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The effectiveness of school-based run/walk programmes to develop physical literacy and physical activity components in primary school children: A systematic review

Shannah Anico[a], Laura Wilson[a], Emma Eyre[b] and Elizabeth Smith[c]

[a]London Sport Institute, Middlesex University, London, UK; [b]Centre for Sport, Exercise and Life Sciences, Coventry University UK, Coventry, UK; [c]HE Sport, Hartpury University, Gloucester, UK

ABSTRACT

The objectives of this review were to systematically review the research on school-based run/walk programmes and their measurements of physical literacy (PL) and physical activity (PA)-related components and to assess the different intervention methods and their impact on encouraging PL and PA. To be included in the review, studies had to satisfy all inclusion criteria. An electronic search was conducted on six databases, the last date search was 25 April 2022. All outcome measures were grouped using the Shearer et al. (2021) PL checklist and additional PA related outcomes. Ten studies were included in the final review. Five different run/walk interventions were identified and six studies followed or referred to The Daily Mile (TDM) protocol. Outcomes relating to the physical domain were most commonly explored, and no studies explored the cognitive domain. Four studies reported significant differences in cardiovascular endurance measures. Positive findings were also reported for outcomes relating to motivation and self-perception/self-esteem in the affective domain. Overall, run/walk programmes appear to provide promising results in favour of physical and affective development in PL. However, further high-quality studies are needed to draw firm conclusions. This review highlights the popularity of TDM and its potential to contribute to PL development.

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School; intervention; physical literacy; physical activity

1 Introduction

Schools are identified as essential environments for contributing to children's daily physical activity (PA) levels (Jones et al., 2020; Naylor et al., 2015; Public Health England, G. U, 2020b; Shah et al., 2017; Taymoori & Lubans, 2008) and prove a popular environment to roll out PA-based initiatives as children spend a large portion of their day in school (Jones et al., 2020; Naylor et al., 2015; Shah et al., 2017). Children and young people should be engaging in an average of 60 minutes per day of moderate to vigorous physical activity (MVPA) across the week, and at least 30 of their 60 active minutes per day should be achieved during school time (UK Chief Medical Officer Physical Activity Guidelines, 2019;). However, with increasing timetable pressures on schools and physical education (PE), the opportunity for active play is often not prioritised (Norris et al., 2015; Youthsporttrust.org, 2018). School-based PA programmes are offered as an opportunity for pupils to be active throughout the school day outside of PE lessons, including during breaktime or in-class activities (Jones et al., 2020). These PA-focused initiatives are often introduced to combat rising childhood obesity and sedentary behaviours in young children by increasing daily PA at school (Chalkley et al., 2020b; Jones et al., 2020).

Existing systematic reviews and meta-analyses of school-based PA programmes have reported the effects of participation, including improved; PA and/or Sedentary behaviours (M. B. Owen et al., 2014; Dobbins et al., 2001; Hynynen et al., 2016; Jones et al., 2020; Kriemler et al., 2011), Motivation (Dobbins et al., 2013; Kelso et al., 2020), MVPA (Nathan et al., 2018), and academic outcomes (Watson et al., 2017). However, these findings are often inconsistent across reviews, and many components are inconclusive or only indicate small effects (Dobbins et al., 2013; Jones et al., 2020). One suggested limiting factor for these findings is the variation in intervention designs within reviews (Jones et al., 2020).

In recent years, school-based run/walk programmes have gained popularity (Chalkley et al., 2018b, 2020a) and involve walking, jogging, or running a route on school grounds for either a set distance or time (Chalkley et al., 2020b; Sherar et al., 2020). School-based running programmes are often also referred to at a policy level as "active mile initiatives", which typically entail running for approximately 15 minutes at a self-selected pace until a one-mile distance is covered (Chalkley et al., 2018a; Public Health England, G. U, 2020; The Daily Mile, 2022). Due to the self-select nature and variation in pace, the interventions are referred to in the present review as "run/walk" interventions rather than solely "running interventions". Several national and local policies feature school-based interventions with specific attention on run/walk programmes such as The Daily Mile™ (TDM; Public Health England, G. U, 2020; The Daily Mile, 2022). The United Kingdom (UK) Government Childhood obesity: A plan for action report, Chapter 2 (Department of Health and Social care, 2019) and the School Sport and Physical Activity Plan (Department for Education, Department for Digital, Culture, Media & Sport and Department of Health and Social Care, 2019) all promote the implementation of "active mile

CONTACT Shannah Anico SA2618@live.mdx.ac.uk London Sport Institute, Middlesex University, London UK

initiatives" (Public Health England, G. U, 2020). Existing work on programmes like TDM (Marchant et al., 2020) and Marathon Kids (MK; Chalkley et al., 2018a, 2018b) have found that the programmes offer schools a flexible and straightforward approach to encouraging daily PA without needing additional equipment, staff training or funding to implement, all of which have repeatedly been noted as limitations in other forms of school-based activities.

Since TDM's launch in Stirling in 2012, the programme has grown in popularity across the globe. The programme received £1.5 million as part of the Sport England National lottery funding in order to help primary schools in England implement TDM and to date, the initiative is taking place in approximately 87 countries, with over 3,175,000 children completing TDM daily (Sherar et al., 2020; The Daily Mile, 2022). Much discussion has been raised on how far these programmes go in establishing positive physiological change, mental health and improved academic attainment and in turn encouraging long-term PA participation (Daly-Smith et al., 2019; Fairhurst & Hotham, 2017; Thorburn, 2020). Daly-Smith et al. (2019) and Thorburn (2020) both noted that current TDM studies driving policy have lacked quality and clarity in their findings and call for further investigation to confirm conclusions. Since its initial launch, research into TDM has developed; however, there are still currently no known reviews examining this specific intervention type, which aim to draw firm conclusions about the potential outcomes of participation.

The concept of physical literacy (PL) has been discussed as a way to encourage and maintain lifelong engagement in PA. PL can be described as a "multifaceted concept" that consists of affect, physical and cognitive domains that interlink (Cornish et al., 2020; Edwards et al., 2017; Shearer et al., 2021; Whitehead 1, 2001). Embodying a PL perspective in research looks beyond exclusively physical outcomes and also provides a holistic perspective considering psychological and cognitive elements. Globally, many definitions of PL are adopted by leading sports associations (Edwards et al., 2017). The Whiteheadian perspective is thought to cover a variety of movements and physical and psychological skills that go beyond solely competitive sports participation, and represents a holistic approach to PA, considering the lifelong processes associated with participation (Edwards et al., 2017; Whitehead 1, 2001). The International Physical Literacy Association (IPLA) also uses this popular definition. According to the IPLA website, PL can be defined as "The motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life" (IPLA, 2017). While PL is lifelong, initiatives implemented during childhood are popular because it is a critical stage for developing PL attributes and lifelong PA participation (Belanger et al., 2018; Shearer et al., 2021). In the School Sport and Physical Activity Action Plan (Department for Education, Department for Digital, Culture, Media & Sport and Department of Health and Social Care, 2019), PL is also included as a core feature of children's school experiences and PA participation. It is thought that creating positive daily PA habits in schools could contribute to developing PL components in children and, in turn, increase the likelihood of developing a lifetime habit of PA (Department for Education, Department for Digital, Culture, Media & Sport and Department of Health and Social Care, 2019).

Given its inclusion of the three domains, PL can capture a broad range of processes that contribute to lifelong learning and engagement in physical activities (Cairney et al., 2019; Whitehead et al., 2013). Investigating PL could be more worthwhile than solely focusing on physical factors relating to health like body mass index (BMI) or motor skills that perhaps do not consider the broader processes associated with lifelong engagement (social, cognitive, affective etc.). Children with greater PL are thought to be more likely to meet daily PA guidelines (Cornish et al., 2020) and often, these elements are seen in conjunction with one another. Engaging in meaningful PA experiences will provide children with the opportunity to develop and nurture their PL; in doing so, they also then contribute to developing regular PA habits (Durden-Myers et al., 2018; Whitehead 1, 2001). Nevertheless, there are currently no known reviews assessing the influence of school run/walk programmes alongside PL and PA-related outcomes. Exploring the domains of PL with this intervention type may also provide an opportunity to address potential concerns on the efficacy of the interventions on children's PA participation.

Therefore, the aims of this review were 1) To systematically examine the research on school-based run/walk programmes and the measurements of PL constructs and PA-related components. 2) To assess the different intervention methods of school-based run/walk programmes and their impact on encouraging PA participation or developing PL.

2 Materials and methods

The reporting of this systematic review followed the PRISMA 2020 guidelines. The project was registered with PROSPERO (CRD42021253675), and ethical approval was granted by the institutional ethics committee.

2.1 Search strategy

An electronic search was conducted on six databases: 1) SPORTDiscus, EBSCOhost 2) MEDLINE, EBSCOhost 3) Sage journals, EBSCOhost 4) PubMed 5) ScienceDirect 6) APA PsycINFO, EBSCOhost. The last date of the search for all databases was 25 April 2022. The databases used included areas relevant to PL and PA components. A subject librarian and two researchers (SA and LS) developed the search strategy. The search of databases included a combination of keywords and subject headings for interventions research on children, school-based run/walk programmes and PL or PA components based on the Population Intervention Control Outcome (PICO) framework displayed in Table 1.

2.2 Inclusion

The study characteristics used to determine eligibility for inclusion were based on the PICO framework (Higgins et al., 2019). The inclusion and exclusion criteria for the systematic review are shown in Table 2. Studies had to satisfy all inclusion criteria to be included in the review, this included assessing at least one outcome in the PL checklist (Shearer et al., 2021). The checklist is a recent tool developed to identify PL qualities in outcome measures. The tool is based on existing PL research

Table 1. PICO framework and search terms.

PICO	Application	Code	Search terms
Population	*Interventions research on children 4–16 years old*	1	Child* OR adolescent OR Youth* OR Teen OR Young people OR Young person OR Juvenile*
Intervention	*School-based run/walk programmes (Reception, primary and secondary only)*	2	Run OR Walk OR Jog AND intervention OR programme AND school*
Comparison	*Control or randomised control groups*		
Outcome	*Physical literacy or physical activity components*	3A	Physical literacy – Physical outcomes AND "physical literacy" OR "Physical activity" OR exercise OR "physical fitness" OR sports OR sedentary OR cardiovascular OR activity OR aerobic OR "motor control" OR coordination OR performance
		3B	Physical literacy – Affective outcomes AND "physical literacy" OR "Affective well-being" OR affective OR self-efficacy OR self-confidence OR confidence OR behaviour OR motivation OR Enjoyment OR emotion OR attitude OR belief
		3C	Physical literacy – Cognitive outcomes AND "physical literacy" OR "Cognitive function" OR cognitive OR well-being OR Knowledge OR understanding OR value
		3D	Other outcomes – relation to physical activity and public health research OR Obesity OR obese OR weight OR "weight loss" OR "weight reduction" OR "weight management" OR "weight maintenance" OR BMI OR "body mass index" OR "academic achievement" OR "body composition"

Searches were conducted by combining codes (1,2 and 3A, 1,2 and 3B, 1,2 and 3C, 1,2 and 3D).

Table 2. Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Peer reviewed, Full-access, Written in English language, Published before 25 April 2022 Experimental research design, Mixed-methods or quantitative based Interventions must: - Measure at least one outcome in line with the Shearer et al. (2021) PL checklist. This included: confidence, motivation, emotional regulation, enjoyment, persistence/ resilience/commitment, adaptability, willingness to try new activities, autonomy, self-perception/ self-esteem, perceived physical competence, object-control, stability, locomotor, movement skills – land, movement skills – water, moving using equipment, cardiovascular endurance, muscular endurance, co-ordination, flexibility, agility, strength, reaction time, speed, power, rhythmic ability, aesthetic/ expressive ability, sequencing, adapt movement strategies to the situation/ environment, progression from simple-complex skills, knowledge and understanding of benefits of physical activity, knowledge and understanding of importance of physical activity, knowledge and understanding of effects of physical activity on the body, knowledge and understanding of opportunities to be active, knowledge and understanding of sedentary behaviour, ability to identify and describe movement, creativity and imagination in application of movement, decision making (ability to think, understand and make decisions, knowing how and when to perform), ability to reflect and improve own performance, including setting optimal challenges, knowledge and understanding of tactics, rules and strategy, knowledge and understanding of safety considerations and risk. - Be based in a primary school setting - Adhere to the definition of school-based run/walk programmes as per (Chalkley et al., 2020b; Shearar et al., 2020). This included: walking, jogging, or running a route on school grounds for either a set distance or time. The intervention should take place in addition to PE and throughout the school week or term. - Include participants aged between 4–16 years (pre-adolescents) in primary school	Conference reports or readings, editorial and forewords Non-experimental research design, Qualitative methods only, process evaluations or protocols Interventions relating to medical illness and/or physical disability or specific health conditions.

and considers the different definitions of PL that have been adopted internationally (Shearer et al., 2021).

2.3 Selection and extraction

Two researchers conducted the data screening independently (SA and LS). All studies that returned from the initial searchers were screened in two stages in accordance with the review's inclusion and exclusion criteria (Higgins et al., 2019). First, all titles and abstracts were reviewed, and duplicates were removed. After stage one, assessors met to discuss any disagreements. At stage two, full texts were screened. Both researchers reviewed the resources twice for the familiarisation process. All studies and records of the selection process took place on a shared standardised Microsoft Excel form to reduce selection and publication bias (Higgins et al., 2019). Studies that did not meet the study criteria were removed. Any disagreements between the researchers were resolved by discussion between the two until consensus was reached.

In order to answer the review objectives and facilitate the risk of bias assessments, the basic characteristics were extracted from each study, as recommended by Higgins et al. (2019) and Mengist et al. (2020) and recorded in Microsoft Excel. One reviewer (SA) extracted data from the articles and a second verified the data (LS). The extracted data included year of publication, study type, country, sample size, and intervention characteristics.

2.4 Quality and reporting

The PEDro Scale was used to assess the risk of bias in each study included in the review. The tool has been validated and used widely in sports and exercise as a tool for quality assessment (Cashin & McAuley, 2019; Yamato et al., 2017). Three

Table 3. Study characteristics and quality score.

Authors	Control	Sample	Study type	Quality tool	Quality score
Booth et al. (2020)	Y+	5463	Cohort study	PEDro	Fair
Brustio et al. (2018)	N	276	Cohort study	PEDro	Good
Mønness and Sjølie (2009)	N	105	Cohort study	PEDro	Fair
Garnett et al. (2017)	N	129	Cohort study	PEDro	Fair
Breheny et al. (2020)	Y	2280 (IG = 1153, CG = 1127)	Intervention study	PEDro	Good
Brustio et al. (2020)	Y	548 (IG = 279, CG = 269)	Intervention study	PEDro	Fair
Chesham et al. (2018)	Y	379 (IG-252, CG = 127)	Intervention study	PEDro	Fair
Marchant et al. (2020)	N	258	Cohort study	PEDro	Poor
Brustio et al. (2019)	Y	795 (CG = 309, IG = 486)	Intervention study	PEDro	Fair
De Jonge et al. (2020)	Y	659 (IG = 282, CG = 377)	Intervention study	PEDro	Fair

Y, Control used; N, no control; Y+, Control plus an activity; IG, intervention group; CG, control group; PEDro, Physiotherapy Evidence Database

researchers (SA, LW & EE) independently assessed the quality of the studies. The included studies were scored on 11 criteria, and points were awarded when a criterion was satisfied. Studies were scored as "criteria met" (✓) or "criteria not-met" (×). The final quality scores are displayed in Table 3 and detailed criteria scoring is displayed in Table 4. Total scores of between 9 and 11 were considered "excellent", 6 to 8 "good", 4 to 5 "fair" and less than 3 "poor" (Moseley & Pinheiro, 2022). Inter-rater reliability for the PEDro risk of bias indicated strong reliability between assessors (SA, LW k = 0.76) (SA, EE k = 0.92). Any disagreements were resolved via discussion between SA, LW and EE until consensus was reached.

2.5 Data synthesis

The outcome measures assessed in the included studies were grouped under the relevant PL domain (physical, affective or cognitive) using the PL checklist developed by Shearer et al. (2021). In line with the study's aims, PA outcomes were also grouped. PA-related outcomes were deemed as any outcome measure that related to, or connected with, participation in PA and exercise, specifically measures that had been used in public health research and did not meet the PL checklist criteria (Biddle et al., 2019; Chaput et al., 2020; Hills et al., 2015). The items were scored as "assessed" (✓), "not-assessed" (×) or "Unclear" (?). Researcher one (SA) categorised each paper and the second researcher (LS) verified the groupings. Meta-analysis was not performed due to the variety between interventions with regard to study design, outcome measures, assessment tools and study/method quality. Therefore, findings were synthesized narratively and results are presented in outcome measure tables. The included studies were then assessed based on their study aims and outcomes and the relation to PL development.

3 Results

3.1 Study selection

A total of 25,780 papers were recorded in the initial search, of which 11,268 duplicates were removed, and 3244 were removed for not meeting the journal article inclusion criteria. After screening titles and abstracts of 11,268 articles, 59 full-text articles were reviewed at screening stage 2. Following stage two, 10 studies were deemed eligible for inclusion in the review and the remaining 49 were excluded. Figure 1 displays a full breakdown of the exclusion of studies.

3.2 Characteristics and quality

For each study, the use of control, sample size, study type, quality tool and score are presented in Tables 3 and 4 includes a breakdown of all quality criteria and scored outcomes. The intervention characteristics extracted from each study include the study location, intervention type, intervention characteristics (length of study, frequency of completion and duration of intervention), with data presented in Table 5.

3.3 Intervention characteristics

3.3.1 Design

Five different intervention types were included in the review (Table 5). Three studies implemented TDM as described by TDM website, and three implemented TDM with some form of variation from its initial protocol. Breheny et al. (2020) permitted teachers to adapt TDM as they thought it to be "motivational" for the pupils. This could include integrating maths classes or using reward tools. Two studies had an intervention group (IG), and an intervention-plus group (IPG) who performed a modified intervention. In De Jonge et al. (2020), the IG performed TDM as usual, and IPG performed TDM and received additional teacher support. Teacher support included visits to the school within the first 2 weeks of implementation, regular contact through WhatsApp such as weather reports and motivational support, and every 3 weeks teachers would have discussions with support staff on the potential barriers and issues with TDM (De Jonge et al., 2020). Brustio et al. (2020) varied the frequency between intervention groups. Subgroups were as follows: the 2_Times subgroup (IG2), which performed TDM less than 2.5 times per week, and the 3_Times subgroup, which performed TDM more than 2.5 times per week (IG3).

One study intervention, reportedly "Inspired by" TDM Brustio et al. (2018), performed a walking intervention in which pupils walked 1 km along a marked school path for approximately 10 mins. Similarly, Booth et al. (2020) assessed the impact of 15 min bouts of self-paced activity, such as TDM, compared to more intense running schemes. The TDM protocol was neither explicitly mentioned nor adhered to in Booth et al. (2020), but the interventions shared similar qualities. Mønness and Sjølie (2009) performed 20 min daily walking and was the only to note that the intervention took place across varied terrains; the course involved "varied gradient, steepness, climbing and balancing". Garnett et al. (2017) investigated the intervention "Move it! Move it!" in which pupils, their families and school teachers voluntarily attended a morning run/walk

Table 4. Quality score criteria.

	1. Eligibility criteria were specified	2.Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received)	3. Allocation was concealed	4.The groups were similar at baseline regarding the most important prognostic indicators	5.There was blinding of all subjects	6.There was blinding of all therapists who administered the therapy	7.There was blinding of all assessors who measured at least one key outcome	8.Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	9.All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by "intention to treat"	10.The results of between-group statistical comparisons are reported for at least one key outcome	11.The study provides both point measures and measures of variability for at least one key outcome
Booth et al. (2020)	×	×	✓	✓	×	×	×	×	×	✓	✓
Breheny et al. (2020)	✓	✓	×	✓	×	×	✓	×	✓	✓	✓
Brustio et al. (2018)	✓	×	×	✓	×	×	×	✓	✓	✓	✓
Brustio et al. (2019)	✓	×	×	×	×	×	×	✓	✓	✓	✓
Brustio et al. (2020)	✓	×	×	×	×	×	×	✓	✓	✓	✓
Chesham et al. (2018)	✓	×	×	×	×	×	×	✓	✓	✓	✓
De Jonge et al. (2020)	✓	×	×	×	×	×	×	✓	✓	✓	✓
Garnett et al. (2017)	✓	×	×	×	×	×	×	✓	✓	✓	✓
Marchant et al. (2020)	✓	×	×	×	×	×	×	×	✓	×	✓
Mønness and Sjølie (2009)	✓	×	×	×	×	×	×	✓	✓	×	✓

× Criteria not assessed, ✓ Criteria assessed

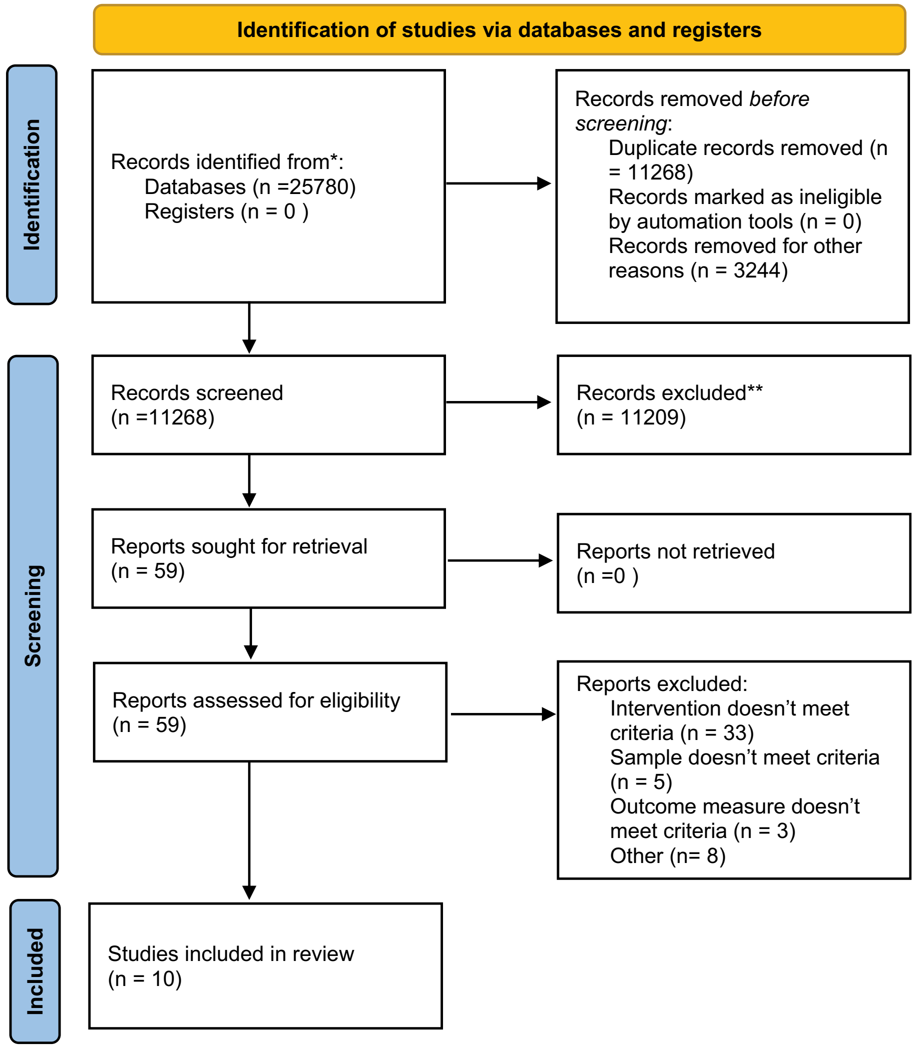

Figure 1. PRISMA flow diagram.

programme. The programme was completed Monday, Wednesday and Friday 7:45 am – 8:10 am, individual miles were tracked, and incentives were received at different milestones.

3.3.2 Length, frequency and duration

Booth et al. (2020) was the only study to record immediate pre- and post-intervention effects after one performance of the intervention. All other participations varied from 3 to 12 months. All studies stated the time of year of implementation and data collection; however, no studies investigated the potential seasonal impact on adherence or affect. Two studies conducted pre-, mid- and post-assessments (Breheny et al., 2020; Brustio et al., 2020).

The frequency of participation ranged from one completion (Booth et al., 2020) up to five times per week, with durations ranging from 10 to 25 mins (Breheny et al., 2020; Brustio et al., 2018, 2020; Chesham et al., 2018; Marchant et al., 2020; Mønness & Sjølie, 2009). De Jonge et al. (2020) performed TDM only on days when schools did not have PE scheduled, this was estimated to be 3/4 times per week, and compliance was reported. Brustio et al. (2020) was the only study reported to have compared different intervention frequencies. Mønness and Sjølie (2009) was the only study to report a replacement activity took place on missed intervention days. The intervention did not take place on three school days due to bad weather whereby it was replaced with an indoor PA.

3.3.3 Training

Five studies out of 10 studies provided some form of basic training or introduction to the intervention (Breheny et al., 2020; Brustio et al., 2019, 2020; Chesham et al., 2018; De Jonge et al., 2020). The training tools used included leaflets (Brustio et al., 2019; Chesham et al., 2018) or guidance to online information (TDM website; Breheny et al., 2020; Brustio et al., 2020), staff or public meetings (Brustio et al., 2020), and welcome packs (De Jonge et al., 2020). The welcome packs provided in De Jonge et al. (2020) included a "how-to" poster, temporary tattoos, flyers for parents, intervention instruction manuals for teachers, and a calendar that can be used to track participation. One study mentioned that no specific intervention training was required due to the simplicity of the intervention design (Brustio et al., 2018). The two remaining studies either did not mention training tools or did not specify

Table 5. Intervention characteristics.

Authors, Year	Location	Intervention type	Intervention characteristics: Length	Frequency	Duration	Intervention delivery	Intervention training
Booth et al. (2020)	UK	15 min of self-paced activity	Once	Once	15 min	Self-paced run/walk activity similar to The Daily Mile. Children ran or walked at self-selected pace for 15 min.	
Brustio et al. (2018)	Italy	1 km walking intervention	4 months	5X/week	10 min	1 km walk around marked path on school grounds at 11am every day. Delivered by class teachers in addition to usual timetable.	-
Mønness and Sjølie (2009)	Norway	20 min daily walk	6 months	5 X/ week	20 min	Timed class walks on rugged forest trial. Delivered by class teacher at a time convenient to school timetable. Substituted with indoor PA during bad weather.	-
Garnett et al. (2017)	USA	Move it! Move it!	n/a	3 X/ week	25 min	Voluntary morning running and walking programme. Monday, Wednesday and Friday 7:45am-8:10am, students, families and school staff run/walk laps of the school play area. Individual miles are tracked and incentive received at different milestones.	-
Chesham et al. (2018)	UK	TDM	6 months	5X/week	~15 min/1-mile distance	15 min self-selected pace walk/jog/run around school play area. Delivered by class teachers as a break from lesson not to replace PE or any PA in the day.	Leaflet
Marchant et al. (2020)	UK	TDM	3–6 months	5X/week	~15 min/1-mile	15 min self-selected pace walk/jog/run around school play area. Delivered by class teachers as a break from lesson not to replace PE or any PA in the day.	-
Brustio et al. (2019)	Italy	TDM	3 months	3X/ week	~ 15 min / 1-mile distance	15 min self-selected pace walk/jog/run around school play area. Delivered by class teachers as a break from lesson not to replace PE or any PA in the day.	Leaflet
Breheny et al. (2020)	UK	TDM*	12 months	5X/week	~15 min/ 1mile distance	15 min self-selected pace walk/jog/run around school play area. Delivered by class teachers as a break from lesson not to replace PE or any PA in the day. Teachers were also allowed to adapt the implementation using motivational material.	General TDM information and guidance to official website
De Jonge et al. (2020)	Netherlands	TDM*	3 months	3X –4/ week	~15 min/1-mile distance	2 forms of intervention. Intervention group: 15 min self-selected pace walk/jog/run around school play area. Delivered by class teachers as a break from lesson not to replace PE or any PA in the day. Intervention-plus group: The Daily Mile plus additional teacher support	Welcome pack. Intervention-plus group teachers received personal support
Brustio et al. (2020)	Italy	TMD*	6 months	2X or 3/week	~15 min/1-mile distance	2 forms of intervention delivery: 15 min self-selected pace walk/jog/run around school play area. Delivered by class teachers as a break from lesson not to replace PE or any PA in the day. 'Group_2' completed TDM 2 times per week and 'Group_3' completed TDM 3 times per week	Public Meeting. General TDM information and guidance to official website

Note: TDM, The Daily Mile; TDM*, Variation in intervention; IG, intervention group; CG, control group

Table 6. PL checklist (Shearer et al., 2021).

	Affective									
Author	Confidence	Motivation	Emotional regulation	Enjoyment	Persistence/ resilience / commitment	Adaptability	Willingness to try new activities	Autonomy	Self-perceptions / self-esteem	Perceived physical competence
Booth et al (2020)	×	×	×	×	×	×	×	×	✓	×
Breheny et al. (2020)	×	×	✓	×	×	×	×	×	×	×
Brustio et al. (2018)	×	✓	×	×	×	×	×	×	×	×
Brustio et al. (2019)	×	×	×	×	×	×	×	×	×	×
Brustio et al. (2020)	×	×	×	×	×	×	×	×	×	×
Chesham et al. (2018)	×	×	×	×	×	×	×	×	×	×
De Jonge et al. (2020)	×	×	×	×	×	×	×	×	×	×
Garnett et al. (2017)	×	×	×	×	×	×	×	×	✓	×
Marchant et al (2020)	×	×	×	×	×	×	×	×	×	×
Monness et al. (2009)	×	×	×	×	×	×	×	×	×	×

Author	Physical																		
	Object-control	Stability	Locomotor	Movement skills - Land	Movement skills - Water	Moving using equipment	Cardiovascular endurance	Muscular endurance	Coordination	Flexibility	Agility	Strength	Reaction time	Speed	Power	Aesthetic / Expressive ability	Sequencing	Adapt movement	Progression from simple-complex skills
Booth et al (2020)	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Breheny et al. (2020)	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×
Brustio et al. (2018)	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×
Brustio et al. (2019)	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	✓	×	×	×	×
Brustio et al. (2020)	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×
Chesham et al. (2018)	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×
De Jonge et al. (2020)	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×
Garnett et al. (2017)	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Marchant et al (2020)	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×
Monness et al. (2009)	×	✓	×	×	×	×	✓	✓	×	✓	×	×	×	×	×	×	×	×	×

Author	K&U of benefits of PA	K&U of important of PA	K&U of effects of PA on the body	K&U of opportunities to e active	K&U of sedentary behaviour	Ability to identify and describe movement	Cognitive Creativity and imagination in application of movement	Decision -making (Ability to think, understand and make	Ability to reflect and improve own performance	K&U of tactics, rules and strategy	K&U of safety considerations and risk
Booth et al (2020)	×	×	×	×	×	×	×	×	×	×	×
Breheny et al. (2020)	×	×	×	×	×	×	×	×	×	×	×
Brustio et al. (2018)	×	×	×	×	×	×	×	×	×	×	×
Brustio et al. (2019)	×	×	×	×	×	×	×	×	×	×	×
Brustio et al. (2020)	×	×	×	×	×	×	×	×	×	×	×
Chesham et al. (2018)	×	×	×	×	×	×	×	×	×	×	×
De Jonge et al. (2020)	×	×	×	×	×	×	×	×	×	×	×
Garnett et al. (2017)	×	×	×	×	×	×	×	×	×	×	×
Marchant et al (2020)	×	×	×	×	×	×	×	×	×	×	×
Monness et al. (2009)	×	×	×	×	×	×	×	×	×	×	×

PL, physical literacy; K&U, Knowledge and understanding; × Criteria not assessed, ✓ Criteria assessed.

intervention-specific training (Garnett et al., 2017), in one case, general study participation information was provided (Brustio et al., 2018).

3.3.4 Delivery

Nine interventions were delivered by class teachers (Breheny et al., 2020; Brustio et al., 2018, 2020, 2019; Chesham et al., 2018; De Jonge et al., 2020; Marchant et al., 2020; Mønness & Sjølie, 2009) or by specialist trained school staff (Garnett et al., 2017). One intervention was led by the research team (Booth et al., 2020).

3.4 Physical literacy-related outcomes

According to the Shearer et al. (2021) checklist, no studies explored all three domains of PL; all studies explored either the physical or affective domains, and no studies explored the cognitive domain (Table 6). No unified PL method of assessment was identified, all methods of assessment were distinct, and no studies aimed to measure or track PL.

3.4.1 Physical domain

Cardiovascular endurance (CE) was the most frequently explored area in the physical domain (n = 7; Table 6). The methods of assessment varied across the majority of studies. However, all focused on the outcome result (e.g., distance run) and not competence scoring (e.g., technique). The tools included a British Athletics Linear track test (Breheny et al., 2020), step test (Mønness & Sjølie, 2009), 6-min run test (Brustio et al., 2020, 2019), and shuttle run tests (Chesham et al., 2018; De Jonge et al., 2020; Marchant et al., 2020).

There was an inconsistency in the magnitude of CE change within the findings, although all studies reported some form of positive difference from baseline, as shown in Table 7. In total, four studies have found significance in CE (Brustio et al., 2020; Chesham et al., 2018; De Jonge et al., 2020; Mønness & Sjølie, 2009). Interestingly, three of the studies used control groups (CG) and performed TDM intervention, the third (Mønness & Sjølie, 2009) conducted a 20 min walking intervention and completed an additional control analysis. The duration of intervention participation varied between 3 (Brustio et al., 2019; De Jonge et al., 2020) and 6 (Brustio et al., 2020; Chesham et al., 2018; Mønness & Sjølie, 2009) months. Three studies that found statistically significant results noted that TDM was completed approximately three times per week. Brustio et al. (2020) observed a significant difference between groups in favour of IG ($F = 13.932$, p-0.008) (correcting for age and BMI) and an overall performance improvement of 7.2%. Findings were also greater in IG3 (Effect size (ES) 0.51) compared to IG2 (ES = 0.29). Similarly, Brustio et al. (2019) found that IG increased between baseline and 3-month follow-up (estimated difference (ED) 25.15 m, standard error (SE) 6.39 m, $p < 0.001$, percentage change = 3.1%) compared to CG (ED 4.44 m, SE = 6.69 m, $p = 0.911$, PC = 0.5%). After adjusting for age and sex, De Jonge et al. (2020) found a significant intervention effect on shuttle run tests in favour of both IG (IG 1.1 stage, 95% Confidence Interval (CI) 0.8 to 1.5, IGP 0.6, 95% CI 0.5 to 1.0).

Breheny et al. (2020) was the only study to conduct mid-follow-up assessments at 4 months and post-intervention at 12 months and was the longest intervention duration for participation. The study identified small difference in CE but in favour of the CG at both time points (4 months mean difference (MD) 5.96, 95% CI 113.81 to 9.94, $p = 0.436$) (12 months MD −65.61, 95% CI 113.81 to 17.21, $p = 0.048$). Overall improvements were observed in CE results in both groups, but these were statistically non-significant, although there was a large amount of missing data reported. Marchant et al. (2020) reported no differences but there were seasonal differences in data sets.

In addition to CE, Brustio et al. (2019) assessed power and Mønness and Sjølie (2009) stability, flexibility and muscular endurance. Brustio et al. (2019) recorded power through standing long jump and, an increase in performance was observed in favour of IG (ED 5 ± 0.6 cm, $p < 0.001$, percentage change 4.7%) compared to CG (ED 3 ± 0.8 cm, $p < 0.001$, percentage change 3.8%); however, no significant difference was observed between groups pre-post TDM participation. Mønness and Sjølie (2009) identified significant intervention effects on all measures assessed. For stability, there was significant increase on balance seconds (Mean (M) 11.11 ± 2.09, 95% CI 6.95 to 15.27, $p = 0.00$) following the intervention. Muscular endurance was measured through a back-endurance test in which the study recorded a performance increase of 11% post-intervention (M 13.89 ± 6.31, 95% CI 1.34 to 26.45, $p = 0.03$). Hamstring flexibility performance also increased by 8% (M 5.59 ± 1.19, 95% CI 3.41 to 7.77, $p = 0.00$).

3.4.2 Affective domain

In total, four studies explored the affective domain of PL (Booth et al., 2020; Breheny et al., 2020; Brustio et al., 2018; Garnett et al., 2017). Table 6 shows the areas assessed, and Table 7 shows the outcomes of the affective domain. Small positive effects were found in emotional regulation. Breheny et al. (2020) used Self-Reported Quality of Life and Well-being (Child Health Utility Dimension) and Child Well-Being (Middle Years Development instrument) tools to assess the outcome. The authors found small non-significant difference between groups in favour of the IG for quality of life (MD 0.003, 95% CI

Table 7. PL results.

	Affective domain			Physical domain				
Outcome	Motivation	Emotional regulation	Self-perception/Self-esteem	Stability	Cardiovascular endurance	Muscular endurance	Flexibility	Power
Increase	1	1	2*	1*	7*	1*	1*	1
No change/ relationship	-	-	-	-	-	-	-	-
Reduction	-	-	-	-	-	-	-	-

X number of studies, * significant results.

−0.05 to 0.05, p = 0.894) and well-being (MD 1.90 m, 95% CI −3.07 to 6.87, p = 0.499) at 12-months.

Brustio et al. (2018) investigated the motivation using The Participant Observation Questionnaire. Overall, the study found that participating in the intervention could positively influence motivation orientations towards PA participation. After controlling for age, Brustio et al. (2018) observed significant interaction between group and time in social status (F (1237) = 4.852, p = 0.028), team (F (1273) = 6.015, p = 0.015) and energy release (F(1273) = 8.527, p = 0.038). Specifically, significant decreases were observed in social status and an increase in team and energy release in IG. For CG, an increase was observed in social status and a decrease in team and energy release.

Booth et al. (2020) observed the impact of different classroom break activities on cognition and well-being. The adapted Children's Feeling Scale and Felt Arousal Scale were used to assess self-perception/self-esteem, and results for the two measures were recorded as "affect" and "alertness". Statistically significant correlations were observed between change in alertness and affect associated with all physical activities performed. This included 15 min self-paced activity (SPA), CG and bleep test. Specifically, statistically significant differences were identified with SPA and CG for affect and alertness in linear mixed model regression analysis for unadjusted data (affect MD 0.21 ± 0.07, 95% CI 0.05 to 0.37, p = 0.006, ES 0.06) (alertness MD 0.32 ± 0.04, 95% CI 0.22 to 0.41, p = 0.000, ES 0.15) and fully adjusted models (affect MD 0.21 ± 0.07, 95% CI 0.05 to 0.38, p = 0.005, ES 0.06) (alertness MD 0.31 ± 0.04, 95% CI 0.22 to 0.41, p = 0.00, ES 0.15), although effect sizes were small. Similarly, statistically significant differences in change scores were also observed in IG for affect and alertness in unadjusted (affect MD 0.28 ± 0.07, 95% CI 0.11 to 0.44, p = 0.000, ES 0.07) (alertness MD 0.19 ± 0.04, 95% CI 0.10 to 0.28, p = 0.000, ES 0.08) and fully adjusted scores (affect MD 0.27 ± 0.07, 95% CI 0.10 to 0.44, p = 0.001, ES 0.07) (alertness MD 0.19 ± 0.04, 95% CI 0.10 to 0.28, p = 0.001, ES 0.07). Interestingly, no difference in change scores was observed in affect between the bleep test group and CG. CG alertness scores were significantly lower in alertness than the bleep test group. Garnett et al. (2017) also explored self-perception/self-esteem through the self-regulated learning tool. However, the study found no statistically positive correlation between self-esteem and miles ran (r = 0.6, p = 0.46).

3.5 Physical activity-related outcomes

Six studies assessed outcomes relating to the PA checklist (Booth et al., 2020; Breheny et al., 2020; Brustio et al., 2020, 2019; Chesham et al., 2018; Garnett et al., 2017). The most commonly explored outcome was BMI, which was assessed in five studies (Breheny et al., 2020; Brustio et al., 2020, 2019; Chesham et al., 2018; Garnett et al., 2017). Tables 8 and 9 display these findings in further detail.

3.5.1 Body composition and PA

Chesham et al. (2018) was the only study to assess body composition/adiposity. The study calculated composition by the sum of skinfolds at four sites (triceps, bicep, iliac crest and subscapular). Analysis showed significant improvements in IG body composition compared to CG (M − 1.4 mm, 95% CI −2.0 to −0.8, p = 0.034). This was also the only investigation to measure PA and sedentary time. Follow-up assessments indicated significant improvements in favour of IG for daily MVPA (M + 9.1 min, 95% CI 5.1 to 13.2, p = 0.027) and reduced daily sedentary time (M − 18.2 min, 95% CI −10.7 to −25.7, p = 0.017).

3.5.2 BMI

For BMI outcomes, all studies reported non-significant differences between groups following intervention participation. Brustio et al. (2019) noted no significant difference between IG and CG in BMI (p > 0.05) at 3 months. The authors did note a − 0.6% change between IG baseline (M 17.5 kg.m-2, 95% CI 17.3 to 17.7) and post-test results (M 17.4, 95% CI 17.2 to 17.6), although the same change was also recorded between CG

Table 8. PA outcomes identified.

	Anthropometric measures	Cardio metabolic health	Physical fitness	Mental fitness	Cognitive function	Physical activity or sedentary behaviour
Booth et al. (2020)	×	×	×	×	✓	×
Breheny et al. (2020)	✓	×	×	×	×	×
Brustio et al. (2018)	×	×	×	×	×	×
Brustio et al. (2019)	✓	×	×	×	×	×
Brustio et al. (2020)	✓	×	×	×	×	×
Chesham et al. (2018)	✓	×	×	×	×	✓
De Jonge et al. (2020)	×	×	×	×	×	×
Garnett et al. (2017)	✓	×	×	×	×	×
Marchant et al. (2020)	×	×	×	×	×	×
Mønness and Sjølie (2009)	×	×	×	×	×	×

× Criteria not assessed, ✓ Criteria assessed.

Table 9. PA results.

	Physical activity related outcomes				
Outcomes	Daily MVPA	Daily sedentary behaviour	Body composition	BMI	Cognitive function
Increase	1*	-	2*	-	1*
No change/ relationship	-	-	-	2	-
Reduction	-	1*	-	2	-

MVPA, Moderate to vigorous physical activity; BMI, Body mass index; X number of studies, * significant results.

baseline (M 17.3, 95% CI 17.2 to 17.7) and post-test results (M 17.3, 95% CI 17.0 to 17.6). After correcting for age and gender, no significant group X time interactions were observed for BMI (F_{1793} = 0.792, p = 0.374). At 12 months, Breheny et al. (2020) recorded a small increase in favour of IG compared to CG, but this was not statistically significant (MD −0.036, 95% CI −0.085 to 0.013, p = 0.0146). Brustio et al. (2020) observed no difference in BMI and the waist-to-height ratio at any time point. No significant group X gender X time, nor group X time interactions were observed for BMI (F = 1.393, partial η 2 = 0.005, p = 0,234 and F = 1.280, partial η 2 = 0.004, p = 0.275 respectively). Garnett et al. (2017) used pre-existing BMI scores from school records and the authors reported a non-significant negative correlation between mile run and BMI (r = −0.07, p = 0.39).

3.5.3 Cognitive function

Booth et al. (2020) assessed cognitive function through three computer tasks: inhibition using an adapted stop-signal task, visual-spatial working memory using an adapted static box task and verbal working memory using a reading span task. The study found significant improvements with small effects in all measures after one performance of a self-paced activity compared to CG in unadjusted and fully adjusted models (ES 0.04–0.17, p < 0.05).

3.5.4 Waist to height

Brustio et al. (2019) and Brustio et al. (2020) measured the waist-to-height ratio. Brustio et al. (2019) recorded a 2.2% change in Waist-to-height ratio (cm) between IG baseline (M 0.46, 95% CI 0.47 to 0.48) and post-test (M 0.47, 95% CI 0.46 to 0.48) results. Brustio et al. (2020) recorded a small significant reduction at 3 months in waist-to-height ratio for IG3 (2.7%) but findings at 6 months were similar to baseline values.

4 Discussion

This is the first review to examine the current research on school-based run/walk programmes and their potential impact on PL and PA. Ten articles were identified, and results showed limited exploration of all domains of PL. No studies attempted to chart overall PL progress, but using the Shearer et al. (2021) checklist, it was possible to investigate individual domains and group the outcomes assessed within these. The results of the review suggest that participating in run/walk interventions contributes to improved performance in components of the physical (CE, power, stability and muscular endurance) and affective domains (motivation and emotional regulation) as well as some PA-related outcomes (MVPA, body composition and cognitive function) but no studies investigated all three PL domains nor was the cognitive domain explored at all. The limited exploration suggests missed opportunities to identify intervention functions that optimise PL development.

In line with existing research, the outcomes assessed most commonly met the criteria for the physical domain of PL. Cornish et al. (2020) and Edwards et al. (2018), both found frequent exploration of the physical domain and a lack of investigation within the remaining areas, particularly the cognitive domain. Whilst there has been some exploration into the impacts of TDM on cognitive function (Booth et al., 2020; Hatch et al., 2021; Morris et al., 2019), these studies did not meet the inclusion criteria for the PL outcomes in the review as they focused solely on cognitive development rather than the knowledge and understanding of participation that is addressed in the Shearer et al. (2021) checklist and PL definition. Often this measure is under investigated in research but is equally important in understanding PL and PA participation, so should be considered in the future research (Cornish et al., 2020; Edwards et al., 2018). According to Whitehead (2001; 2013) the domains of PL are equal and should not be parted. Recently, research aiming to measure PL has shown that domains are often separated and assessed as individual constructs (Cornish et al., 2020; Edwards et al., 2018). One suggestion is that the strong focus on the physical domain (PA, CE and BMI), rather than holistic PL approach in current investigations is as a result of research being driven by a sport, rather than a health, perspective (Cornish et al., 2020; Edwards et al., 2018). The lack of assessment is also reflected in the measurement tools available that aim to assess PL as a whole as often these are also focused on physical outcomes (Shearer et al., 2021).

There is not yet a recognised standardised assessment that measures PL within young children. A recent review by Shearer et al. (2021) investigated the current measures of the PL domains (physical, affective and cognitive) and highlighted that there are still only three assessment tools, which aim to measure all elements of PL explicitly, those are The Canadian Assessment of Physical Literacy (CAPL), the Physical Literacy Assessment for Youth (PLAY tools) and Passport for Life (PFL), although these are not all internationally recognised. The lack of uptake for these tools could be due to the large debate surrounding the assessment of PL (Jean de Dieu & Zhou, 2021; Longmuir et al., 2015). With PL being a multifaceted concept, some believe that "assessing" PL is not an appropriate reflection of the concept and instead Whitehead et al. (2013) suggested "charting" PL progression as a more suitable approach. Given that PL is an individualised journey, charting individual progression could be considered a more appropriate approach than comparison to norms, enabling research to capture the individualised experiences that embody PL rather than producing an "end result" (Whitehead et al., 2013). Many other PL tools exist but do not adopt the multifaceted nature of PL and tend to favour certain domains; research has shown that these measures tend to focus on motor skills or fundamental sports skills (physical domain) (Jean de Dieu & Zhou, 2021; Longmuir et al., 2015). The lack of clarity surrounding a unified definition of the concept, and the charting of PL, led to different interpretations and measurements of PL. This uncertainty could explain the imbalance in this review's exploration of the concept and its domains and the uptake of interventions looking to investigate the impacts on PL. Conclusions could not be drawn on the concept of PL due to the variation in domain assessment featured in this review, but promising results were identified for physical and affective related outcomes.

Firstly, all studies within this review reported positive findings for outcome measures under the physical domain, but not all of these findings were statistically significant. The physical domain was most commonly assessed utilising CE (n = 7) rather than motor skills such as coordination, or locomotor or object control competence, which are listed within the Shearer et al. (2021) checklist and noted as equally important elements when capturing the domain (Edwards et al., 2017). Four studies reported significant positive changes in CE following completion of TDM (Brustio et al., 2020; Chesham et al., 2018; De Jonge et al., 2020) or a walking intervention (Mønness & Sjølie, 2009), and three reported beneficial but non-significant changes (Breheny et al., 2020; Brustio et al., 2019b; Marchant et al., 2020), but none reported negative associations. The studies that reported significant findings were no longer than 6 months (3 months, Brustio et al., 2019; De Jonge et al., 2020) and 6 months (Brustio et al., 2020; Chesham et al., 2018; Mønness & Sjølie, 2009) and the only study to track CE over a longer period of 12 months reported non-significant improvements (Breheny et al., 2020). The non-significant change over a longer period of time (12 months) may suggest that participation intensity could decline over a year, leading to less impact on CE. Although it is not possible to draw conclusion at this stage, future research may benefit from comparing CE over longer periods (6–12 months) and also identifying fidelity in participation to determine if there is a decline in performance intensity that may influence CE outcomes. Braaksma et al. (2018) recommended that PA intervention durations should be a minimum 6 weeks for cardiovascular fitness benefits and performed three or four times per week. All studies that reported significant improvements in CE also reported frequency to be of similar standard each week to Braaksma et al. (2018) (three or four times per week), although only one study compared intervention frequencies (Brustio et al., 2020). The authors concluded that performing TDM more than 2.5 times per week (IG3) was more beneficial for CE than performing TDM 2 times per week (Brustio et al., 2020). In general, physical fitness is generally seen as a stable trait of PA in young children (Chen et al., 2018; Raistenskis et al., 2016) and CE is found to have positive associations with cognitive and academic performance (Marques et al., 2018; Ruiz-Ariza et al., 2017) and strong associations with PL (CAPL; Lang et al., 2018). Interventions that can improve physical fitness and its components (CE) at a young age are considered crucial in reducing the risks of cardiovascular diseases and other factors like poor mental health and chronic pain that are associated with low CE (Rodrigues et al., 2013). These review findings taken in combination with intervention research are promising in promoting this type of school-based intervention and its potential benefits on health-related outcomes associated with CE improvements. Future research should investigate the connection between CE and PL in run/walk programmes specifically and in wider populations (Lang et al., 2018). This research may help to inform current and future policy and school guidance that currently focuses on encouraging PL development and PA through school-based interventions.

With many school-based run/walk programmes originating as public health initiatives, they are often driven by PA and obesity rather than PL, which is a more novel concept. The public health driven perspective could explain the lack of exploration of the physical elements like motor skills and instead a more dominant investigation of PA-focused measures like CE and BMI, which were two of the most commonly measured outcomes in this review. With the interventions also focusing only on locomotor movements (walk/jog/run), the lack of investigation into other outcome measures like fundamental movement skills (FMS) and coordination is expected. However, these are equally important components that contribute to PA participation and other health-related outcomes, so should not be overlooked (Brusseau et al., 2020). The development of FMS is considered vital in the refinement of more specific motor patterns for young children, and run/walk programmes can provide children with the opportunity to freely practise their skills within supportive school's environment (Sherar et al., 2020). Therefore, it may be of benefit for research to consider broader physical related outcomes like FMS in these settings that could contribute to wider skill development in children.

In affective measures, there were significant improvements in components of motivation following a walking intervention (n = 1; Brustio et al., 2018) and self-efficacy/self-esteem after one performance of SPA (n = 1) (Booth et al., 2020). Specifically, motivational benefits in terms of "social status" and "team" were identified, which is promising given that existing research demonstrates social support from friends is important in developing autonomous motivation, which is positively associated with PA participation (K. B. Owen et al., 2017). Similar qualitative studies such as Chalkley et al. (2020a) reported positive pupil experience after participating in the MK programme. The study found that autonomy to participate, perceived benefits, and supportive school environment facilitated pupil's enjoyment of MK. There was limited evidence available in relation to the affective domain in this review, with only four studies measuring affective related outcomes (Motivation, Brustio et al. (2018), Self-efficacy/self-esteem, Booth et al. (2020) and Garnett et al. (2017) and Emotional regulation, Breheny et al. (2020)). However, these study findings alongside similar qualitative research do provide positive insights addressing research concerns surrounding run/walk programmes and pupils' experiences such as potential boredom. However, there were only small effects, and most often were non-significant so larger scale research is needed. It is recommended that research looks to also clarify any causality between outcome measures and intervention methodologies in order to draw firm conclusions on run/walk programmes and affective outcomes (Dale et al., 2019; Liu et al., 2015).

In terms of PA-related outcomes, there was a focus on weight-related measures (Breheny et al., 2020; Brustio et al., 2020, 2019; Chesham et al., 2018; Garnett et al., 2017) and little or no exploration of other outcomes like daily PA, cognitive function or physical and mental fitness. All five studies assessed either body composition (Chesham et al., 2018), BMI (z; Breheny et al., 2020; Brustio et al., 2020, 2019; Chesham et al., 2018; Garnett et al., 2017) or waist-to-height ratio (Brustio et al., 2020, 2019). As previously mentioned, many school-based run/walk programmes have developed as public health initiatives where the focus is on reducing obesity and increasing PA participation, so this is not unexpected. Nevertheless, identifying other activity outcomes like daily PA and sedentary behaviours could be important contributors to understanding the long-term impact of intervention participation (Sherar et al., 2020). There was also limited evidence in this review to support the impact of school-based run/walk programmes on BMI despite its popularity in investigations, and no studies reported any significant changes in BMI over three (Brustio et al., 2019), six (Brustio et al., 2020; Chesham et al., 2018) and 12 months (Breheny et al., 2020). Collectively, these findings and existing reviews (Mei et al., 2016; Waters et al., 2011) suggest that BMI may only be reduced through multi-structured longitudinal interventions, although further research is needed (Demetriou & Höner, 2012; Jacob et al., 2021; Mei et al., 2016). It appears that self-selected pace programmes (Booth et al., 2020; Chesham et al., 2018) are effective at improving cognitive function, daily PA, and body composition over time, all of which are promising for contribution to PA participation. Measures of PA outcomes overall were limited within the review so it is not possible to draw conclusions on run/walk programmes in general. Future research may benefit from evaluating the contribution run/walk programmes including varied implementation (self-select pace etc.) has on these measures.

TDM was the most commonly investigated intervention, three studies performed TDM in accordance with the website (Brustio et al., 2019; Chesham et al., 2018; Marchant et al., 2020) and a further three performed TDM with some variation (Breheny et al., 2020; Brustio et al., 2020; De Jonge et al., 2020). The remaining studies all shared similar characteristics to TDM, including being adaptations of the intervention (Brustio et al., 2018) and having similar qualities, such as frequency (Mønness & Sjølie, 2009), time, distance (Booth et al., 2020) and self-selected pace (Garnett et al., 2017). One reason for the success of TDM could be the pace of the intervention. All studies that used TDM focused on a "self-selected" pace (n = 6) whilst some other remaining interventions (n = 2) in this review focused on a selected pace, such as walking or just jogging and running. Research shows that PA that provides children with choice can promote autonomy (Roemmich et al., 2012; Teixeira et al., 2012). The choice of self-select pace in TDM could promote autonomy in children and, in turn, benefit intrinsic motivation and PA participation. Therefore, a specific focus on self-selected pace programmes that are integrated into curricula would be beneficial.

The included studies that focused on "self-selected pace" reported greater findings than other interventions when the same outcomes were assessed. However, there was inconsistency within the findings for TDM intervention, which could be due to the quality of the available data. Only one study using TDM scored "good" (Breheny et al., 2020) and all other studies that reported greater findings in CE scored either "fair" or "poor" (Brustio et al., 2020, 2019; Chesham et al., 2018; De Jonge et al., 2020). Interestingly, the study of higher quality also reported smaller intervention effects on CE compared to studies that performed similar methodology. Most of the studies (n = 8) in this review were categorised as "fair" or lower for quality scoring (scored <5, see, Table 3).

Interventions implemented within school settings face certain challenges that can negatively impact upon quality scoring. Firstly, it is not possible for participants or intervention administrators to be blinded, and allocation is often difficult to conceal. For example, it may not be possible for randomised interventions to take place within the same school due to chances of cross-over-effects and contamination as other pupils may observe the intervention and copy it. However, it is possible to blind the assessors to the groupings and limit the risk of bias that can be caused by knowledge of groups during data collection and analysis (Forbes, 2013), yet only one study was noted to have completed this within the review (Breheny et al., 2020). It is recognised that the blinding may be a barrier to this type of intervention study. However, it is recommended that future research blinds aspects of study design where possible, such as study assessors.

Only one study implemented randomised groups (Breheny et al., 2020), and all other study groupings were predetermined (e.g., schools chose to take part in the intervention or not). Without CG, research is unable to discount the potential effects of confounding variables, and determine the extent to which findings can be attributed to intervention participation (Polgar & Thomas, 2013). Often, within the recruitment for intervention studies, schools either opt to be experimental groups or control, so research teams are unable to randomise the allocations. There are also then potential ethical concerns that need to be considered (Polgar & Thomas, 2013). Specifically, Mønness and Sjølie (2009) noted that it would be unethical to split classes from the same school and instead more suitable to control for age effects by using growth curves to estimate natural improvement. Randomisation within one school could also lead to crossover effects within the study between CG and IG and would be difficult to manage. Almost all studies in this review were also based within one school so randomisation may not have been appropriate.

According to the quality scores in Table 4, only three studies reported that groups were similar at baseline regarding important prognostic indicators (Booth et al., 2020; Breheny et al., 2020; Brustio et al., 2018). Without controlling for baseline differences, any reported impact of participation could be misleading. Often participants were treated as one group regardless of initial baseline scores for variables such as fitness or BMI and the reported measures were based on participant mean scores. This could lead to interpretation bias within the findings as the participant response to treatment may vary based on the initial baseline findings.

Given the nature of the included interventions, participants' self-selected pace to complete their distance could also vary the treatment response experienced. The lack of clarity around treatment integrity could lead to bias within the interpretations of the findings. For example, schools could implement the intervention with a focus on running rather than self-selected jog, run or walk, which would influence the extent of impact on participant-reported measures like fitness. In order to understand the true extent of the "self-selected" nature of the intervention and difference within or between participant groups, it is recommended that future research is clear on the interpretation of baseline groups and intervention integrity. These suggestions are in line with similar reviews where it was stated that clarity on intervention implementation and integrity is needed before firm conclusions can be drawn on outcomes (Love et al., 2019).

Finally, many studies also reported missingness in follow-up data, which could indicate issues with adherence to intervention or research design. Often this can be down to participants leaving schools and not being present on research days; however, large values were reported within this review; missingness ranged from 39.5% (Brustio et al., 2019) up to 56% (Breheny et al., 2020). One reason for the large recorded score could be due to poor compliance with the intervention. Breheny et al. (2020) performed multiple imputations to complete the data set, and no significant difference was observed between the input and complete case analysis. However, no other studies within the review reported data imputation to reduce the risk of bias, it is recommended that studies report complete and input case analyses. The present review is unable to determine if the missingness of data is related to intervention adherence. Therefore, future research would benefit from the inclusion of process evaluations in addition to intervention studies.

4.1 Limitations

The findings of the review were limited to the search terms and strategy conducted. The review was restricted to only quantitative studies; therefore, no other types of studies (qualitative, process evaluations, etc.) and grey literature exploring PL, PA or this intervention type were not included in the review. Qualitative studies were excluded for not meeting the criteria and/or checklist included in the review. Often the methodologies of qualitative studies were limited and firm conclusion could not be drawn with regard to intervention implementation or outcomes explicitly assessed. Qualitative studies and forms of process evaluations may, however, have captured psychological elements, PA and other domains of PL from a holistic perspective and should be considered. It is recommended that future research reports detailed intervention methodology to prevent exclusion in other PL-related reviews. During the writing of the review, a consensus statement on PL in England was started which may result in a new definition of PL and/or approach in research. To date, there is no "gold-standard" for PL definition or for approaching methods of monitoring or charting PL. It is recognised that this may have limited the inclusion of studies in the review.

Intervention adherence was not explicitly reported nor featured in the inclusion criteria of the review. The variance in intervention adherences such as times per week of intervention completion could impact the variance in results between studies included in this review. It is recommended that future intervention studies report fidelity measures where possible.

4.2 Conclusion

The present study is the first-known review to offer an insight into run/walk programmes and their implementation in school settings. The result of participating in run/walk programmes showed promising benefits for the physical and affective domains of PL, including CE, motivation and self-perception/self-esteem. However, no studies assessed PL as a whole nor was the cognitive domain of PL explored. Positive findings were also reported for PA-related outcomes such as daily PA, waist-to-height ratio and cognitive function. TDM was the most commonly implemented intervention and those studies that participated on average 3 times per week for a minimum of 3 months showed positive PL or PA related outcomes. The findings of this review can be used to support current and future policy recommendations on the implementation of run/walk programmes and their contribution to potential PL development. It is recommended that further research considers all domains of PL and methods to "chart" PL progress, particularly over longer periods of time, in order to provide a detailed account of progression.

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