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# Effects of a 7-week active breaks intervention program on physical literacy and body mass index

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**Introduction:** Physical literacy (PL) emerges as a highly effective resource for creating lasting physical activity habits at a time when physical inactivity has become one of the main risk factors in our population. Thus, active breaks (AB) could be an ideal option for increasing physical activity time in schoolchildren.

**Methods:** A cross-sectional quasi-experimental study was conducted, involving 89 participants aged 8-12 years from Extremadura. The Canadian assessment of physical literacy (CAPL-2) was administered to assess the participants' physical literacy level. The BMI was also measured.

**Results:** Higher scores were obtained in all domains and subdomains of the CAPL in the experimental group. Significant differences were found both in total physical literacy score ( $p < 0.001$ ) and in all domains and subdomains, except for the subdomains self-reported question, intrinsic motivation and knowledge and understanding domain ( $p = 0.344$ ).

**Conclusion:** The results of the study support the positive effects of an AB program of PL and its domains. The development of active break programs could help to increase the PL level of schoolchildren.

## KEYWORDS

physical literacy, active breaks, schoolchildren, CAPL-2, physical activity

## 1 Introduction

Physical inactivity has become the main risk factor in our population (Rezende et al., 2016; Bull et al., 2020) due to its contribution to the development of cardiovascular disease (Je et al., 2013), obesity, overweight, and diabetes (Bull et al., 2020; Michel et al., 2022). Despite this, the minimum physical activity (PA) guidelines and recommendations are clear that young people should engage in at least 60 min of moderate and vigorous physical activity per day, yet only than 20% of adolescents comply with these recommendations (WHO, 2021).

The promotion of healthy lifelong lifestyles justifies the use of resources to motivate and raise awareness of the reasons for and purposes for being more active (Frohlich and Potvin, 2008). Therefore, all interventions aimed at promoting PA should focus not only on the amount and intensity of physical activity (Cairney et al., 2019), but also on raising participants' awareness of why it is important to be active and to

maintain sustainable PA habits over time. Therefore, changes in behavior and PA habits will provide a healthier lifestyle, reducing levels of sedentary lifestyles in childhood and adolescence (Pate et al., 2011; Chaput et al., 2020), as well as diseases associated with physical inactivity, such as obesity, diabetes, or mental illness, with PA as the main tool to achieve this (van Sluijs et al., 2021). The importance of all this is heightened by the knowledge that children's elementary school years are a critical period for the development of long-term healthy lifestyles (Conti and Heckman, 2013), as habits formed in childhood are more likely to persist into adulthood (Pérez-Navero et al., 2018).

Physical literacy (PL) is emerging as a highly useful tool not only for promoting long-lasting habits of PA over time (Borchers and Pieler, 2010), but also for understanding why young people are or are not physically active (Whitehead, 2010). While physical activity is defined as "any bodily movement produced by the contraction of skeletal muscles that increases energy expenditure above the resting metabolic rate" (Caspersen et al., 1985, p. 127), PL is different and refers to an individual's understanding, knowledge, physical competence, motivation, and ability to be physically active on a sustained basis over time (Whitehead, 2010).

Nevertheless, there is undoubtedly a need to increase the amount of PA time for young people. Given its importance, active breaks (AB) could be an excellent option to increase children's physical activity during breaks from learning tasks (Howie et al., 2014), providing intention and commitment to physical activity during these periods (Bailey et al., 2024). This type of practice has increased through several strategies (Howie et al., 2014), promoting not only physical but also psychological outcomes (Erwin et al., 2014). Furthermore, a recent review revealed that ~14% of PA interventions for children in Europe are based on AB (Porter et al., 2024). These interventions are mostly delivered during AB between classes, allowing them to be more active (McLellan et al., 2022). On the other hand, carrying out these activities during breaks in the school day (AB) could make a valuable contribution to promoting the practice of PA among schoolchildren (Hyndman, 2017).

Thus, the PA programs implemented during this period of time have shown how they help students to become more physically active, increasing not only the levels of physical activity but also the intensity with which the practice is performed (Ansón and García-Jiménez, 2017).

Currently, several studies have revealed how PL interventions have had positive effects on PL, both in extracurricular activities (Mandigo et al., 2019), and in physical education classes (Coyne et al., 2019). Studies on PL interventions during recess are scarce, but some studies implementing PA-based interventions have shown positive effects on PL (Mendoza-Munoz et al., 2022). Although no studies have been found that directly relate the positive effects of AB to PL, benefits of AB on academic performance (Petrigna et al., 2022), attention (Méndez-Giménez and Pallasá-Manteca, 2023), and concentration (Contreras Jordan et al., 2020; Fiorilli et al., 2021), wellbeing and PA habits (Petrigna et al., 2022; Peiris et al., 2022) have been reported. Thus, PL work during these periods could be highly beneficial for improving the domains of motivation (Méndez-Giménez and Pallasá-Manteca, 2023), physical competence, and daily physical activity time (Galle et al., 2020; Masini et al., 2020a).

Therefore, the aim of this study was to evaluate the effect of a 7-week AB intervention on PL and its domains in schoolchildren aged 8–12 years and to examine the body composition of participants before and after the intervention.

## 2 Material and methods

### 2.1 Study design

A cross-sectional quasi-experimental study with pre and post intervention assessments was designed to evaluate the effect of a 7-week PL based active breaks program.

### 2.2 Ethics

The research received the approval of the Bioethics and Biosafety Committee at the University of Extremadura (registrar number: 91/2024), in accordance with the revisions made to the Helsinki Declaration by the 64th General Assembly of the World Medical Association (Fortaleza, Brazil, 2013) and in compliance with Law 14/2007 on Biomedical Research.

### 2.3 Procedures

Participants aged 8–12 years from three primary schools were recruited. The management team of the schools was contacted by e-mail and in person. To this end, the objectives and procedures of the study, the participants required, the test to be conducted, and the duration and content of the intervention were explained to those responsible for each of the schools. The schools contacted the parents or guardians of the students, who decided whether or not their children would participate in the study. Once contact was established, authorization was obtained from the pupils' parents or guardians, and informed consent was obtained from the pupils themselves.

Prior to the start of the study, of the two classes selected from each center, one was randomly assigned to the experimental group (EG) and the other as the control group (CG). Both the assessments and the intervention were conducted by qualified personnel who were part of the study; school personnel did not participate in the study. Children in the CG only participated in the initial and final assessments. Participants in the CG performed free activities as in any normal recess. The children in the EG participated in the assessments and also in a program of active breaks based on physical literacy development for 7 weeks.

### 2.4 Participants

The final sample consisted of 89 participants, of which 49.4% were male and 50.6% were female. To be included in this study, the students needed to meet the following inclusion criteria: (1) age 8–12 years; (2) no pathology preventing physical activity; (3) informed consent from parents or legal guardians; (4) residence in Extremadura.

## 2.5 Intervention

This intervention was based on the study protocol developed by [Mendoza-Muñoz et al. \(2022\)](#). The theoretical and conceptual underpinning of this intervention focused on physical literacy, covering four distinct areas: physical competence, daily physical activity, knowledge and understanding, and motivation and confidence. The study lasted a total of 9 week, with the first and ninth weeks corresponding to the pre and post intervention assessment, respectively. During the remaining 7 weeks, the EG preformed a total of 21 physical literacy-based sessions, lasting 20 min, during the break period of the school day. On the other hand, the CG conducted the activities that the normally conducted in their daily lives during the school day, with the same timetable, frequency, and duration as the EG.

The sessions were divided into two distinct parts. The first part was aimed at working on knowledge content in an active way, through different activities such as orienteering races, relay races, or linking the answer ([Table 1](#)), where we work on content such as healthy lifestyle habits, benefits of physical activity, how to be more active, sports and their values, and basic physical capacities. On the other hand, during the second half of the session, a activity was played that remained constant throughout each week's sessions, but whose difficulty was progressively adjusted in each session, achieving a gradual increase in challenge during the week. This activity and its different variants were aimed at increasing the physical competence, motivation and confidence of the participants. The sports and games they participated in were *Mother Earth defender*, *Protect the pinnie*, *Keep it up*, *Farmers Shepherding Sheep*, *Tail chase*, *Switch it up*, *Knock Down*. These activities were obtained from PlaySport ([Ontario Physical Health Education Association, 2022](#)), initially developed by Ontario Physical and Health Education Association in partnership with Brock University. Each part lasted ~10 min, and each of the content was covered during the same week. The resources used were developed by the research team ([Supplementary material S1](#)).

For the development of the intervention and the presentation of results, the PLIRT guidelines established by [Carl et al. \(2023\)](#) for PL interventions have been considered ([Supplementary Table S1](#)).

## 2.6 Measures

In order to carry out the procedures, the study protocol Wellbeing, Obesity and Motricity Observatory (WOMO) ([Mendoza-Munoz et al., 2020](#)) was followed. The evaluation guide Canadian Assessment of Physical Literacy 2 (CAPL-2), developed by the Healthy Active Living and Obesity Research Group (HALO), belonging to the Children's Hospital of Eastern Ontario Research Institute ([Healthy Active Living Obesity Research Group, 2017](#)) in its Spanish adaptation was used for the assessment of the PL.

### 2.6.1 Anthropometry

Although no standardized data were used for the measurements, the conditions established by the OMS ([de Onis et al., 2007](#)) and the ALADINO study ([Perez-Farinos et al., 2013](#))

TABLE 1 Activities and contents developed during the AB program.

Week	First part of session (10 min per day)		Second part of session* (10 min per day)	
	Activities	Activities Content	Activities	Objective
1	Physical literacy and body composition assessment			
2	Orientation relay	Physical lifestyle habits	Mother earth defender	Enhance physical competence, motivation and confidence
3	Orientation relay	Benefits of PA How to be more active?	Protect the pinnie	
4	Relay races	Sports skills	Keep it up	
5	Relay races	Type of sports	Farmers Shepherding sheep	
6	Link the answer	Kind of fitness (strength and endurance)	Tail chase	
7	Link the answer	Kind of fitness (speed and flexibility)	Switch it up	
8	Link the answer	All contents	Knock down	
9	Physical literacy and body composition assessment			

\*All the activities belonging to the second part of the session were obtained from PlaySport (Association), initially developed by Ontario Physical and Health Education Association in partnership with Brock University.

were followed. For the bodyweight measurement of participants' were measured without shoes and dressed in light clothing. A bioimpedancemeter (Tanita MC-780 MA, Tanita Corporation, Tokyo, Japan) was used. Weight was recorded in kg. Height was obtained using a height gauge (Tanita Tantois, Tanita Corporation, Tokyo, Japan), recorded in centimeters and approximation in millimeters. Participants stood with arms relaxed and feet balanced on a vertical surface, perpendicular to the ground.

To obtain the body mass index (BMI), the sex, age, and height of each participant were entered into the electrical bioimpedance device.

### 2.6.2 Physical literacy

The Canadian Assessment of Physical Literacy 2 (CAPL-2) was used for the assessment of the PL ([Tremblay et al., 2018](#); [Health, Economy, Motricity and Education Research Group \(HEME\) and Promoting a Healthy Society Research Group, PHSO; Longmuir et al., 2018a](#)). The scores ranges from 0 to 100 points, resulted from the sum of its four domains. Each domain is composed of different test, obtained a final score of each of them. The domains of PL are: physical competence, daily physical activity behaviors, knowledge and understanding and motivation and confidence.

1. Physical competence domain (PC domain). It allows to evaluate the physical competence of the participants. This domain consists of three tests, each one evaluated from 1 to 10 points, obtaining a final score for this domain out of 30 points. These tests are:
  - a) Isometric abdominal plank during 2 min (Longmuir et al., 2018b).
  - b) Progressive aerobic cardiovascular endurance run “PACER.” Capacity cardiorespiratory test.
  - c) Canadian Agility and Movement Skill Assessment “CAMSA.” Agility circuit.
2. Daily physical activity behavior (DB domain). The final score of this domain is obtained from the number of total daily steps of the participant recorded through an activity wristband (Xiaomi mi Band 3, Xiaomi Corporation, Pekin, China), and the number of minutes of physical activity performed by the participants for at least 60 min.
3. Knowledge and understanding (K&U domain). To obtain the score for this domain, participants answer five questions, scoring up to 10 points. Four of the five question scored 0 or 1 each, while the last question is a fill in the blanks question in a story, scored from 1 to 6 points.
4. Motivation and confidence (M&C domain). This domain attempts to measure participants’ confidence and motivation to be physically active. Its score ranges from 1 to 30 points. It consists of four parts: intrinsic motivation, competence, predilection and adequacy.

between two factors: group (experimental and control) and two timepoints (baseline, post-intervention) in all dependent variables. Significant differences were set at  $p \leq 0.05$ .

### 3 Results

The characteristics of the participants in both the control and experimental groups are shown in Table 2. No significant differences were found between the control and experimental groups for any of the anthropometric variables or for age ( $p = 0.168$ ;  $p = 0.508$ ).

Table 3 shows the BMI and CAPL-2 scores for both the control and experimental groups, as well as the intergroup and intragroup differences.

Regarding the experimental group, all domain and subdomain scores of the CAPL were higher in the post-intervention assessment than pre-intervention. Significant improvements were found in total PL ( $p < 0.001$ ), as well as in all domains and subdomains except self-reported question ( $p = 0.085$ ), Intrinsic motivation ( $p = 0.617$ ) and K&U domain ( $p = 0.344$ ).

About intergroup differences, the results reported no differences between the control and experimental groups in the pretest, except for the CAMSA test, where the score was higher in the control group than in the experimental group ( $p = 0.002$ ). In the case of the post-test, significant improvements were detected in the experimental group with respect to the control, in the M&C domain and its subdomain’s predilection and adequacy.

No intergroup or intragroup differences were reported for BMI.

## 2.7 Statistical analysis

Statistical procedures and calculations were performed using Statistical Package for the Social Sciences (SPSS, version 25.0; IBM SPSS Inc., Armonk, NY, USA). Data are presented as mean and standard deviation (SD) or median and interquartile range (IR) for variables with normal and non-normal distributions, respectively. Shapiro-Wilk and Levene’s tests were used to test the normality and homogeneity of the data. Then, inferential tests were performed for all dependent variables. A two-way repeated measures analysis of variance (ANOVA) was performed to examine the interaction

## 4 Discussion

The concept of PL has become a highly relevant and widely researched concept in recent years (Gilic et al., 2022), and has become a fundamental concept for schoolchildren’s participation in a wider range of physical activities (Caldwell et al., 2020). Currently, several studies of PA programs have reported changes in PL levels of participants. These studies were conducted during Physical Education classes (Kriellaars et al., 2019) as well as during after-school activities (Mandigo et al., 2019; Bremer et al., 2020). However, only one study protocol was found that addressed the

TABLE 2 Total sample characteristics and stratified by group.

Gender	All participants	Experimental group ( $n = 43$ )		Control group ( $n = 46$ )		Between-group comparison
		Male	Female	Male	Female	
N (%)	89 (100)	21 (48.8)	22 (51.2)	23 (50)	23 (50)	
	Median (IR)	Median (IR)		Median (IR)		$p$
Age (years)	11 (2)	11 (2)		10 (2)		0.508
Weight (kg)	39.60 (43.3)	42.8 (43.3)		39.15 (29.3)		0.209
BMI (kg/m <sup>2</sup> )	18.85 (17.01)	19.02 (15.73)		18.40 (14.6)		0.426
	Mean (SD)	Mean (SD)		Mean (SD)		
Height (cm)	146.18 (8.30)	147.47 (9.31)		144.98 (7.50)		0.168

TABLE 3 Outcome of BMI and physical literacy measures at baseline and post-intervention.

	Experimental group (n = 43)					Control group (n = 46)					Between group pre	Between group post
	Baseline		Post-intervention		Within-group	Baseline		Post-intervention		Within-group		
	Mean	SD	Mean	SD		<i>p</i>	Mean	SD	Mean			
BMI	19.82	4.00	19.76	4.01	0.667	18.93	3.44	18.97	3.56	0.763	0.260	0.330
DB domain (points)	17.070	1.117	19.814	1.104	<0.001	19.304	1.080	19.370	1.067	0.927	0.154	0.773
Self-reported question (points)	3.581	0.208	3.907	0.164	0.085	3.587	0.201	4.065	0.158	0.010	0.985	0.489
Diary steps (points)	13.488	1.032	15.907	1.033	0.001	15.717	0.998	15.304	0.999	0.545	0.124	0.676
PC domain (points)	15.821	0.885	19.360	0.828	<0.001	17.261	0.856	18.458	0.800	0.032	0.245	0.435
CAMSA (points)	5.332	0.268	6.919	0.238	<0.001	6.522	0.259	6.871	0.230	0.099	0.002	0.886
Plank (points)	6.907	0.509	7.837	0.433	0.025	6.804	0.492	7.413	0.419	0.126	0.885	0.483
PACER (points)	3.581	0.310	4.605	0.373	<0.001	3.935	0.300	4.174	0.361	0.348	0.415	0.409
M&C domain (points)	25.912	0.432	27.421	0.464	0.003	25.630	0.418	25.000	0.448	0.196	0.641	<0.001
Predilection (points)	6.784	0.167	7.233	0.167	0.020	6.889	0.162	6.546	0.162	0.063	0.652	0.004
Adequacy (points)	6.814	0.192	7.374	0.154	0.016	6.524	0.185	6.270	0.149	0.253	0.279	<0.001
Intrinsic motivation (points)	6.453	0.151	6.535	0.146	0.617	6.293	0.146	6.283	0.141	0.945	0.448	0.217
Competence (points)	5.860	0.158	6.279	0.148	0.013	5.924	0.153	5.902	0.144	0.892	0.773	0.071
K&U domain (points)	6.535	0.263	6.837	0.233	0.344	6.587	0.254	6.957	0.226	0.232	0.887	0.714
Overall physical literacy (points)	65.337	1.899	73.433	1.814	<0.001	68.783	1.836	69.784	1.754	0.350	0.195	0.152

BMI, Body mass index; DB, daily behavior domain; PC, physical competence domain; CAMSA, Canadian Agility and Movement Skill Assessment; PACER, Progressive Aerobic Cardiovascular Endurance Run; M&C, motivation and confidence domain; K&U, knowledge and understanding domain.

effects of an active breaks program on physical literacy, on which this study is based (Mendoza-Munoz et al., 2022).

The present study aimed to evaluate the effects of a 7-week active breaks intervention on PL and its domains in schoolchildren aged 8–12 years, also analyzing participants’ body composition before and after the intervention. The results obtained reveal that the program was effective in improving general PL and in several specific domains, except for the K&U domain ( $p = 0.334$ ), in which the EG scored higher than the CG, although without significant differences.

Activity during active breaks in the school day has been shown to be an excellent way to improve the health of schoolchildren, both

in terms of reducing body fat, increasing speed and coordination (Aguilar-Jurado et al., 2020), as well as improving cognitive performance (Latorre-Román et al., 2021). In this sense, Vicedo et al. (2021) concluded that these periods represent valuable opportunities to increase children’s physical activity time and help them reach the minimum recommended levels of healthy PA.

Because of its importance, it is inevitable to think about how AB could be used to improve health and, with it, the time dedicated to physical activity of schoolchildren. If we review systematic studies on AB (Vicedo et al., 2021), we find numerous interventions aimed at promoting PA, however, those that address the importance of AB to improve PL are less frequent. Promoting PL is critical, given its



impact on health. Nevertheless, when considering the benefits of AB interventions, one could find an ideal tool and space to help schoolchildren adopt a healthy lifestyle through PA and PL.

Although there are currently different tools that can assess the PL in schoolchildren, Shearer et al. (2021), in their systematic review of PL assessment tools, highlighted that the CAPL-2 is currently the most robust explicit assessment instrument at present, demonstrating validity and reliability in the assessment of PL. Thus, several studies have attempted to give visibility to the assessment of PL in schoolchildren in different countries through the CAPL-2 (Dania et al., 2020; Mendoza-Munoz et al., 2024; Hadier et al., 2024; Elsborg et al., 2021; Knisel et al., 2024; Li et al., 2020; Longmuir et al., 2015), showing that the level of PL in this population is low or “in progress” (Li et al., 2020; Longmuir et al., 2015; Dania et al., 2020).

Analyzing the evolution of each of the domains in both groups after the intervention, we can observe that in the DB domain, significant differences were found in the EG ( $p < 0.001$ ), but not in one of its subdomains, despite obtaining a higher score in the post-assessment (Self-reported question;  $p > 0.05$ ). Our results differ from those found by Mendoza-Munoz et al. (2022) who, in their 4-week study, found no significant improvements in this domain, which could be due to the duration of the intervention or to the contents of the intervention itself. On the other hand, Masini et al. (2020b), in their 14-week study of active breaks, showed significant improvements in the number of weekly steps taken by their participants. Similarly, Torrandell and Vidal-Conti (2021) found that those schoolchildren who were more active during breaks had a greater number of hours of physical activity during the week.

Therefore, the EG in our study may have increased significantly in this domain after receiving more encouragement to engage in daily physical activity, relative to the CG, and the duration of the intervention may be entirely relevant in empowering and stimulating participants sufficiently to increase their daily and weekly physical activity time. The fact that significant differences were found in a more objective test such as the number of steps participants took per week, compared to a more subjective test such as answering a self-reported question about the number of days they were physically active, may support the idea that the intervention time was sufficient to motivate students to increase their daily steps, but not to make them aware that by doing the activities during breaks, they were simultaneously increasing the number of days they were physically active. Future interventions based on AB should further investigate the long-term effects on participants' daily physical activity routines.

On the other hand, the EG obtained significant improvements in the PC domain and its subdomains, in contrast to the CG, which did not obtain significant improvements in any of the subdomain but did obtain significant improvements in the final score of the domain. One possible explanation for this could be that each of the subdomains achieves higher scores, though not sufficient to yield significant improvements individually. Therefore, these improvements might have accumulated to influence the overall score of the domain, resulting in a significant change in the global computation.

The significant differences found in the EG in this domain may be due to the relationship between PL, health, and fitness (Caldwell et al., 2020). In this way, PL becomes a determining factor in the development of children's physical fitness (Gilic et al., 2022). Increasing pupils' motor engagement time during active breaks, through activities that promote the development of cardiorespiratory capacity, strength, and agility may be fundamental for their development. In this regard, Mendoza-Munoz et al. (2022) reported significant improvements in this domain, as well as in the CAMSA and PACER subdomains. These results, similar to those observed in our study, could also have been influenced by the association demonstrated in various studies between the general level of PL and cardiorespiratory capacity (Lang et al., 2018) and agility (Mandigo et al., 2019). Thus, the significant improvements in the general level of PL might have contributed to advancements in this domain and its subdomain.

Regarding the M&C domain, our results show significant differences in the total score of the domain and its subdomains for the EG. However, in the subdomain of intrinsic motivation, no significant differences were found for this group ( $p = 0.617$ ). Furthermore, a significant increase was also observed in the EG compared to CG after the intervention. Therefore, this domain could become the most relevant factor for children to reach the minimum recommendations for physical activity (Belanger et al., 2018), since both the motivation of students to be active and the place of activity have a positive influence on increasing their activity (Lang et al., 2018). In this regard, several physical activity-based interventions (Abós et al., 2016), and PL (Bremer et al., 2020) have reported improvements in motivation level, reflected in a willingness to participate in a greater number of physical activities and sports after their interventions (Bremer et al., 2020).

No significant improvements were found in the knowledge and understanding domain, although a positive trend was observed in the EG. The literature has shown that knowledge about physical activity is an essential component of the cognitive domain of PL (Gilic et al., 2022), although its direct effects on physical activity practice are still unknown. However, several studies have shown positive relationships of this domain with PC (Li et al., 2020) and M&C (Li et al., 2020; Knisel et al., 2024). Due to the influence of PA on the children's cognitive performance (Reloba et al., 2016), it could be that due to the low intensity of the task proposed during the intervention, or the short time spent performing PA daily, no significant differences were found in this domain (Luque-Illanes et al., 2021). In addition, the limitations of the intervention may have been insufficient to facilitate understanding and retention of the knowledge necessary for children to recognize the value of physical activity in their lives. This opens up a line of future research where future studies could investigate the importance of knowledge and understanding of physical activity and its practice, as well as explore whether the intervention time is limited to achieve meaningful learning.

In terms of body composition, no significant differences in BMI were found in either group, highlighting the importance of a longer intervention duration to observe substantial changes in this variable (Henaghan et al., 2008). However, given that several studies have reported differences in students' PL levels as a function of BMI (Delisle Nystrom et al., 2018; Mendoza-Munoz et al., 2021), further

research should study the long-term effects of physical literacy on schoolchildren and explore the benefits of physical literacy on schoolchildren's body composition.

One of the main strengths of this study is that it allows us to know and support the findings found by [Mendoza-Munoz et al. \(2022\)](#) about the benefits of implementing active breaks programs on PL in schoolchildren. However, the main difference with respect to that study is not only the duration, but also in the type of activities and content addressed throughout the intervention. In addition, the use of the CAPL-2 to measure the PL in schoolchildren allows it to be assessed in a comprehensive and objective manner in its different domains. Therefore, the findings of this study have important applications for health promotion, physical education, and educational policy. The implementation of this type of program could help not only to improve PL, but also to know the level of PL of schoolchildren, making it possible to take measures in the different intervention programs by adapting them to the needs of all students, since a child with a low level of PL will tend to avoid physical activity as much as possible, will have little confidence in their physical capacity and will not be motivated to participate in structured physical activities ([Tremblay et al., 2018](#)), therefore, physical literacy in all schoolchildren will be fundamental.

## 4.1 Limitations

The main strength of this study is the use of an objective assessment of physical literacy, validated for assessment in schoolchildren between 8 and 12 years of age ([Longmuir et al., 2018a](#)). However, this study has several methodological limitations that need to be carefully considered. Firstly, the sample size ( $n = 89$ ) is relatively small for a study of this nature, which could affect the statistical power and consequently the detection of significant effects, especially in those subdomains where no significant differences were found (self-reported questions, intrinsic motivation and knowledge and understanding domain). This limitation becomes particularly relevant when analyzing the effects in specific age subgroups within the studied range (8–12 years). The selection of the sample by convenience, limited to schools in Extremadura, is another substantial limitation that affects the external validity of the study. The specific characteristics of the Extremadura context, including its socio-economic, cultural and educational particularities, could differ significantly from other Spanish regions or international contexts. This geographical and contextual specificity limits the generalizability of the results to other school populations with different socio-demographic characteristics, educational resources or pre-existing physical activity programmes. The duration of the active-break intervention represents another significant limitation. Although positive effects were found on the total physical literacy score and in most domains and subdomains, the intervention period was not long enough to assess the sustainability of these effects in the medium and long term. This temporal limitation is particularly relevant in the context of physical literacy, where the main goal is to create lasting physical activity habits. The absence of longitudinal follow-up prevents us from determining whether the observed gains in physical literacy

levels are maintained beyond the immediate intervention period or whether these changes actually translate into sustainable physical activity habits.

## 5 Conclusions

The results of this study support the positive effects on physical literacy and its domains of an activity-based active breaks program covering all domains. In contrast to other studies, this work was notable for the duration and specific focus of the activities and for the application of the CAPL-2 for a comprehensive assessment of physical literacy domains. These findings have important implications for the design of intervention programs and the formulation of educational policies that promote physical literacy and health in schoolchildren. The implementation of active breaks could contribute to improving the level of PL in students, which is crucial to prevent physical inactivity in those with low confidence and motivation to engage in structured physical activity.

In conclusion, active breaks programs specifically designed to improve physical literacy offer a promising avenue for strengthening physical health and engagement in physical activity in schoolchildren. Future studies could focus on interventions of longer duration and in different contexts to explore the long-term effects on children's physical behavior and body composition, thus facilitating the adoption of active and healthy lifestyles from an early age.

## Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding authors.

## Ethics statement

The studies involving humans were approved by the research received the approval of the Bioethics and Biosafety Committee at the University of Extremadura (regstral number: 91/2024), in accordance with the revisions made to the Helsinki Declaration by the 64th General Assembly of the World Medical Association (Fortaleza, Brazil, 2013) and in compliance with Law 14/2007 on Biomedical Research. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the minor(s)' legal guardian/next of kin for the publication of any potentially identifiable images or data included in this article.

## Author contributions

JU-M: Investigation, Writing – original draft, Writing – review & editing, Project administration, Validation. LM-B: Conceptualization, Supervision, Writing – review & editing. JC-V: Data curation, Methodology, Writing – review & editing. RP-C:

Conceptualization, Project administration, Writing – review & editing. JM-E: Formal analysis, Supervision, Writing – review & editing. MM-M: Conceptualization, Investigation, Methodology, Writing – original draft, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2025.1535729/full#supplementary-material>

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