In addition to contributing to the MVPA recommendations, this AB-based intervention appears to contribute to the balance between sedentary behavior and LPA, which is also relevant for public health (van der Ploeg &,

Hillsdon, 2017). LPA is defined as any activity with an energy expenditure between 1.5-3 METs and includes static (e.g., standing) and ambulatory activities. These activities that are required at times of the AB program also add up if the spectrum of energy expenditure is considered and the dichotomous approach between non-beneficial levels and highly beneficial levels of MVPA is overcome (van der Ploeg &, Hillsdon, 2017).

On the other hand, the VVPA increased 10'05”/week due to the AB program. The effects of VVPA on the childrens and adolescents health are not sufficiently determined. Recently, research on high intensity interval training (HIIE /HIIT) programs has attracted a lot of interest. Latest observational data in adolescents have shown that small amounts (<7 min) of MVPA are associated with favorable temporal changes in cardiometabolic risk factors, including blood pressure, waist circumference, and aerobic fitness (Hay et al., 2012). Although most of the recommendations for children and adolescents with regular PA refer to the 60-minute daily MVPA (WHO, 2010; 2020), repeated episodes of high intensity exercise (HIIT) have shown positive effects to improve cardiorespiratory fitness in children and adolescents in 7-10 week interventions with 2-3 sessions/week (Eddolls et al., 2017). Future longer-term investigations should verify the health effects of possible increases in VPA and VVPA obtained through AB programs.

Finally, the effects of the program affected both sexes equally. These results diverge from those obtained by Goh et al. (2019), who found higher increases in PA levels among boys. We believe that in the present study, the videos generated were aligned equally with the interests and likes of boys and girls, and that the mechanics of the application motivated PA equally, regardless of gender.

In light of the results obtained in the present study and considering that a large part of the child population performs academic and leisure activities that involve a huge amount of sitting time (e.g., studying, playing video games, watching television, etc.), educational policies and interventions that carry out structural changes (e.g., relative to classroom furniture) and methodological changes in academic subjects are essential, integrating movement in the classroom, in order not only to reduce mental fatigue and increase levels of MVPA of boys and girls, but also to reduce the levels of sedentary lifestyle in school hours.

The results of this study should be viewed with caution since it has a number of limitations. First, its quasi-experimental design and the lack of randomization of treatment groups. Only an experimental design could have established clear causal relationships. Second, the reduced *n* of the sample. Third, the failure to contemplate a follow-up measure to analyze whether any result in behavior change was maintained when the AB program was stopped. Furthermore, the instrument used (accelerometers) may not have been the most suitable for recording and evaluating the participants' PA, mainly in the choreographic steps performed on site, without displacement and with turns. Finally, two more limitations of the study are also that the data were obtained from a single primary

school, and that the intervention had a limited duration (only one week). Therefore, longitudinal studies with experimental designs that address a broader spectrum of ages are necessary.

CONCLUSIONS

The results of this study suggest that AB programs that involve both the teacher and the student in their design could be effective in increasing students' levels of MVPA. Furthermore, this increase in PA during the school period does not seem to be compensated by a reduction in PA the rest of the day. In sum, AB programs that involve the teacher by introducing PA into classroom routines can make an important contribution to promoting pediatric health in schools.

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