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Systematic Review

Are Physically Active Breaks in School-Aged Children Performed Outdoors? A Systematic Review

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Abstract: (1) Background: Children spend an ever-increasing amount of time performing sedentary behaviors, and an important part of their daily life is at school. Learning in an outdoor environment improves children's physical activity levels, and their cognitive and social spheres. Furthermore, physically active breaks are a solution to reduce sedentary behaviors and improve well-being and academic performance. The study evaluated the published literature on physically active breaks during school hours and explored (a) if the interventions were proposed in an outdoor context and (b) the outcomes of these interventions. (2) Methods: This review collected 31,559 articles from different electronic databases. After the screening, the results were analyzed narratively. (3) Results: 41 studies have been included in the analysis. As reported by the results, most of the interventions took place in the classroom, and only three studies were performed outside. A common aspect of all studies is the feasibility of active breaks, assessing positive outcomes. (4) Conclusions: Physically active outdoor breaks are poorly adopted, highlighting the necessity for deeper study on this topic. Although the protocols considered present differences, generally breaks increase physical activity levels, present positive learning outcomes, and improve social well-being. Furthermore, they are sustainable in terms of time, cost, and effort of the teacher.

Keywords: break; academic achievement; school; learning

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1. Introduction

Outdoor learning (OL), within a natural setting, improves the physical activity levels as well as the cognitive and social spheres of children [1]. Some studies proposed outdoor structured nature-based learning programs [2,3], such as the Udeskole (education experience based outdoor) [4], the Forest School (education located in a forest) [5], or outdoor environments, adapted to teach math, language, history, or religion [6]. OL programs educate students' initiative, planning, experimentation, elaboration and self-evaluation [7] and they are sustainable because they are affordable and feasible (no additional costs and efforts are required of the school to perform such interventions).

Studies that included OL within conventional teaching methods [8] reduced sedentary behaviors [9] and increased physical activity levels [6,10,11], induced positive academic outcomes [12–16], improved social well-being [17], and increased intrinsic school motivation [18]. Interventions outdoors are sustainable from an economic point of view, have numerous benefits for young children in terms of well-being and learning [19,20], and they remain in the children's minds [21]. A natural environment allows children to move in a large area, face different materials, front challenges, and create opportunities of various types [22]. Furthermore, children have different physical and social connection opportunities [22].

Children spend the majority of their waking time in the school setting [23,24] and about 80% of their time they spend seated [25], determining an ever-increasing time of sedentary behaviors [26]. Certainly, quarantine and lockdown caused by the COVID-19 pandemic exacerbated sedentary behavior levels, triggering musculoskeletal pain onset due to long periods of time seated and online distance learning [27]. Furthermore, the COVID-19 pandemic negatively affected psychological well-being [28]. The positive effects of physical activity on cognitive development and social skills are well-known [21,29,30], which is why limiting sedentary behaviors and promoting different physical activities is essential from early childhood [31]. Schools are adopting active learning, OL, and physically active breaks to improve the physical, psychological, learning, and social spheres [32], but further improvements are required for these to become a routine practice [7,32]. A recent review of the literature studied movement learning methodologies and effects, suggesting further investigations into the school hours breaks intervention [33]. Furthermore, breaks during schools do not require additional school time, energy, and they do not take time away from the lessons, making them ideal and sustainable. Considering the positive outcomes of physically active breaks and that brief bouts of outdoor activities improve on-task behavior [34] and general well-being, the objective of this review was to analyze the protocols adopted and to see (a) if they were performed outdoors and (b) the effects of physically active breaks on school-children's well-being and academic performance.

2. Materials and Methods

The systematic review adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist and explanation [35]. A similar protocol has been adopted before [33] but not registered on specific databases.

2.1. Eligibility Criteria

The inclusion–exclusion criteria of this analysis were for Population, Intervention, Comparison, Outcomes, and Study design (PICO-S). The population was formed by children aged between 3–11 (pre-school/primary/elementary). Studies that included only a special population were excluded due to the possible specific outcomes. The intervention included in the studies was formed by physically active breaks while curricula physical education, recess and after-school interventions were excluded. No comparison eligibility criteria were adopted, and the outcomes of interest were: (a) outdoor physically active breaks; and (b) physical fitness parameters and education outcomes. Intervention, cross sectional, longitudinal, correlational (randomized and non-randomized controlled, and quasi randomized studies) and original peer-reviewed English written studies were considered. Other kinds of study designs were excluded.

2.2. Data Collection

The electronic databases PubMed, Web of Science, and Scopus were searched, including studies published until 16 February 2022. The following keyword groups were adopted and matched with the Boolean operators AND/OR:

Group 1: child, preschool, infant, toddler, pupil, kindergarten;

Group 2: primary school, elementary school, student, education;

Group 3: psychomotor education, physical education, kinesiology education, active play, motor play, active learning, nature play, whole school, movement integration, comprehensive school, physical activity break.

This is a string example:

(Child* OR preschool * OR infant * OR toddler * OR pupil * OR kindergarten) AND ("primary school" OR "elementary school" OR student * OR education) AND (psychomotor education OR physical education OR kinesiology education OR active play OR motor play

OR nature play OR whole school OR movement integration OR comprehensive school OR physical activity break OR active learning).

2.3. Study Record

The manuscripts detected in the electronic databases were included in EndNote software (EndNote version X8; Thompson Reuters, New York, NY, USA). Duplicates were detected first. In a second analysis, two independent investigators performed a selection process based on the eligibility criteria on the title, abstract and full-length. If the two investigators disagreed, the senior investigator was involved and provided the tie-breaking decision. All investigators were not blinded to the authors or associated institutions of the manuscripts during the selection process. Information on the sample (age, gender, and sample size) and intervention (type, duration, and frequency) characteristics and physical fitness and educational outcomes were collected. The data were discussed narratively and represented through tables.

2.4. Study Risk of Bias Assessment

The objective of the present study was to evaluate if the literature adopted physically active breaks outdoors, and eventually the effects of a break on children's well-being from a critical point of view without a synthesis of the results. Consequently, because the population is heterogeneous, the intervention is specific and the results were not analyzed with statistical analysis, it has been decided not to perform the risk of bias assessment.

3. Results

3.1. Study Characteristics

A total of 31,559 studies have been included after the electronic database searches. A total of 7276 studies were duplicates. After the screening process against the eligibility criteria, a final number of 39 have been detected. Two studies were included after the references check. The final number of 41 studies have been included in the systematic review. The flow diagram is represented in Figure 1.

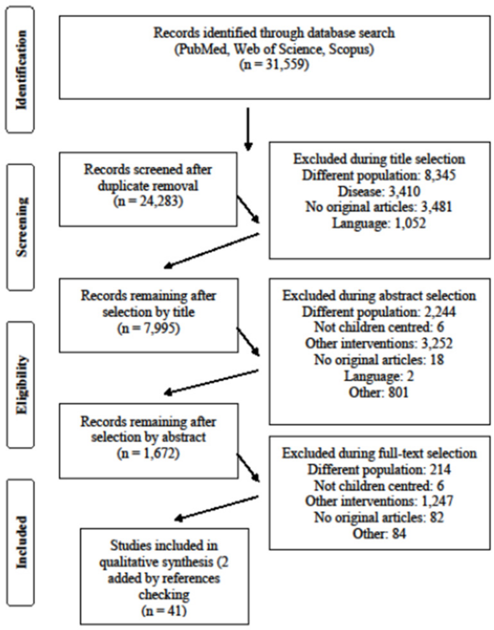

Figure 1. Flow diagram of the article screening process.

The population of the studies was composed of children with an age range from 3.8 to 11.9 years, with a mean age of 9.2 years. The sample comprised 18,632, of whom 8374 were girls, and 8474 were males; 1784 had no specified gender (see Table 1).

Table 1. Study characteristics.

1st Author, Year	Intervention Program	Number (Female)	Age (Years)	Length AB	PA Device	Evaluation Adopted
Aadland, 2017 [36]	ASK	1129 (541)	10.2 (0.3)	5 min	Acc	Executive functions Andersent test
Bershwinger, 2013 [37]	NI	18 (7)	9.2 (0.4)	10 min	Ped	No
Broad, 2021 [38]	FUNtervals	35 (13)	6 (1)	4 min	Acc	On-task behavior
Brusseau, 2018 [39]	CSPAP	240 (125)	7.9 (1.2)	3–10 min	Ped	Pacer; TGMD
Brusseau, 2016 [40]	CSPAP	1460 (730)	8.4 (1.8)	3–10 min	Acc	Pacer/Fitnessgramm
Burns, 2017 [41]	CSPAP	1460 (730)	5–12	10 min	No	TGMD
Burns, 2015 [42]	CSPAP	327 (162)	9.6 (1.7)	10 min	Acc	No
Carlson, 2015 [43]	NI	1322 (710)	8.8 (1.5)	10 min	Acc	No
Centineo, 2021 [44]	NI	628 (323)	10.5	NI	No	No
Cradock, 2014 [45]	NI	393 (206)	10.2 (0.8)	NI	Acc	No
Egan, 2018 [46]	SPARK	161 (78)	7.3 (0.9)	10 min	No	AP
Emeljanovas, 2018 [47]	Brain Break	181 (83)	8.5 (1.1)	5–9 min	No	APAS
Erwin, 2011 [48]	NI	106	10.1 (0.9)	5–10 min	Ped	No
Fu, 2016 [49]	CSPAP	758 (376)	10.1 (0.5)	5 min	No	PACES
Groffik, 2012 [50]	NI	239 (137)	9.5 (0.4)	30 min	Acc	No
Howie, 2015 [51]	NI	96	10.7	12 min	No	Trial-making; operational digit recall, AP
Howie, 2014 [52]	NI	96	10.7	12 min	No	PACER; on task behavior; KBIT-2
Janssen, 2014 [53]	NI	123 (60)	10.4 (0.6)	15 min	Acc	20-SRT
Leng Goh, 2016 [54]	TAKE 10!	210	8–11	10 min	No	On task behavior
Ma, 2014 [55]	FUNtervals	88 (44)	8–11	4 min	No	d2 test
Mattson, 2020 [56]	CSPAP	789	7–12	10 min	No	No
Mavilidi, 2020 [57]	NI	87 (34)	9.1 (0.6)	5 min	No	On-task behavior
Mavilidi, 2020 [58]	NI	68	11–12	10 min	No	AP
Mazzoli, 2021 [59]	NI	141 (65)	7.7 (0.6)	5 min	Acc	Attention task, on task behavior, working memory
McLoughlin, 2020 [60]	CSPAP	105 (59)	10.6 (1.6)	NI	Acc	No
Mok, 2020 [61]	Brain Break	3036(1540)	11–12 y	3–5 min	No	APAS
Muüller, 2019 [62]	DASH study	300 (150)	10.1 (0.9)	NI	No	20-SRT
Mullins, 2019 [63]	NI	254	6–10	10 min	No	No
Munoz-Parreno, 2021 [64]	NI	166 (74)	10.9 (0.7)	7 min	No	NIH-Examiner
Murtagh, 2013 [65]	Bizzy Break!	90 (41)	9.3 (1.4)	10 min	Ped	No
Popeska, 2018 [66]	Brain Break	238 (128)	9.2 (1)	4 min	No	APAS
Resaland, 2016 [67]	ASK	1129 (542)	10.2 (0.3)	10 min	Acc	AP
Resaland, 2018 [68]	ASK	1129 (542)	10.2 (0.3)	10 min	Acc	AP
Schmidt, 2016 [69]	NI	92	11.7 (0.4)	10 min	No	d2 test
Sneck, 2022 [70]	MovingMaths	36 (22)	9.4	10 min	Acc	AP
Somers, 2019 [71]	CSPAP	378 (169)	9	10 min	No	AP
Watson, 2019 [72]	Acti-Break	374 (195)	9.1 (0.6)	3–5 min	No	AP
Weaver, 2018 [73]	PACES	229 (104)	7.3 (0.8)	10 min	Acc	No
Webster, 2020 [74]	NI	99 (50)	3.8 (0.6)	10 min	Acc	TGMD
Webster 2015 [75]	NI	118	3.8 (0.7)	10 min	No	No
Zhou, 2021 [76]	Brain Break	704 (334)	9.4 (0.9)	3–5 min	No	APAS

Note: Accelerometer: Acc; Active Break: AB; Active Smarter Kids (ASK); Academic Performance: AP; Attitudes toward Physical Activity Scale: APAS; Comprehensive School Physical Activity Program: CSPAP; Disease, Activity and Schoolchildren's Health: DASH; Kaufmann Brief Intelligence: KBIT-2; No Info; NI; Progressive Aerobic Cardiovascular Endurance Run: PACER; Physical Activity Enjoyment Scale: PACES; Physical Activity: PA; Pedometer: Ped; Test of Gross Motor Development: TGMD; 20 m Shuttle Run Test: 20-SRT.

3.2. Intervention Characteristics

The interventions proposed ranged from 1 week to 1 school year with a mean duration of 13 weeks. The frequency was five times per week while the mean duration was 9 min, ranging from 4 to 30.

Eighteen interventions adopted a pedometer or accelerometer to evaluate physical activity level, and some studies adopted the Attitudes Toward Physical Activity Scale ($n = 3$). Physical fitness was evaluated with the Progressive Aerobic Cardiovascular Endurance Run ($n = 4$), the 20 m Shuttle Run Test ($n = 2$) and the Andersent test. Three studies adopted the Test of Gross Motor Development 2nd or 3rd edition (3), one study used the executive functions or the Physical Activity Enjoyment Scale. A total of eight studies evaluated academic performance, while six studied the on-task behavior. Attention tasks were adopted three times. The Kaufmann Brief Intelligence (KBIT-2), Trail-Making Test, an Operational Digit Recall test, a working memory, and the NIH-Examinern were adopted one time each (details in Table 1).

3.3. Intervention Procedures

Only three interventions were proposed outside. Examples of physically active breaks performed outdoor were jumping jacks, spelling jacks, walking breaks, and outdoor/classroom games [37]. An intervention available inside or outside the classroom consists of adopting cards with movement activities with core content and/or specific reference to health or multicultural topics [48]. Other interventions were proposed in the playground with movement games, rhythmic and dance activities, sports, and game equipment [50].

The majority of the interventions (31 studies), instead, were proposed inside the classroom with physically active breaks, such as stretching or relaxation exercises, walking around the classroom or in place, jumping, doing squats, push-ups, or sit-ups, and/or passing a ball [36,39,45,49,55,58,67,68,74] and were also associated with curricula subjects [57,70]. Children performed mobility, stretching, walking around the classroom, jumping, squats, pulse-raising exercises, passing a ball, and relaxation exercises [40–42,46,56,60,65,71]. In the classroom there was also the Brain Breaks intervention that consisted of video exercises supervised by the teachers with movement-integrated learning [47,61,66,76]. Similarly, classroom teachers incorporated physically active breaks with academic learning objectives [43,54,62]. Physically active breaks were also proposed as games [72].

One exercise break was performed not in the playground but the physical exercise classroom [53], while other studies did not provide information if the intervention was proposed inside or outside the classroom.

3.4. Intervention Outcomes

The majority of the physically active breaks interventions ($n = 40$) found positive outcomes. A total of 15 studies detected an increase in physical activity level while two studies found an increase in motor skills. Improvements were also detected in executive function, cardiorespiratory endurance, general health, decreased body fat, and physical activity knowledge ($n = 1$ each).

Improvements were also detected in academic performance ($n= 8$), on-task behavior ($n = 6$), attention level and cognitive functioning ($n = 4$), and a general improvement in classroom behavior ($n = 1$).

Mavilidi and colleagues [58] observed that breaks could be performed before the examination without negatively affecting academic outcomes. One study asserted poor academic results deriving from active beaks [66], while only Schmidt and colleagues [69] found that active breaks do not affect physical activity levels. Details can be found in Table 2.

Table 2. Main findings of the included studies.

1st Author, Year	Main Conclusion
Aadland, 2017 [36]	Activities increase executive functions and academic performance
Bershwinger, 2013 [37]	AB increased children's daily PA
Broad, 2021 [38]	Improvement in task behavior
Brusseau, 2018 [39]	Increased gross motor skills/cardiorespiratory endurance
Brusseau, 2016 [40]	Increased PA level
Burns, 2017 [41]	Improved motor skills
Burns, 2015 [42]	Increased PA level
Carlson, 2015 [43]	AB improved PA level
Centineo, 2021 [44]	Improved health and academic achievement
Cradock, 2014 [45]	Increased PA level
Egan, 2018 [46]	Effectiveness of the intervention
Emeljanovas, 2018 [47]	Effectiveness of the exercise program
Erwin, 2011 [48]	Effectiveness of the exercise program
Fu, 2016 [49]	Greater improvements
Groffik, 2012 [50]	Increased PA level
Howie 2015 [51]	Improvement in task behavior
Howie, 2014 [52]	Improved math performance
Janssen, 2014 [53]	Improved selective attention
Leng Goh, 2016 [54]	Increased on-task behavior
Ma, 2014 [55]	AB increased attention
Mattson, 2020 [56]	Improved PA knowledge
Mavilidi, 2020 [57]	AB improved on-task behavior/learning scores
Mavilidi, 2020 [58]	AB can be used before examinations
Mazzoli, 2021 [59]	Improved cognitive functioning
McLoughlin, 2020 [60]	Importance of PA
Mok, 2020 [61]	Exercise videos are ideal as a PA solution
Muüller, 2019 [62]	Decreased body fat
Mullins, 2019 [63]	Positive intervention
Munoz-Parreno, 2021 [64]	Improved cognitive functioning
Murtagh, 2013 [65]	Increased PA level
Popeska, 2018 [66]	Positive effects of AB video exercises
Resaland, 2016 [67]	Increased PA level. Poor academic increase
Resaland, 2018 [68]	Increased academic scores
Schmidt, 2016 [69]	No effect of PA intervention
Sneck, 2022 [70]	Increased math performance
Somers, 2019 [71]	Increase in academic achievement
Watson, 2019 [72]	Improved classroom behavior
Weaver, 2018 [73]	Increased PA level
Webster, 2020 [74]	Increased PA level
Webster 2015 [75]	AB improved time on-task behavior
Zhou, 2021 [76]	The intervention is useful

Note: Active Break: AB; Physical Activity: PA.

4. Discussion

The present review found that only some physically active break interventions were proposed outdoors, highlighting the necessity of further investigation on this topic in the future. The second finding is that most of the interventions, outdoor or indoor, increased physical activity, physical fitness, academic performance, attention, and on-task behavior.

All studies that proposed intervention outdoors [37,48,50] reported positive outcomes. It is essential to highlight that OL is fundamental for children's cognitive and social well-being, especially in a natural setting or in a green schoolyard [77]. Conventional school-ground facilitated vigorous competitive rule-bound games differently, from a green design that has positive outcomes in all students (without distinction of gender) promoting socialization [78]. Conventional school grounds with fences, barren, and flat surfaces limit the opportunities to be physically active, while green spaces promote physical and social well-being [79]. Ideally, a school, should have to include green spaces to allow outdoor activities, stimulating children's personalities, not only from a physical but from a cognitive, emotional, and social point of view. Only in this way is it possible to obtain the best effects on children's physical, mental and social well-being.

Similar to the study by Daly-Smith and colleagues [80], differences in the study design, interventions, duration and intensity, and outcomes, were detected in the outdoor and indoor interventions, making the comparison of the studies impossible [81]. A common aspect is that most studies presented an increase in physical activity level and academic outcomes (Table 2); indeed, physical activity positively affects cognitive and academic performance in children [82,83] and improves selective attention and verbal off-task classroom behavior [55]. This approach may also enhance neurocognitive aspects: coordinative exercises can positively affect the prefrontal-dependent tasks, increase the allocation of attentional resources [84], and thus provide positive outcomes to the curricula subjects after the break [85].

The finding of this review strongly supports the importance of physically active breaks and to let children learn in an outdoor context. Considering our findings, after the analysis of the literature on outdoor and indoor interventions, we suggest a standard operating procedure [81] for an outdoor physically active break proposal: ten minutes intervention proposed five/six times a week during the curricula school hours. It is composed by two minutes of walking activity or coordination exercises. Then, it follows a longer central part (about 6 min) with structured games or moderate-to-vigorous structured physical activities, e.g., jumping, push-up, stand-up. Two minutes of stretching or mobility exercises conclude the intervention proposal. A summary of the standard operating procedure is presented in Figure 2.

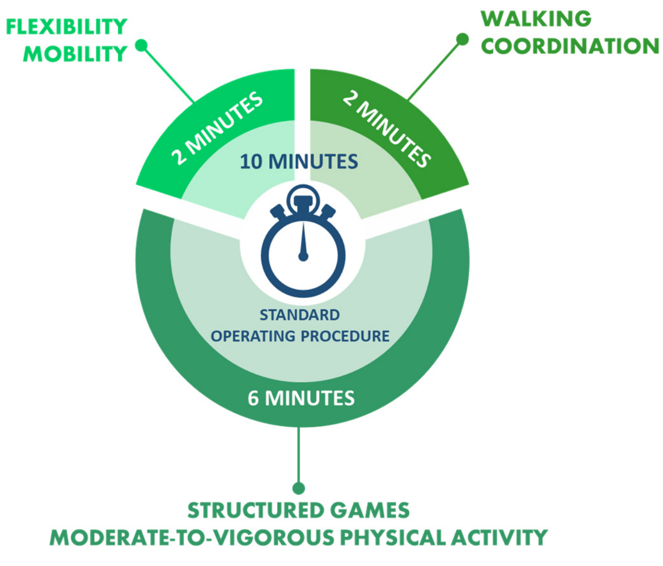

Figure 2. Standard Operating Procedure proposal for an outdoor physically active break.

In the standard operating procedure, physical breaks have been proposed for all school days, because a study in adolescents highlighted the importance of daily physical activity breaks to maintain working memory (the key to successful learning) and the task preparation process [86]. Furthermore, the same study proposed aerobic and coordinative exercises and it has been decided to adopt this kind of proposal in the first minutes of the break [86]. The second part of the physically active intervention has been structured because a recent systematic review and meta-analysis [87] highlighted how short bouts of acute aerobic exercise improve cognitive performance. Furthermore, moderate-to-vigorous physical activity reduces off-task behaviors, improving the attention of the classroom [88]. This is important especially in those people with lower baseline cognitive performance [89].

Finally, the intervention aims to enhance flexibility and mobility to maintain or improve range of motion, and at the same time to restore children's normal physiological values.

A break requires ten minutes of time and does not require specific cost, equipment, or structure, making it sustainable and feasible to limit sedentary time and improve well-being in schoolchildren. This also helps schools to achieve wellness policies [90] without effective cost. Furthermore, the interventions do not overburden teachers' effort, nor require specific preparation, providing an enjoyable approach for both teachers and children [24] ideal for schoolchildren.

Limitations of the studies was the impossibility to perform the meta-analysis due to the differences in the studies' protocols. Furthermore, some break interventions were part of bigger programs that included different kinds of interventions (active learning, and movement interventions), such as the comprehensive school physical activity program (CSPAP), the Active Smarter Kids (ASK), the Disease, Activity and Schoolchildren's Health (DASH), making it difficult to detect the precise effect of the break. Future studies should focus on people with disabilities, since positive outcomes are detected when physical interventions are proposed to specific categories [91].

5. Conclusions

Physically active outdoor breaks are poorly adopted as interventions to improve physical activity and academic performance, even if they are affordable, feasible and sustainable interventions. The second conclusion is that physically active breaks present positive outcomes on well-being and academic performance. Consequently, this review strongly suggests adopting physically active breaks in an outdoor context. Since different protocols are present, we propose a standard operating procedure for outdoor breaks.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su14073713/s1, Table S1: PRISMA 2020 Checklist.

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