

Psychological outcomes of classroom-based physical activity interventions in children 6- to 12-year-olds: A scoping review

Resultados psicológicos de las intervenciones de actividad física en el aula en niños de 6 a 12 años: Una revisión de alcance

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Abstract. This scoping review synthesizes the evidence of the psychological outcomes of physical activity interventions in the classroom in children aged 6 to 12 years and describes the characteristics of the physical activity interventions implemented. We systematically searched in databases MEDLINE, SCOPUS, PsycINFO, ScienceDirect, Web of Science and SciELO, of randomized control trials published up to July 2020 of classroom-based physical activity interventions with children's psychological health variables as outcomes. Sixteen trials (14,877 participants) with children aged 6 to 12 years were included. There were significant effects on several indicators of: a) psychological health outcomes: well-being, self-esteem, body image satisfaction b) self-efficacy and motivation to physical activity and c) behavior inside the classroom: self-regulation, bullying and disruptive behavior. The most effective interventions are those that included physical activity integrated into the curriculum 2-5 times a week, in sessions between 4' to 10', implemented mainly by the classroom teacher and with audio-visual support. However, the heterogeneity in program designs did not allow definitive conclusions. While psychological outcomes are mainly primary outcomes in the interventions studied, more evidence is required on other indicators of psychological health such as mental health symptoms. In addition, studies need to employ objective measures of physical activity to a better comprehension of their effects on psychological health of schoolchildren.

Keywords: Physical Activity; Children; Psychological health; Schools; Intervention; Scoping review.

Resumen. Esta revisión de alcance sintetiza la evidencia de los resultados psicológicos de las intervenciones de actividad física en el aula en niños de 6 a 12 años y describe las características de las intervenciones de actividad física implementadas. Realizamos búsquedas sistemáticas en las bases de datos MEDLINE, SCOPUS, PsycINFO, ScienceDirect, Web of Science y SciELO, de ensayos controlados aleatorios publicados hasta julio de 2020 de intervenciones de actividad física en el aula con variables de salud psicológica de los niños como resultados. Se incluyeron dieciséis ensayos (14 877 participantes) con niños de seis a 12 años. Hubo efectos significativos en varios indicadores de: a) resultados de salud psicológica: bienestar, autoestima, satisfacción con la imagen corporal b) autoeficacia y motivación para la actividad física y c) comportamiento dentro del aula: autorregulación, acoso y comportamiento disruptivo. Las intervenciones más efectivas son aquellas que incluyen actividad física integrada en el currículo 2-5 veces por semana, en sesiones de 4' a 10', implementadas principalmente por el docente de aula y con apoyo audiovisual. Sin embargo, la heterogeneidad en los diseños de los programas no permitió sacar conclusiones definitivas. Si bien los resultados psicológicos fueron la variable de estudio principal en la mayoría de las intervenciones estudiadas, se requieren más estudios sobre otros indicadores de salud psicológica, como sintomatología de salud mental. Además, los estudios deben emplear medidas objetivas de la actividad física para una mejor comprensión de sus efectos sobre la salud psicológica de los niños en edad escolar.

Palabras clave: Actividad Física; niños; Salud psicológica; Escuelas; intervención; Revisión de alcance.

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Introduction

Physically active boys and girls are more likely to have better physical and psychological health compared to their inactive peers (Bailey et al., 2013; Hillman & Biggan, 2017; Singh et al., 2019). Nevertheless, the World Health Organization (WHO) estimates that 20% of children and young people worldwide have some degree of deterioration in their psychological health (WHO, 2013), mainly due to depression, anxiety, and disruptive behaviors (Polanczyk et al., 2015). Most of these problems remain undetected and untreated until adulthood, which ends up affecting their social environment, academic and work performance, as well as mental health, including drug use, and suicide attempts (Erskine et al., 2015; WHO, 2014), generating important sanitary, social and economic consequences for the society as a whole (Bronsard et al., 2016).

On the other hand, it is well known that physical activity is a protective factor in the prevention and treatment of

multiple diseases and it is associated with better psychological health (Biddle & Asare, 2011; Hillman & Biggan, 2017). In this line, a systematic review reported that children with high levels of physical activity and good levels of physical fitness have better psychological health (Poitras et al., 2016), and another systematic review that included longitudinal and cross-sectional studies, described direct associations between physical activity and low levels of psychological discomfort (distress, negative affect and depression), and greater psychological well-being (self-image, satisfaction with life and happiness) (Rodríguez-Ayllon et al., 2019).

Despite the benefits noted, the child population currently has high prevalence of physical inactivity (National Physical Activity Plan Alliance, 2018). In this sense, the Global Action Plan on Physical Activity 2018-2030 suggests an inclusive approach to school, so that the school environment allows the participation and integration of physical activity in different educational contexts (Pan

American Health Organization [PAHO], 2019). Consequently, active commuting, recess, curricular physical education lessons and the regular classroom, make the school an ideal environment for the promotion of physical activity (Ensenyat et al., 2020; Langford et al., 2015) and psychological health (O'Connor et al., 2018). Different types of physical activity interventions in the classroom have been described, such as, Movement Integration, which includes providing movement breaks during academic lessons, to teach academic content through movement (Vazou et al., 2020) and Active Breaks, that are characterized by including short periods (8-10 minutes) of physical activity (for example, walking, running, or jumping) in the classroom, which may include the review of academic content in physically active dynamics (Watson et al., 2017).

These physical activity interventions have shown increasing evidence of positive effects (McDonald et al., 2018) in the physical activity levels (Masini et al., 2020), academic performance (Bedard et al., 2018; Watson et al., 2017), and cognitive functions (Daly-Smith et al., 2018; Donnelly et al., 2016), and to a lower extent in improving indicators associated with psychological health. In this area, a recent systematic review that included 15 articles in a total sample of 6286 boys and girls from 148 primary schools (Papadopoulos et al., 2022) points out that physical activity in the classroom can affect the enjoyment of physical activity, self-efficacy in learning with video exercises, quality of life and self-confidence (Papadopoulos et al., 2022).

Another systematic review and meta-analysis of the literature on physical activity interventions in schools and its effects on psychological health in the infant-juvenile population (age four to 19 years), reported a reduction of anxiety and improvement of psychological well-being in this population (Andermo et al., 2020). However, that review is not specific for physical activity integrated in the classroom, and the results should be taken with caution due to the heterogeneity of the sample (Andermo et al., 2020). In the same direction, a review in the youth population (mean age 12–25.9 years) with mental disorders showed evidence of the beneficial effects of physical activity interventions as an effective strategy to promote mental health and as an early intervention to reduce symptoms of depression and anxiety (Pascoe et al., 2020). However, the context where the studies of these reviews were carried out is not educational, so it is necessary to explore the psychological outcomes and characteristics of physical activity interventions, specifically performed within the classroom (O'Reilly et al., 2018).

However, scoping review studies on physical activity interventions in the classroom are unknown, that synthesize the effects on various indicators of psychological health (for example, anxiety, self-efficacy, self-esteem, and behavior inside the classroom), and describe the characteristics of physical activity implemented in the classroom.

Therefore, the aims of this review were two: 1) synthesize the evidence of the psychological outcomes of classroom-based physical activity interventions in children 6 to 12 years old; and 2) describe the characteristics of the physical activity interventions implemented.

Methods

Search Strategy

The scoping review was conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews (PRISMA-ScR) guidelines (Tricco et al., 2018).

The search strategy followed the guidelines of Peer Review of Electronic Search Strategies (PRESS) (McGowan et al., 2016). A systematic search was conducted in July 2020, with MeSH terms "exercise", "schools", "child", "mental health", in the databases MEDLINE, SCOPUS, PsycINFO, ScienceDirect, Web of Science and SciELO. The general search syntax was: (active breaks OR movement integration OR movi-kids OR brain break OR classroom break OR movement break OR lesson break OR HIIT OR physical activity) AND (primary school OR elementary school OR children OR child) AND (mental health OR well-being OR anxiety OR self-esteem OR depression), with adaptations when necessary according to each database.

Selection of studies and inclusion criteria

Two reviewers independently performed a literature search (AR-C and DR-M). All those articles that complied with the search phrase were considered, and only those articles that met the following inclusion criteria were selected: a) Physical activity intervention: inside the classroom; b) Outcomes: Psychological variables such as well-being, happiness, self-esteem, self-efficacy, quality of life, anxiety and/or depressive symptoms, behavioral problems; c) Sample: healthy boys and girls between 6 and 12 years old; and d) Methodological design: randomized controlled trials in which the control group did not receive any physical activity intervention (Table 1).

Table 1.
Inclusion criteria

Criteria	Description
Physical activity intervention	Physical activity interventions inside the classroom
Sample	Healthy boys and girls between 6 and 12 years old
Outcome	Psychological variables well-being, happiness, self-esteem, self-efficacy, quality of life, anxiety and/or depressive symptoms, behavioral problems
Methodological design	Randomized controlled trials in which the control group did not receive any physical activity intervention

The exclusion criteria were: a) interventions carried out outside the school; b) Articles including children under 6 years old, adolescents or adults; c) Cross-sectional or longitudinal studies without a physical activity intervention program; d) Studies in which interventions were targeted to selected groups of children such children with

overweight or obesity or those with a diagnosis of physical or mental disorders; e) Studies published in non-scientific journals (such as conference abstracts, dissertations, theses, commentaries); f) Studies published in languages other than English or Spanish.

Data extraction

In the first step, duplicate records obtained from databases were deleted using Mendeley software. After that, two reviewers selected records that met the inclusion criteria, and when decisions could not be made only from the title and summary, full-text documents were retrieved. The selected articles were independently verified by three reviewers, and discrepancies were discussed until an agreement was reached. A pre-piloted standardized questionnaire previously employed by the authors was used to extract data from the included studies, to evaluate their methodological quality and synthesize evidence. The following data were extracted from all included studies: author; year of publication; study design; study location; sample size and characteristics; intervention/control condition characteristics; outcome measures and outcome data.

Results

Study selection

This systematic search identified 537 potential records of classroom-based physical activity interventions with effects on psychological health. After duplicates were excluded from the databases, sorting and eligibility criteria were applied. Finally, 16 articles were included in this review (Figure 1).

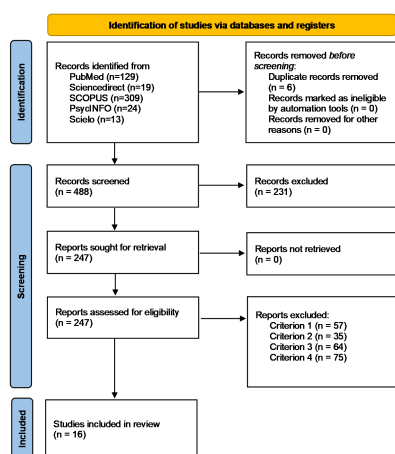


Figure 1. Study selection flowchart according to PRISMA statement (Page et al., 2021).

Psychological variables studied, their outcomes and measuring instruments

In nine out of 16 articles, psychological variables were primary outcomes (Aadland et al., 2018; Christiansen et al., 2018; Emeljanovas et al., 2018; Gammon et al., 2019; Glapa et al., 2018; Mavilidi et al., 2020; Mok et al., 2020; Raney et al., 2017; Schmidt et al., 2019), in the remaining seven studies, psychological variables were

secondary outcomes (Adab et al., 2018; Koch et al., 2019; Lawlor et al., 2016; Schmidt et al., 2019; van den Berg, Saliassi, et al., 2019; van den Berg, Singh, et al., 2019; Watson et al., 2019).

The outcomes of the studies were organized into three groups, namely: a) psychological health, which includes well-being, self-esteem, anxiety symptoms, body image satisfaction, and quality of life; b) attitudes towards physical activity that encompasses resources such as self-efficacy and motivation for physical activity and c) behavior in the classroom which includes behavioral self-regulation, bullying and disruptive behavior. Table 2 presents the results grouping the total of psychological variables identified in the 16 studies, reporting the significant and non-significant differences, intragroup (pre vs post intervention) and intergroup (intervention group vs experimental group).

Psychological health

These outcomes were present in eight interventions (Aadland et al., 2018; Adab et al., 2018; Christiansen et al., 2018; Gammon et al., 2019; Mavilidi et al., 2020; Schmidt et al., 2016; van den Berg, Saliassi, et al., 2019; van den Berg, Singh, et al., 2019). There were significant positive effects intragroup in the intervention group on well-being (including positive and negative affect) in one intervention (Schmidt et al., 2016) (Table 2). The remaining seven intervention programs did not significantly improve or worsen, the measured psychological health indicators. In the study by Schmidt et al. (2016), by a mediational analysis they showed that changes in positive affect during the interventions mediated the effect between cognitive engagement and focused attention as well as between cognitive engagement and processing speed.

There were significant intergroup effects in favor of the intervention group on the self-esteem variable (which includes general, academic and social self-concept/self-esteem,) and body image (including physical self-concept) in one intervention (Christiansen et al., 2018) (Table 2). For the other seven remaining interventions, no significant between-group differences were observed in psychological health indicators, neither for nor against the intervention group.

In the study by Christiansen et al. (2018), analyzes were performed to detect differences between the intervention group and the control group, which were adjusted for gender, age group, social class, recreational sport, and body image. In this sense, the physical self-concept increased in the control group, only for the students who presented a thinner self-perceived body image. Unlike the intervention group, where physical self-concept increased in all students. Furthermore, those students in the intervention group who did not participate in recreational sports improved their general self-esteem more than their control group counterparts.

Attitudes to physical activity

These outcomes were present in eight interventions

(Christiansen et al., 2018; Emeljanovas et al., 2018; Glapa et al., 2018; Koch et al., 2019; Lawlor et al., 2016; Mok et al., 2020; Schmidt et al., 2019; van den Berg, Singh, et al., 2019) (Table 2). For the intervention group, there were significant positive intragroup effects on attitudes related to physical activity in three of these eight interventions (Emeljanovas et al., 2018; Glapa et al., 2018; Mok et al., 2020). The remaining five intervention programs did not significantly improve or worsen attitudes to physical activity.

In the intervention group, there were significant positive effects of intragroup on self-efficacy to physical activity in two interventions (Glapa et al., 2018; Mok et al., 2020) (Table 2). In the study by Glapa et al. (2018), prior to the intervention, the experimental group and the control group presented similar scores in "self-efficacy to learn with video exercises", but after the intervention the experimental group obtained substantially higher scores than the control group. In the study by Mok et al. (2020) the intervention group had significant increases in attitudes toward physical activity, specifically for self-efficacy, learning, benefits, and importance of activity compared to the control group. And there were significant positive intragroup effects for the intervention group on motivation for physical activity in two interventions (Emeljanovas et al., 2018; Glapa et al., 2018). Both in the study by Emeljanovas et al. (2018) and in that of Glapa et al. (2018) the intervention had a positive impact on students' motivation and enjoyment of physical activity during learning.

There were significant intergroup effects for attitudes related to physical activity in five of the eight interventions (Emeljanovas et al., 2018; Glapa et al., 2018; Mok et al., 2020; Schmidt et al., 2019; van den Berg, Singh, et al., 2019) (Table 2). For the other three remaining interventions, no significant differences were observed intergroup, neither for nor against the intervention group on motivation for self-efficacy to physical activity.

There were significant intergroup effects for self-efficacy to physical activity in three of the eight interventions (Emeljanovas et al., 2018; Glapa et al., 2018; Mok et al., 2020). Emeljanovas et al. (2018) and Mok et al. (2020), reported that after the intervention, the experimental group had better indicators of self-efficacy for physical activity, specifically in self-efficacy in learning with video exercises, and importance and benefits of performing physical activity. For their part, Glapa et al. (2018) reported only a significant difference between subjects in favor of the control group, for self-efficacy in learning with video exercises.

And there were significant intergroup effects for physical activity motivation in four of these eight interventions (Emeljanovas et al., 2018; Mok et al., 2020; Schmidt et al., 2019; van den Berg, Singh, et al., 2019) (Table 2). For the other four remaining interventions, no significant differences were observed intergroup, neither for nor against the intervention group on motivation for physical activity. Emeljanovas et al. (2018) and Mok et al. (2020)

reported that the intervention group scored better in goal orientation (motivation) and interest (enjoyment) in performing physical activities. And Schmidt et al. (2019) reported that students who participated in both the physical activity-incorporated learning intervention group and the physical activity-only intervention group enjoyed the lessons more than students in the control group in the traditional classroom condition. And the study by van den Berg, Singh, et al. (2019), reported that children enjoyed the intervention program, which included short sessions of physical activity (juggling) with mathematical content, more than children who participated in traditional mathematics classes.

Behavior in the classroom

These outcomes were present in five interventions (Aadland et al., 2018; Adab et al., 2018; Gammon et al., 2019; Raney et al., 2017; Watson et al., 2019). There were significant positive intragroup effects for the intervention group in two of these five interventions (Raney et al., 2017; Watson et al., 2019) (Table 2). The remaining three intervention programs did not significantly improve or worsen Behavior in the classroom.

In the study by Raney et al. (2017) and Watson et al. (2019) there were significant intragroup differences for behavioral self-regulation and disruptive behavior. In particular, for the study by Raney et al. (2017) behaviors such as non-compliance (not following instructions), inattention and disruptive behaviors, times decreased significantly after the intervention in the intervened group. Additionally, Raney et al. (2017), after analyzing by age (between kindergarten, first and second grade), for kindergarten the intragroup differences are maintained, for first grade only the decrease in inattention time is maintained, but for second grade there is only a significant increase at the time of disruptive behaviors. In the study by Watson et al. (2019), while no effect of the intervention for classroom behavior was found at the whole class level, the results showed that classroom behavior improved at the individual level, particularly for children.

And there were significant intergroup effects in favor of the intervention group in one of the five interventions (Raney et al., 2017) (Table 2). For the other four remaining interventions, no significant differences were observed intergroup, neither for nor against the intervention group on behavior in the classroom. In the study by Raney et al. (2017) there were significant differences between groups for disruptive behavior, where the intervened group presented shorter time of this behavior after the end of the intervention.

Measuring instruments

For the measurement of psychological variables, the most used self-report questionnaires were the Attitude toward Physical Activity Scale (APAS) in three interventions (Emeljanovas et al., 2018; Glapa et al., 2018; Mok et al., 2020) (Table 2). The scale initially developed in

English was internationally validated in a sample of students between grades 1 and 7 in five countries (Lithuania, Poland, Serbia, Singapore, and Zimbabwe) (Mok et al., 2015). The responses are of the Likert type, ranging from 1 (strongly disagree) to 4 (strongly agree). The scale includes a demographic section, 38 items, and eight subscales: 1) self-perception of physical fitness, 2) Self-efficacy in using video exercise, measured self-efficacy in using video exercises, 3) personal orientation to goals or objectives in physical activity, 4) interests and enjoyment in physical activity, 5) attitudes toward the importance of physical activity, 6) benefits of physical activity, 7) Learning in school subjects, measured contributions of video exercise to learning in school subjects, 8) measured contributions of video exercise to health.

Also, the Self-Perception Profile for Children (SPPC)

was used in three interventions (Christiansen et al., 2018; van den Berg, Saliassi, et al., 2019; van den Berg, Singh, et al., 2019) (Table 2). The SPPC scale is calculated as the average of six items. Each item consists of two statements, for example, (1) “some kids feel they are very good at their schoolwork”, (2) “other kids worry about whether they can do their assigned schoolwork”. After choosing the most appropriate statement, the children indicated whether the chosen statement was “more or less true” or “really true” for them. Each item was rated on a four-point scale, with a score of one indicating the lowest perceived competence and a score of four reflecting the highest level of competence. The SPPC and C-PSPP are widely used and have been shown to be valid and reliable (Muris, Meesters, & Fijen 2003; Welk & Eklund 2005).

Table 2. Psychological variables studied, their outcomes and measuring instruments

(REF)	PO	EG	Psychological health					Attitudes related to physical activity		Behavior in the classroom	
			Well-being	Anxiety symptoms	Self-esteem	Body image satisfaction	Quality of life	Self-efficacy to physical activity	Physical activity motivation	Behavioral self-regulation	Bullying and/or disruptive behavior
(Aadland et al., 2018)	1	EG	✓ 00 Kidscreen-27	-	-	-	-	-	-	✓ 00 CBRS	-
(Adab et al., 2018)	2	EG	✓ 00 PedsQL	-	✓ 00 PedsQL	✓ 00 CBIS	-	-	-	-	✓ 00 Kidscreen-52
(Christiansen et al., 2018)	1	EG	-	-	✓ 0* C-PSPP / SPPC	✓ 0* C-PSPP / CBIS	-	✓ 00 C-PSPP	-	-	-
(Emeljanovas et al., 2018)	1	EG	-	-	-	-	-	✓ 0* APAS	✓ ** APAS	-	-
(Gammon et al., 2019)	1	EG	✓ 00 PANAS	-	✓ 00 SQ	-	✓ 00 CHU9D	-	-	-	✓ 00 SQ
(Glapa et al., 2018)	1	EG	-	-	-	-	-	✓ ** APAS	✓ *0 APAS	-	-
(Koch et al., 2019)	2	EG1 EG2 EG3	- - -	- - -	- - -	- - -	- - -	✓ 00 ✓ 00 ✓ 00 SQ	- - -	- - -	- - -
(Lawlor et al., 2016)	2	EG	-	-	-	-	-	✓ 00 SQ	-	-	-
(Mavilidi et al., 2020)	1	EG	-	✓ 00 CAQ	-	-	-	-	-	-	-
(Mok et al., 2020)	1	EG	-	-	-	-	-	✓ ** APAS	✓ ** APAS	-	-
(Raney et al., 2017)	1	EG	-	-	-	-	-	-	-	✓ *0 Classroom behavior observations	✓ 0* Classroom behavior observations
(Schmidt et al., 2019)	2	EG1 EG2	- -	- -	- -	- -	- -	- -	✓ 0* ✓ 0* PACES	- -	- -
(Schmidt et al., 2016)	1	EG1 EG2 EG3	✓ *- ✓ *- ✓ *- PANAS-C	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
(van den Berg, Saliassi, et al., 2019)	2	EG	-	-	✓ 00 SPPC	✓ 00 SPPC	-	-	-	-	-
(van den Berg, Singh, et al., 2019)	2	EG	-	-	✓ -0 SPPC	-	-	-	✓ -* VAS	-	-
(Watson et al., 2019)	2	EG	-	-	-	-	-	-	-	✓ *0 DBRS / CBAS-TB	-

REF: Reference. -: Information is not indicated. PO: Psychological variables as outcomes of study in articles (1: psychological variables were primary outcomes; 2: psychological variables were secondary outcomes). EG: Number of experimental groups within the same study. PSYCHOLOGICAL HEALTH. Well-being: includes positive and negative affection. Anxiety symptoms. Self-esteem: General, academic, and social self-concept/self-esteem. Body image satisfaction: Physical self-concept and body image. Quality of life. ATTITUDES RELATED TO PHYSICAL ACTIVITY. Self-efficacy to physical activity. Physical activity motivation: enjoyment and motivation towards physical activity. BEHAVIOR IN THE CLASSROOM. Behavioral self-regulation. Bullying and/or disruptive behavior. OUTCOMES ON PSYCHOLOGICAL VARIABLES. ✓: Psychological variable considered within the study. 0: No significant effects (left for intragroup and right for intergroup). *: Significant effects for GE (left for intragroup and right for intergroup). MEASURING INSTRUMENTS. CBRS: Child Behavior Rating Scale. APAS: Attitude toward Physical Activity Scale. PedsQL: Paediatric Quality of Life inventory. CHU9D: Child Health Utility 9D. C-PSPP: Physical Self-Perception Profile. SPPC: Self-Perception Profile for Children. CBIS: The Children’s Body Image Scale. SQ: Self-report questionnaire prepared for intervention. CAQ: Cognitive Anxiety test Questionnaire. PACES: Physical Activity Enjoyment Scale. PANAS-C: Positive Affect and Negative Affect Schedule for Children. VAS: Visual Analogue Scale. DBRS: Direct Behaviour Rating Scale. CBAS-TB: Classroom Behaviour and Assets Survey-Teacher Behaviour.

Characteristics of physical activity interventions in the classroom

Study characteristics

Of the total articles, the studies were carried out mainly in Europe, the interventions included 14,877 participating boys and girls enrolled at the beginning and 13,401 children analyzed at the end, belonging to a total of 265 schools (Table 3).

Dose-response of physical activity in interventions

The duration of the implemented interventions ranged between four and 30 minutes per session, being the more frequent the session that lasted 10 min (five interventions). Regarding the number of sessions per day and week, they were applied mainly through a daily session (nine interventions), five times a week (nine interventions). And a total duration of interventions between one week and 48 weeks. Four interventions reported the target intensity of physical activity. The objective or subjective instrument to measure physical activity intensity was reported in eight interventions, being accelerometers used in six of them (Table 3).

In addition, the most effective interventions in terms of their psychological results were those that were applied in sessions of between 4 to 10 minutes, 1 to 3 times a day (more frequently 1 to 2 times a day), 2 to 5 times a week (more frequently than 5 times a week), in interventions from 2 to 16 weeks (Table 3).

Intervention characteristics

The most frequently implemented type of intervention consisted of physical activities to improve strength and endurance, such as skipping, imitate sports movement, running or jogging, arm push-ups, and squats (nine inter-

ventions). Further, of the total of interventions, five interventions included motor skills activities, four considered traditional recreational games, and three included dancing. The physical activity was guided mainly by videos in which the participants had to follow instructions and / or imitate movements (nine interventions). In 11 interventions, physical activity included content from the curriculum or general content, that were more frequently contents on the subject of mathematics and/or contents about healthy lifestyles (five interventions) (Table 3).

The implementation of the interventions was carried out by two types of professionals. In three studies, it was applied by research professionals, and in 13 studies it was applied by classroom teachers. Four interventions implemented additional physical activity for experimental groups in addition to the one carried out in the classroom, mainly as tasks to be done at some point during the school day, at breaks, in the schoolyard, and at the physical education lessons. The control group maintained the amount of physical activity performed routinely. However, in six interventions, the control group performed some activities that did not include movement or physical activity, like educational lessons in the form of breaks that integrated general content, information on healthy living, games on blackboard, and paint-color, among others (Table 3).

In addition, the most effective interventions in terms of their psychological results were those that included physical activity interventions with curricular or comprehensive content, mainly through physical exercise of muscular strength and games that develop motor skills. Where the intervention was implemented mainly by the classroom teacher, with audiovisual support (guided video) from virtual platforms such as Brain Breaks® (three interventions) (Table 3).

Table 3. Intervention characteristics classroom-based physical activity interventions

NI	Study characteristics			Dose-response of physical activity in interventions						Intervention characteristics						
	(REF). Country	Sample n°	School n°	ST min	SD n°	SW n°	WI n°	I	MI	EG PHYSICAL ACTIVITY	Vi	CC	R P	AA	H	E
Active Smarter Kids (ASK)	(Aadland et al., 2018). Norway	1202/1080	57	5	1	5	44*	V	-	Rope jumping.	Vi	Maths, English	C T	T, SY	✓	-
WAVES	(Adab et al., 2018). United Kingdom	1467/1392	54	30	1	5	48*	M V	AC and HR	Mainly aerobic physical activity such as dances, coordination, and manipulation challenges, running, and chasing games, and jumps, guided through videos taken from the virtual platforms Wake Up Shake, Activate, Positive Play and Take 10.	Vi	-	C T	B, SY	-	✓
Move for Well-being in School.	(Christiansen et al., 2018). Denmark	3124/2797	24	5	2	5	36*	-	-	Activities guided to teamwork, observation, and feedback, including very energetic physical activity, massages and mindfulness (meditation).	-	-	C T	PE, B,	✓	-
-	(Emeljanovas et al., 2018). Lithuania	- / 181	1	7*	1	5	12*	-	-	Integration of learning with motor skills and fitness skills guided through videos taken from the virtual platforms Brain Breaks®.	Vi	HL	C T	-	-	-
-	(Gammon et al., 2019). England	321/295	2	-	-	-	12	-	AC	-	-	-	C T	SY	-	-
-	(Glapa et al., 2018). Poland	400/326	3	4*	2	5	16*	-	-	Integration of learning with motor skills and fitness skills guided through videos taken from the virtual platforms Brain Breaks®.	Vi	HL	C T	-	✓	-
Food, Health, & Choices	(Koch et al., 2019). United States of	1387/769	20	10	1	2	40*	-	-	Dances and exercises like jumping jacks guided through videos taken from the virtual platforms Take 10 and Dance Break.	-	HL (Only EG3)	C T	-	✓	-

		America															
Active for life year 5.	(Lawlor et al., 2016). England	2242/2221	60	-	-	-	48*	-	AC	Endurance, strength and flexibility fitness with music, at a pace they can follow for a certain time.	-	HL	C T	-	✓	-	
	(Mavilidi et al., 2020). Australia	90/87	1	10	1	1	1*	-	-	Push-ups, jumping jacks, burpees, and running on the spot.	-	-	R P	-	-	✓	
-	(Mok et al., 2020). Croatia, Lithuania, Macedonia, Poland, Romania, Serbia, South Africa and Turkey	3036/2923	16	4*	2	5	16*	-	-	Integration of learning with motor skills and fitness skills guided through videos taken from the virtual platforms Brain Breaks®.	Vi	HL	C T	-	✓	-	
1-Minute Energiizer	(Raney et al., 2017). United States of America	114/106	2	5	2	5	6	-	-	Exercise like push-ups, jumps jacks, burpees and running on the spot. Movements with music, such as 'Sun Salutation', with controlled breathing.	-	-	C T	-	-	✓	
-	(Schmidt et al., 2019). Switzerland	104/102	1	10	1	2	2	-	AC	Performed physical activity imitating animals.	Vi	French, German (Only EG1)	R P	-	✓	-	
-	(Schmidt et al., 2016). Switzerland	98/92	1	10	1	2	3	-	HR and BS	Game where participants had to run following sequence and order of numbers painted on the ground. Game where they ran and changed speed at the command of the investigator, imagining that they were changing gear in a vehicle.	-	Maths (Only EG1)	R P	-	-	✓	
-	(van den Berg, Saliassi, et al., 2019). Holland	549/512	8	10	1	5	9	M V	AC and HR	Follow and imitate dance movements from the videogame Just Dance.	Vi	-	C T	-	-	✓	
-	(van den Berg, Singh, et al., 2019). Holland	369/323	9	7*	1	4	5	-	PAQ- C	Juggling exercises with balls guided by videos from the virtual platform Smartmoves!.	Vi	Maths	C T	-	-	✓	
ACTI- BREAK.	(Watson et al., 2019). Australia	374/276	6	5	3	5	6	M	AC	Games such as jogging in the place as if a big scary bear is chasing you, musical chairs, dancing following the instructions of the virtual platform GoNoodle and YouTube.	Vi	Read- ing, Maths	C T	-	-	-	

NI: Name of intervention. REF: Reference. -: Information is not indicated. Sample: sample at the beginning/end of the intervention. ST: session time. SD: Number of sessions per day. SW: Number of sessions per week. WI: weeks of intervention. I: Objective intensity of physical activity per session. V: Vigorous. MV: Moderate to Vigorous. M: Moderate. MI: Measurement instrument of physical activity intensity. AC: Accelerometer. HR: Heart rate via heart rate monitors. BS: Borg scale. PAQ-C: The Physical Activity Questionnaire for Children. EG: Experimental group. Vi: Guided intervention through video projection where students had to follow instructions and/or imitate movements. CC: physical activity interventions with curricular or integral content. HL: Healthy Living Based Content. RP: Responsible Professional. CT: Classroom Teacher. RP: Research professional. AA: Time and/or place of additional intervention to the classroom. T: Tasks. B: Breaks. SY: Schoolyard. PE: Physical education lessons. CG: Control Group. H: Continue with physical activity practice and regular activities. E: Educational activities that did not include movement or physical activity. ✓: Indicates activity that performed group control. *Average between the shortest and longest duration of the session reported by the article. *Duration of the intervention transferred from months to weeks or from days to weeks. (1 month x 4 weeks, 1 to 5 days x 1 week).

Discussion

Our scoping review analyzed the psychological outcomes of the classroom-based physical activity interventions and described the interventions in 16 randomized clinical trials. These effects were categorized into: a) psychological health effects, b) attitudes to physical activity and c) behavior in the classroom. Attitudes related to physical activity were the variables more assessed (in 8/16 studies) and showed the highest significant changes intergroup (3/8 studies) and intragroup (5/8 studies). There was insufficient evidence to reach a definitive conclusion about the outcomes of physical activity in the classroom on the psychological health of the child population. This is due to the small number of studies and the high level of heterogeneity between them, as well as the absence of a mediation model that explains the interaction between physical activity and psychological health (Rodriguez-Ayllon et al., 2019).

In addition, the most effective interventions in terms of their psychological outcomes were those that included physical activity integrated into the curriculum 2-5 times a week, in sessions of between 4' to 10' of aerobic exercise, muscle strength and games that develop motor skills, implemented mainly by the classroom teacher, with audio-

visual support. It is not possible to establish a guideline for the intensity of the session. Although in general, studies that have reported on physical activity intensity indicate that classroom activities were performed at moderate to vigorous intensity.

Psychological outcomes of classroom-based physical activity interventions

The results of this scoping review are consistent with the results reported by other systematic reviews focused on the child population, where physical activity is positively associated with psychological health (Biddle et al., 2019; Papadopoulous et al., 2022; Pascoe et al., 2020; Poitras et al., 2016; Rodriguez-Ayllon et al., 2019), and physical activity at school is positively associated with psychological health (Andermo et al., 2020; Vaquero-Solis et al., 2020). However, unlike the systematic reviews mentioned above, in this scoping review there was a paucity of studies evaluating mental health symptoms such as anxiety and depression. In this regard, only one study explored the outcomes of physical activity on anxiety in mathematics tests, being able to verify only the effects of anxiety on academic performance, but not the effects of physical activity intervention on general anxiety levels (Mavilidi et al., 2020).

On the other hand, this review presented findings like those reported by Vaquero-Solís et al. where the main results of the interventions were for attitudes towards physical activity, which include self-efficacy and motivation for physical activity. In this sense, the study by Schmidt et al. (2019) reported that students who participated in both the physical activity-incorporated learning intervention group and the physical activity-only intervention group enjoyed the lessons more than students in the control group. Likewise, the studies by Emeljanovas et al. (2018) and Mok et al. (2020), given increases in self-efficacy and motivation for physical activity, suggest that video-guided (interactive) physical activity breaks in the classroom are an effective approach to communicate and promote the health benefits of physical activity in the school child population.

Similar to the findings reported by Rodríguez-Ayllon et al., although to a lesser extent for this scoping review, effects were observed on well-being and related variables such as self-esteem and satisfaction with body image. In this line, the findings of Schmidt et al. (2016), on the mediating effect of change in positive affect between cognitive engagement and focused attention, as well as between cognitive engagement and processing speed, are interesting. In this way, Schmidt et al. (2016), suggest that a brief cognitively engaging activity contributes to children's attention at school. Although, this study supports an approach on how to study and analyze the effects of physical activity interventions on the well-being of schoolchildren. It is the only finding of this type in the 16 selected studies, and it contrasts with the findings of Aadland et al. (2018) where well-being did not have a mediating effect. Finally, as the findings of Masini et al. (2020), this review reported positive effects on behavior in the classroom.

Nevertheless, the underlying mechanisms responsible for the psychological outcomes of physical activity interventions in the classroom, in which variables of self-efficacy, motivation, self-esteem, and behavior may interact, are not entirely clear (Rodríguez-Ayllon et al., 2019). A plausible explanation is given by the conceptual model of Lubans et al. (2016) which describes a causal relationship between physical self-perceptions and psychological health indicators, such as self-concept and self-esteem (Lubans et al., 2016). This conceptual model proposed for three mechanisms (neurobiological, psychosocial, and behavioral), that describe how physical activity interventions produce positive effects on children's psychological health. It postulates that an activity, such as physical activity, will increase the motivation and well-being of children, if it provides opportunities to satisfy the basic psychological needs of autonomy, competence, and relatedness (Ryan & Deci, 2000; Teixeira et al., 2012).

In this sense, the increase in motivation for physical activity is translated into greater self-efficacy towards physical activity, which has been described as an important predictor of sustained behaviors over time, and which is related to better levels of physical activity (Tang et al., 2019). This

would also lead to the satisfaction of basic psychological needs, better self-esteem, and body image and, consequently, better psychological health in schoolchildren.

In a complementary way, the theory of self-efficacy (Bandura, 1989) mentions that psychological variables can mediate the effect of physical activity on well-being. Since physical activity can positively contribute to self-efficacy, body image and physical self-esteem, consequently, impact psychological health progressively (Diener et al., 2017; Zamani et al., 2016).

Although psychological outcomes are primarily primary outcomes in the interventions studied, more evidence is required that examine the effect of classroom-based physical activity on other indicators of psychological health such as mental health symptoms.

Characteristics of physical activity interventions in the classroom-based implemented

The characteristics of the interventions were similar to those described by Watson et al. (2017) as active breaks, which are short periods of physical activity (8-10 minutes) (Sánchez-López, García López, & Ruiz Hermosa 2020) performed as a break from academic instruction, which may or may not include content of the curriculum. In this regard, several studies have explored the duration, frequency, and optimal intensity of active breaks. Comparing the duration of active breaks has found better results on classroom behavior in 10-minute sessions (Howie et al., 2014), applied to physical activity from a moderate to vigorous intensity (Daly-Smith et al., 2018). In this review, precisely 10-minute sessions and moderate to vigorous intensities were most frequently used, although few studies (4/16) reported the intensity to which the interventions were applied.

The general characteristics of physical activity delivered in the interventions studied in this review are in line with the new health guidelines issued by the WHO for children, where the daily physical activity of moderate to vigorous intensity is suggested, and muscle strengthening activities during the week (Chaput et al., 2020). The type of physical activity most often performed in interventions were precisely aerobic activities that could be executed in the classroom, such as skipping, imitating sports movement, simulate running in place or jogging inside the classroom.

Pascoe et al. (2020) relate moderate to vigorous intensity with positive effects on psychological variables such as self-esteem, self-perception, and self-efficacy. The effects on these psychological variables have already been reported by similar studies (Babic et al., 2014). Poitras et al. (2016) mention that physical activity performed at moderate to vigorous intensity is positively associated with psychological health indicators in the child population. This approach is interesting, since most of the interventions reviewed implemented moderate to vigorous activities, but we do not know if these are effective or more effective than other intensities.

In addition, most of the interventions combined physi-

cal activity with curriculum-focused content, and used videos to guide interventions, being the most frequently implemented Brain Breaks methodology. In this regard, positive effects on psychological variables in the children's school population have been described, supporting the use of Brain Breaks (Zhou et al., 2021). Technology in education and its influence cannot be ignored, proving that there is reason to think that the use of such methods in the delivery of interventions is promising (Popeska et al., 2018). In this sense, a systematic review of physical activity interventions in school suggests an increasing trend related to the integration of web-based methodologies and active breaks during traditional classes (Vaquero-Solís et al., 2020). Likewise, physical activity interventions guided by videos allow classroom teachers to facilitate their implementation, positively addressing barriers frequently detected such as lack of time in the curriculum, or self-perception of the level of competence to deliver physical activity (Nathan et al., 2018).

Strengths and limitations

The results of this review extend the scope of the benefits of physical activity interventions in the classroom on psychological variables in children's school population, as they had been reported only in adolescents (Pascoe et al., 2020). Another of the strengths of this review is that it includes only studies with randomized controlled trials design, which guarantees methodological quality. This review could be useful for future research regarding the methodology, type, duration, frequency, and intensity of physical activity to be used in interventions to improve children's psychological health.

This scoping review has some potential limitations. First, although we have conducted and reported our review using existing guidelines, the characteristics and quality of the included studies could be a limitation. Second, the synthesis of the evidence was restricted to the narrative description because of the variety of indicators and the way they were evaluated among studies. Third, readers should bear in mind when interpreting the results that this scoping review includes studies that have used different instruments to assess psychological outcomes, so it is possible that the variables in the three groupings do not refer to the same constructs, even if they share similar meanings. Finally, gray literature was not included in the search, and we only included studies published in English or Spanish. This may result in a loss of information for the results reported. Finally, it is important to highlight that only one article, of those included in this review, incorporated information related to schoolchildren with special educational needs (van den Berg, Saliasi, et al., 2019); this aspect is of special relevance given the current characteristics of the heterogeneity of schoolchildren.

Conclusions

This scoping review synthesized the evidence for psy-

chological outcomes from a total of 16 randomized clinical trials of classroom physical activity interventions for children aged 6 to 12 years. The results were classified as: a) effects on psychological health, b) attitudes towards physical activity and c) behavior in the classroom. Attitudes related to physical activity were the most evaluated variables and showed the greatest significant changes between and within the participants. The most effective interventions on the psychological variables were those that included physical activity integrated into the curriculum 2-5 times a week, in sessions of between 4' to 10' of aerobic exercise, muscle strength and games that develop motor skills, implemented mainly by the classroom teacher and with audio-visual support. Therefore, the design of physical activity interventions in the classroom, either for academic or research purposes, that have these characteristics is suggested.

However, there are still some knowledge gaps that make it necessary to study this type of intervention. For example, given the predominance of studies in Europe, future studies in school populations outside this continent are necessary. Likewise, it is not possible to establish a guideline for the intensity of the sessions because this component has not reported in most of the included studies. In addition, more studies are required that use an objective measure of physical activity (e.g., accelerometers) to a better comprehension of the effects of the different levels of intensity on the psychological health of children's school population. Another key aspect to consider in future research is the control of mediators, moderators, and confounding factors such as age, sex, total physical activity, socioeconomic level, weight, and physical condition, which may be interfering in the psychological health results of the type of intervention. In addition, it is essential to examine the outcomes of classroom-based physical activity on other indicators of psychological health such as depression or anxiety that have not yet been analyzed.

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