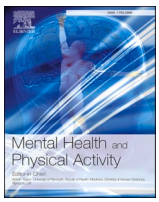
Mental Health and Physical Activity 25 (2023) 100558

Contents lists available at ScienceDirect

Mental Health and Physical Activity

journal homepage: www.elsevier.com/locate/menpa



Thriving families: The feasibility and preliminary efficacy of a multi-component physical literacy program for children with neurodevelopmental, emotional, or behavioural problems

Kemi E. Wright [a,b,*], Ben Jackson [b,c], Melissa K. Licari [c], James A. Dimmock [d], Bonnie J. Furzer [b,c]

[a] School of Health Sciences, Faculty of Medicine & Health, University of New South Wales, Sydney, NSW, Australia
[b] School of Human Sciences (Exercise & Sport Science), The University of Western Australia, WA, Australia
[c] Telethon Kids Institute, WA, Australia
[d] Department of Psychology, College of Healthcare Sciences, James Cook University, QLD, Australia

ARTICLE INFO

Keywords:
Fitness
Behaviour change
Physical activity
Exercise
Motivation
Parents

ABSTRACT

Children with neurodevelopmental, emotional, or behavioural challenges participate in lower levels of physical activity (PA) and subsequently have poorer physical and mental health outcomes. We sought to determine the feasibility and preliminary efficacy of a multi-component physical literacy program for children with neurodevelopmental, emotional, or behavioural challenges. Thirty children and 28 parents were recruited to participate in the 10-week single-group non-randomised feasibility trial. Thriving Families was designed to promote children's physical literacy through (a) providing programmed opportunities for PA, (b) incorporating parents, (c) supporting motivation and engagement, and (d) utilising behaviour change techniques. Program feasibility was determined using qualitative and quantitative feedback. Preliminary efficacy was determined through pre- and post-intervention assessments of children's physical literacy. Results indicate that the program is acceptable and was well received. Effect size estimates for parent knowledge ($d = 0.78$) and confidence ($d = 0.57$) were moderate to large; however, little change was observed for parents' motivation to support PA and children's perceptions of PA support. Moderate or large effects were observed for pre-to-post-program change on children's domains of physical competence. The Thriving Families program appears to be feasible and acceptable for community-based implementation and may provide benefits for physical and psychological outcomes.

What this paper adds?

This study provides a novel intervention strategy utilising a simple framework, grounded in psychological theory to address the physical literacy outcomes in children who have increased risk low physical activity levels and in turn poor physical and mental health outcomes. Our results highlight that multi-component community based physical literacy program is not only feasible but well received by children and families. Findings from this study demonstrate utilising parents as 'coaches', in combination with need supportive instructors is efficacious. In addition, it provides the foundational evidence to support a sufficiently-powered randomised controlled trial targeting children who typically find it difficult to engage in community-based physical activity.

1. Introduction

Children's physical inactivity is a global problem, with only a small proportion of children meeting daily physical activity (PA) recommendations (Cooper et al., 2015). Neurodevelopmental conditions like Autism Spectrum Disorder, Attention Deficit Hyperactivity Disorder, and Developmental Coordination Disorder are associated with lower PA levels (Wright et al., 2018). These conditions often co-occur with emotional and behavioural problems, which create additional barriers to PA participation (Cairney et al., 2010; Halvorsen et al., 2019). Researchers have demonstrated that children in this cohort face challenges related to confidence, motor competence, enjoyment, and social aspects of PA (Cairney, Hay, Faught, Wade, et al., 2005; Mandich, Polatajko, & Rodger, 2003). As a result, these cohorts of children have been shown to

* Corresponding author. School of Health Sciences, Faculty of Medicine & Health, University of New South Wales, Sydney, NSW, Australia.
E-mail address: Kemi.wright@unsw.edu.au (K.E. Wright).

https://doi.org/10.1016/j.mhpa.2023.100558
Received 13 June 2023; Received in revised form 5 October 2023; Accepted 15 October 2023
Available online 21 October 2023

be at an increased risk of poor physical and mental health outcomes when compared with typically developing children (Rivilis et al., 2011; Wright et al., 2018). In light of the difficulties faced by these children and with high co-occurrence rates between neurodevelopmental conditions (Reiersen, Constantino, & Todd., 2008), parents and families struggle to find appropriate community-based programs for their children's needs (Hickingbotham, Wong & Bowling., 2021; Must, Phillips, Curtin, & Bandini, 2015). Therefore, it is crucial for researchers and practitioners to design programs specifically catering to the PA needs of these children.

In an effort to address the high prevalence of physical inactivity, the concept of physical literacy has been posited as a strategy to enhance a child's ability to engage in PA across their lifespan (Cairney, Dudley, Kwan, Bulten, & Kriellaars, 2019). Physical literacy frameworks have been widely adopted across various Western countries; with the Australian Physical Literacy Framework conceptualizing physical literacy as "lifelong holistic learning acquired and applied in movement and physical activity contexts, and integrating physical, psychological, social and cognitive capabilities" (Sport Australia, 2019). Although different definitions and models exist, they all emphasize physical, psychological, and behavioural factors influencing a child's PA participation (Edwards, Bryant, Keegan, Morgan, & Jones, 2017). Accordingly, the concept represents an important intervention target for children with neurodevelopmental, emotional, or behavioural challenges—not least because the physical literacy domains map closely onto the barriers and challenges previously documented for these children. Physical literacy has been shown to predict children's PA involvement and experiences, however, much of the research remains observational or cross-sectional (Belanger et al., 2018; Tremblay, Longmuir, et al., 2018). To extend what is known about physical literacy, it is important that researchers (a) examine the construct among children with specific PA-related needs and challenges (e.g., those with neurodevelopmental, emotional, or behavioural challenges), and (b) move beyond observational approaches by developing interventions and programs designed to improve physical literacy for those children who exhibit the greatest need.

Interventions aimed at improving physical literacy and promoting PA skills are available in the literature (Carl, Barratt, Töpfer, Cairney, & Pfeifer, 2022). However, to date, most of the intervention work has been conducted in schools or with typically developing cohorts (Carl et al., 2022). Bremer and colleagues demonstrated support for the feasibility and acceptability of the 12-week community-based physical literacy intervention; however, they also concluded that overall improvements in physical literacy outcomes were limited (Bremer, Graham, & Cairney, 2020). A systematic review by Carl et al. (2022) highlighted that while the number of physical literacy interventions has rapidly increased, it was recommended that future interventions should be holistic and multidimensional in nature, highlighting the importance of theory-based interventions that explicitly link the theoretical constructs and the intervention components (Carl et al., 2022). Furthermore, the authors identified that information on the evaluation, scalability and effectiveness of interventions were needed. The present study, sought to create a multi-component intervention with these recommendations in mind and to gain insight into the feasibility and preliminary efficacy of such a program.

Guided by the CONSORT guidelines for feasibility and pilot trials, the aim of this non-randomised pilot investigation was to examine the feasibility and preliminary efficacy of the Thriving Families intervention (Eldridge et al., 2016). Feasibility trials represent a necessary first stage in the development and optimisation of complex community-based interventions (Craig et al., 2008) and are typically designed to address issues relating to intervention fidelity, reach, dose, and delivery (Eldridge et al., 2016). Assessments of feasibility are important to identify and correct uncertainties or design weaknesses (e.g., acceptability of testing procedures, participant satisfaction, and rate of retention) that may exist around the 'active ingredients' within an intervention (Craig et al., 2008). Well-designed feasibility studies, therefore, provide insight into the structure, effectiveness, scalability, and implementation of intervention components (Lancaster, 2015). With that in mind, we assessed participant engagement, retention, and perceptions about program elements (and the intervention as a whole) through quantitative and qualitative methods. In addition, although insight into program outcomes is not an essential component of a feasibility study, evaluation of program efficacy is often considered a useful part of feasibility and/or pilot work in anticipating future effectiveness and determining effect size estimations. As such, we specifically assessed changes from baseline to end of intervention on key physiological (e.g., muscle strength, aerobic fitness, flexibility) and psychosocial (e.g., exercise motivation, perceived competence) variables.

2. Materials and methods

2.1. Participant recruitment

Participants were recruited through newsletter, emails and existing paediatric exercise programs affiliated with the author's institution. The program was referred to as the "Thriving Families intervention" in all recruitment materials, and prospective participants were informed that the purpose of the study was to investigate changes in the physical literacy of children across a 10-week intervention. Children were considered eligible to participate if they were aged between 8 and 12 years old, and their parents identified them as having high or specific needs, such as neurodevelopmental conditions, emotional, or behavioural problems. Parents were asked to confirm that they considered their child (a) was unable to participate or had difficulty participating in community-based sport, or (b) experienced significant challenges to such involvement (which are not faced by 'typically developing' children). The first author consulted all families prior to enrolment in the program, with the Child Behaviour Checklist and a motor competency assessment administered during the first session to confirm that all participants presented with neurodevelopmental, emotional and/or behaviours difficulties. Participants were subsequently placed into small groups for their programmed exercise sessions. Further details on the characteristics of the children (and parents) who participated in the study are presented in Table 1. Thriving Families program instructors were tertiary-trained exercise professionals (e.g., exercise scientists or exercise physiologists), and for the purpose of the study, undertook an additional training workshop to support physical literacy outcomes and provide feedback on their experiences in the program. Written consent was obtained from all participants and the study was approved by the relevant human research ethics committee (RA/January 4, 9352).

2.2. Study design

In accordance with the CONSORT guidelines, a single group non-randomised intervention trial design was adopted, as is typical for non-randomised feasibility studies (Eldridge et al., 2016). Due to the nature of the intervention, blinding of participants was not feasible. Qualitative and quantitative approaches to data collection were utilised to allow for insight into participant (i.e., child, parent, instructor) experiences regarding different aspects of the intervention, and to provide evidence of preliminary efficacy for future implementation trials (for an overview, see Fig. 1).

2.3. Program description

Thriving Families is an evidence-based exercise program aimed at improving children's physical literacy, particularly for those facing neurodevelopmental, emotional, or behavioural challenges. The program incorporates four recommended principles for promoting physical literacy and engagement in PA: providing scheduled PA opportunities, involving parents, supporting motivation and engagement, and utilising

Table 1
Descriptive characteristics of child (n = 30) and parent (n = 28) participants.

Characteristic	Value
Child Participants	
Age at initial assessment (years)	
Mean (SD)	9.6 (1.1)
Minimum, maximum	8.0, 11.7
Sex, n (%)	
Male	22 (73.3)
Female	8 (26.7)
Height (cm)	
Mean (SD)	137.9 (9.6)
Minimum, maximum	123.0, 158.0
Weight (kg)	
Mean (SD)	34.8 (10.4)
Minimum, maximum	22.0, 64.7
BMI	
Mean (SD)	17.9 (3.3)
Minimum, maximum	14.2, 25.9
Child behaviour checklist n (%)	
Internalising problems	10 (33.3)
Externalising problems	7 (23.3)
Below clinical cut offs	13 (43.3)
Motor competence n (%)	
Typical motor competence	10 (33.3)
At risk of low motor competence	5 (16.7)
Low motor competence	15 (50)
Parent Participants	
Age at initial assessment (years)	
Mean (SD)	46.0 (4.7)
Minimum, maximum	36, 55
Sex, n (%)	
Male	5 (17.8)
Female	23 (82.2)

behaviour change techniques. In the material that follows, we detail how these components were integrated into the program.

Providing programmed opportunities for PA: Weekly activity sessions lasting 60 min were conducted over a 10-week period to align with local school terms. The sessions involved small-group exercise led by instructors (3 children per instructor). The sessions were structured to include group social interaction (5 min), warm-up activities (10 min), individualized exercise circuits covering physical competence domains (e.g., muscle strength, aerobic fitness, foundational movement skills; 30 min), integrated team building games (10 min), and a group debrief with a home fun activity and goal setting for the following week (5 min). Sessions consisted of exercise and game-based activities that—in addition to directly providing PA—were structured to address key 'physical competence' components of physical literacy identified in previous research within this cohort (Wright et al., 2018, 2020). The selection of activities was determined in consultation with the participant and family, as well as objective assessments of potential deficits in physical competence domains. At the beginning of each session, instructors explained the session plan and its relevance to physical literacy and PA participation. At the end of the session, children were given the opportunity, guided by their instructor, to choose a home fun activity pack aligned with their goals and preferences.

Incorporating parents: Parents were involved through a series of 60 min educational workshops constructed to (a) empower them as supporters and providers of positive PA feedback, and (b) provide positive PA experiences for their children outside of the programmed sessions. The first workshop was based on providing foundational knowledge of the benefits and importance of physical literacy, PA, and the role of parents in supporting children's physical literacy and PA experiences. The second workshop provided practical strategies to enhance children's motivation and confidence, including the formulation of individualized action plans. The final workshop allowed parents to reflect on

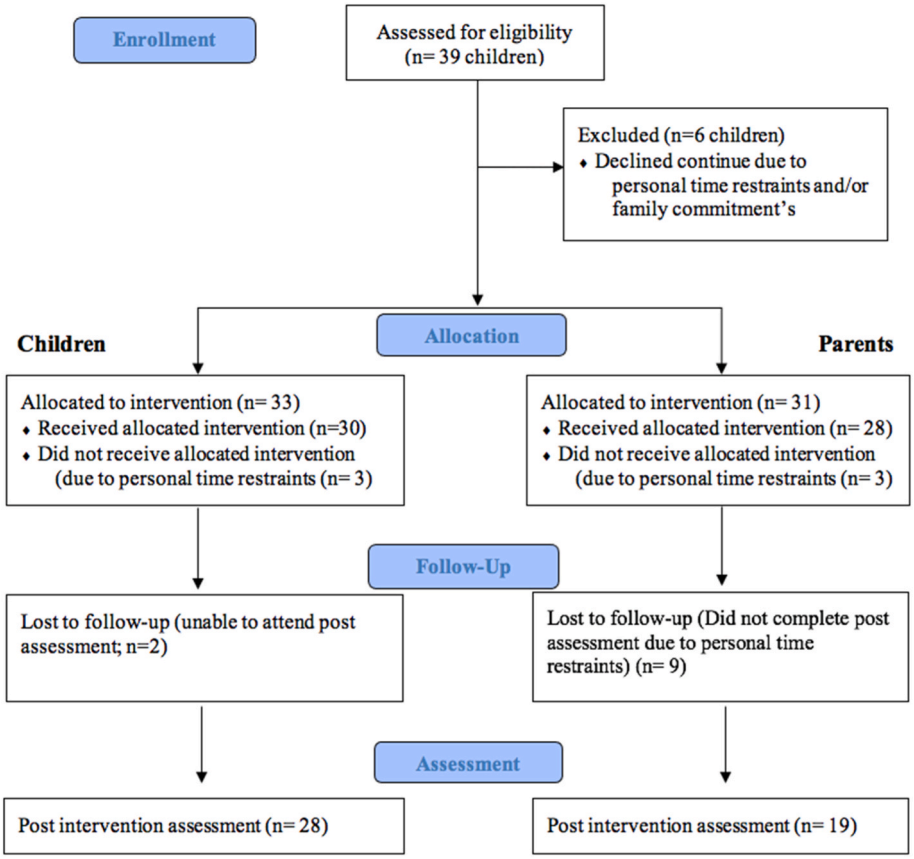


Fig. 1. Flow diagram of the recruitment and analysis process.

the strategies learned and address any challenges or questions.

Supporting motivation and engagement: To enhance children's motivation for PA within and outside the program, we embedded self-determination theory (SDT) principles into parent and instructor training. Drawing from basic psychological needs theory (Ntoumanis, Quested, Reeve, & Cheon, 2017), we encouraged parents and program instructors to support children's autonomy, competence, and relatedness (Deci & Ryan, 1985). The training structure, known as the "MAGIC" framework (Motivation, Autonomy, Grit, Interconnected, Confidence; Fig. 2), was developed for the Thriving Families intervention and was informed by existing SDT-based intervention programs for which members of this research team have been responsible (Sparks, Lonsdale, Dimmock, & Jackson, 2017). The MAGIC framework's components (M, A, I, C) were aligned with key SDT-based concepts. 'Motivation' focused on types of motivation, the value more autonomous forms of motivation, and the importance of enjoyment for intrinsic motivation. 'Autonomy' emphasized choice, provision of rationales, and inviting input from children. 'Interconnected' captured relatedness support and the creation of inclusive environments fostering meaningful connections. 'Confidence' targeted competence-supportive behaviours such as goal-setting, provision of positive feedback, individual development over normative comparison, and expressions of encouragement. Although not directly from SDT, The 'Grit' component addressed resilience and perseverance, given that children with neurodevelopmental, emotional, or behavioural difficulties experience significant challenges to engaging in PA (Mandich et al., 2003; Must et al., 2015). Strategies included learning from mistakes, reframing challenges, growth mindsets, self-kindness, and avoiding criticism and absolutes. A workbook detailed the MAGIC framework elements, enabling parents and instructors to plan implementation strategies. Program instructors were introduced to the MAGIC framework during a 60-min workshop delivered by the lead author and provision of ongoing support was provided to assist instructors with implementing MAGIC elements. For further details Supplementary A.2.

Utilising behaviour change techniques: In addition to the strategies outlined above, we also embedded relevant behaviour change techniques into the Thriving Families program. These elements were selected based on recommendations for supporting lasting behaviour change and were drawn from Michie and colleagues' taxonomy of behaviour change techniques (Michie et al., 2013). Goal setting and action planning were utilised in both the parent and instructor workshops to facilitate individualized PA plans for children. Social support was embedded through children participating in the sessions alongside peers with similar abilities and challenges, and through parent and instructor support. Workshop materials including stickers, magnets (depicting the MAGIC framework), and take-home activity cards were also used as prompts for children, parents, and instructors to remember key messages. For more details see Supplementary A.2.

2.4. Assessing feasibility - quantitative data collection

Aspects of recruitment including program attrition rates were documented (see Fig. 1). Demographic information for parents and children were obtained via questionnaires, including the Child Behaviour Checklist (Achenbach & Rescorla, 2001). Children's body composition was assessed through height and weight to determine body mass index (BMI; See Table 1). To capture exercise intensity and active time within sessions, Polar Team ProTM devices (Polar Electro, Corp., Finland) was used to provide data on activity duration, average heart rate intensity (% heart rate max), and average distance covered (González-Víllora, Sierra-Díaz, Pastor-Vicedo, & Contreras-Jordán, 2019). Key aspects of intervention fidelity and dose were assessed in each participant group (i.e., children, parents and instructors) as outlined in the material that follows.

Children's perceptions of parental support for PA were measured pre and post intervention using an amended 15-item need support questionnaire to assess autonomy support, competence support, and relatedness support (Dimmock et al., 2016). Children perceptions of parental logistic support for PA were measured using an adapted questionnaire to report the frequency of parental encouragement, participation, and transportation support (Dimmock et al., 2016; Rhodes et al., 2016).

Fidelity- and dose-related variables were also assessed with parents in order provide insight into the feasibility of the Thriving Families program. Parents' knowledge about strategies for building children's motivation and confidence for PA was assessed with a 6-item instrument. All items were scored on a 5-point Likert scale, with average scores computed to provide an overall knowledge score. Motivation to support their child's PA behaviour were measured using a modified version of the Behavioural Regulation in Exercise Questionnaire-2 (BREQ-2; Markland & Tobin, 2004). A composite relative autonomy index (RAI) was calculated to reflect self-determined versus controlled motivation for PA support. Parental logistical support for their child's PA were assessed using a parent-oriented version of the child instrument described above. Additionally, parents' confidence in providing autonomy support, competence support, and relatedness support to their children for PA was measured using a 12-item questionnaire scored on a 5-point Likert scale. Finally, parents and instructors provided feedback on the primary intervention component, the Thriving Families workshops, through a 10-item survey assessing usefulness, comprehensibility, and confidence in utilising the workshop skills. All items were scored on a 5-point Likert scale, with higher scores denoting more positive evaluations.

For detailed methodology related to the development and implementation of the above assessment items including questionnaire amendments, scoring conventions and internal consistency estimates see Supplementary A.1.

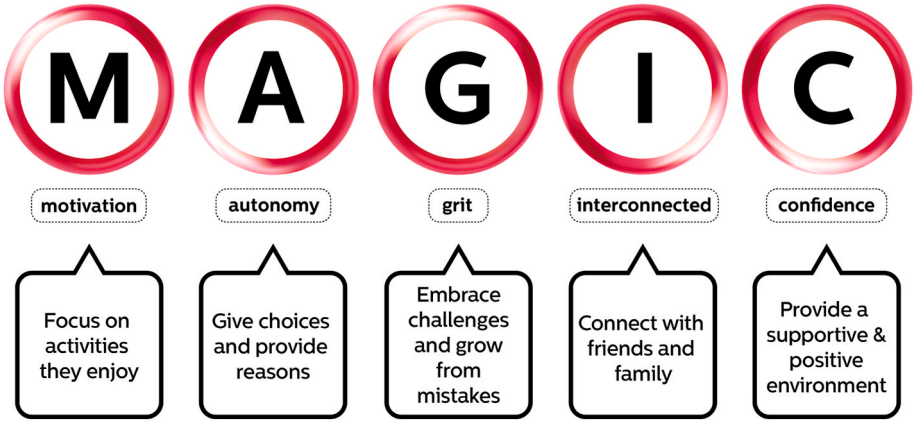


Fig. 2. The M.A.G.I.C framework.

2.5. Assessing preliminary efficacy - quantitative data collection

Children attended pre- and post-intervention assessments lasting approximately 60–75 min. In addition to providing data for feasibility indicators described above, children completed a series of assessments designed to measure the individual components of their physical literacy. Assessments included their motor competence (Movement Assessment Battery for Children – 2nd edition; MABC-2; Henderson & Sugden, 2007), muscle strength (handgrip dynamometry; Beld, Sanden, Sengers, Verbeek, & Gabreëls, 2006), anaerobic power (Wingate anaerobic test; Hebestreit, Mimura, & Bar-Or, 1993), aerobic fitness (Fitkids Treadmill Test; Kotte, Groot, Bongers, Winkler, & Takken, 2015), flexibility (Sit and reach; Tremblay, Longmuir, et al., 2018), and resistance training skill competency (Bebich-Philip, Thornton, Reid, Wright, & Furzer, 2016). In line with previous research, the above assessments were chosen to provide information on the physical competence of participants and have previously been utilised in the study population (Bebich-Philip et al., 2016; Wright et al., 2018).

In terms of self-report outcomes, children's motivation for PA and PA confidence beliefs were measured using a series of questionnaires administered pre- and post-intervention, with assistance provided to ensure children understood each item. Motivation for PA was assessed using an abridged 10-item version of the BREQ-2 (Markland & Tobin, 2004). A composite RAI score was computed to indicate children's autonomous (relative to controlled) motivation for PA. Children's confidence for PA was measured using the perceived competence subscale of the Intrinsic Motivation Inventory (McAuley, Duncan, & Tammen, 1989).

The above assessments were selected for the applicability and appropriateness for the study population, each assessment contributed to a specific physical literacy domain, however the culmination of a single overall physical literacy score was not producible. For detailed methodology related to the development and implementation of the above assessment items including questionnaire amendments, scoring conventions and internal consistency estimates see supplementary A.1.

2.6. Qualitative data collection

At the completion of the 10-week intervention, semi-structured face-to-face interviews were conducted with 19 parents and 8 instructors. On average, parent and instructor interviews lasted 29 and 22 min, respectively. Interviews were conducted by a researcher external to intervention delivery (but who was familiar with all intervention components) to maintain impartiality. Questions were developed after reviewing relevant qualitative methodology sources, (Sparkes & Smith, 2014; Stewart & Shamdasasi, 2014) and the interview schedule was reviewed by all co-authors for suitability and coverage. Participants were encouraged to guide the direction of the conversation, and probing questions were used when necessary to explore an answer in more detail, to clarify an issue, and/or to explore new ideas. Questions were focused on parents' and instructors' experiences in the program, and feedback was also solicited regarding potential improvements that could be made to the program. At the end of the interview, participants were encouraged to ask any questions and to provide any additional information. In line with recent recommendations in the literature, we adopted a reflexive thematic approach to analyses and qualitative data collection was ceased when authors considered that pragmatic saturation had been reached (Braun & Clarke, 2021).

3. Data analysis

Data were initially screened for missing values, and any missing data was not replaced. Where an individual data point was missing the participant was excluded from the analysis related to that outcome measure. Two child participants who enrolled did not provide complete data (and were subsequently excluded from further analysis) as they were unable to complete a post-intervention assessment. Nine parents did not complete post-intervention questionnaires and were excluded from the analysis. Recruitment of participants occurred between October 2017 and December 2018, aligning with school terms and was based on family availability over the intervention period. Whilst physical activity was not the primary outcome of this trial, the recruitment target of 40 families was based on a power analysis allowing for a 10% drop-out based on this outcome, given it would be the primary outcome for the large future trial. Given this was a feasibility and preliminary efficacy trial the study is not appropriately powered to determine statistical significance, with the main aim of the trial to test the 'active ingredients" of the intervention which are planned to be incorporated into future larger trials. Descriptive data for children and parents were generated to provide participant demographic information (See Table 1). Feasibility data are presented in the form of attrition and adherence rates, as well as aggregate means and standard deviations for pre-and post-intervention scores. Characteristics of the Thriving Families group exercise sessions (intensity, duration, distance covered) are reported as averages. Change over time in the feasibility and preliminary efficacy variables was assessed statistically using paired samples t-tests, and standardised Cohen's *d* effect sizes were also calculated to indicate the magnitude of any change.

Qualitative data were audio recorded and transcribed verbatim. The six steps of thematic analysis developed by Braun and Clarke was utilised for data analysis, allowing for the description and coding of themes relating to participants' perceptions of the feasibility and efficacy of Thriving Families program (Braun & Clarke, 2021). Where meaning units are reported, names have been changed and any identifying information has been removed.

4. Results

4.1. Recruitment and baseline characteristics

A total of 39 families provided their informed consent and were deemed eligible and recruited via rolling recruitment to participate between October 2017 and December 2018. Following the initial assessment, 6 children withdrew due to family, medical, or other commitments (representing an 84% program completion rate). Fig. 1 illustrates the number of participants recruited, those lost to follow up, and those used in feasibility analysis. Baseline characteristics of the parent ($n = 28$) and child ($n = 30$) participants who completed the intervention are shown in Table 1.

4.2. Quantitative and qualitative feasibility data

To support the rolling recruitment method, the Thriving Families program was delivered four times over four school terms during the collection period. All the intended workshops and exercise sessions were delivered as planned, with parent workshop attendance at 92%. Thriving Families group exercise sessions (i.e., dose received) lasted an average of 59 min, with children covering an average of 1500 m per session and working at a heart intensity between 69 and 95% of their estimated heart rate maximum. No adverse events were recorded during the intervention period. The post-workshop evaluation questionnaire (see supplementary A.3) revealed that more than 90% of parents and instructors agreed or strongly agreed with all questions in the post workshop evaluation. Mean scores across all items were high and ranged from 4.24 to 4.75 (on a 5-point response scale). Importantly, 96% of parents found the workshop to be useful in developing their knowledge about building their child's confidence and motivation for PA and, and 93% reported that the workshops improved their confidence in implementing strategies to provide a need-supportive environment. Similarly, 100% of instructors felt that the workshop was useful in developing their knowledge on building children's confidence and motivation for PA and improving their confidence to implement need-supportive strategies

(see supplementary A.3).

With respect to children's perceptions of parent PA support, using Cohen's d values as an indicator of the magnitude of change over time, we observed negligible change on children's perceptions of autonomy support, (M_{pre} = 2.64, SD_{pre} = 0.86; M_{post} = 2.49, SD_{pre} = 0.87; d = 0.17), competence support (M_{pre} = 2.65, SD_{pre} = 0.86; M_{post} = 2.64, SD_{post} = 0.80; d = 0.01), relatedness support (M_{pre} = 3.41, SD_{pre} = 0.68; M_{post} = 3.43, SD_{post} = 0.53; d = 0.03), or parent logistical support for PA (M_{pre} = 3.18, SD_{pre} = 0.81; M_{post} = 3.24, SD_{post} = 0.61; d = 0.08). For the interested reader, outputs from inferential (i.e., paired sample t-test) statistics are presented in Tables 2 and 3; it is important to reiterate here, though, that the study was not intended to be powered to detect statistically significant differences (on these or other outcomes).

In terms of parent variables, we observed moderate-to-large effect size estimates for changes in parent knowledge for building their child's confidence and motivation for PA (M_{pre} = 3.21, SD_{pre} = 0.73; M_{post} = 3.78, SD_{pre} = 0.73; d = 0.78) and parent confidence to provide a need-supportive environment (M_{pre} = 3.31, SD_{pre} = 0.81; M_{post} = 3.76, SD_{pre} = 0.76; d = 0.57). The quality of parents' motivation to support their child's PA (RAI) also demonstrated evidence of a meaningful (i.e., moderately-sized) improvement in the quality of parents' motivation for supporting their child's PA (M_{pre} = 5.34, SD_{pre} = 2.85; M_{post} = 6.50, SD_{pre} = 2.64; d = 0.42). Effect size estimates for parents' amotivation regarding their child's PA, (M_{pre} = 0.75, SD_{pre} = 0.79; M_{post} = 0.67, SD_{pre} = 0.92; d = 0.01), or their provision of logistic support (M_{pre} = 3.63, SD_{pre} = 0.65; M_{post} = 3.60, SD_{pre} = 0.70; d = 0.04) indicated very little change over time. See Table 2 for paired sample t-test statistics.

Qualitative data were grouped according to two broad categories representing (a) reflections on the program in general and the MAGIC framework and (b) the effect of the program on children's physical literacy outcomes. Parents appreciated several elements of the program and the MAGIC framework. One parent commented, for example, "the parent workshop, going through the MAGIC principles and the action plans and troubleshooting, certainly helped to really address areas we need to focus on again at home or outside of this environment". Instructors reinforced the value of the framework, with one noting, "I think one thing that's very easy to administer is the idea of the MAGIC principle. Having a framework for it I think helped reinforce, not necessarily bringing something new to the table, but reinforced the things that we think are important and we should be doing". Another instructor echoed this point, commenting, "the way I've phrased things, just, like, in terms of building confidence in the kids and using different terminology. Like, putting it in a different way. That workshop really did help me, like, see another way of approaching it."

In terms of positive aspects of the program, the parent education workshop—and program more generally—also appeared to facilitate greater self-reflection among parents and supported a renewed desire to encourage their child's PA experiences and participation. One parent indicated, for example, "I guess, reflecting back on that and reflecting back on some of my behaviours and frustrations before, with some of the things I've done here as well I probably recognise there were a few things that I could have done better in the past, and they're mistakes that I probably won't make again." Another parent reinforced this message, saying, "because I've got a child who doesn't normally choose to be physically active, she's just not gonna go and do it on her own. So, I have to be part of that, and I have to make her fun. So, if anything I walk away with it's that she's just not gonna do it off her own back, that I have to be part of that, and, and that's okay. And that's just the way it's gonna be, and just have fun, she's a kid." Reflecting on the workshop, another parent highlighted, "I remember after, it might have been the first parent workshop actually, going and sharing it with my husband and commenting about, I think these things would be good for her, kind of incorporating it in and sharing it with others members of the family." For additional meaning unit examples to illustrate parent and instructor perceptions, see supplementary material A.4.

Aside from endorsing elements of the program and workshop, parents and instructors also suggested improvements that (if feasible) may bolster the effectiveness of the program in the future. Parents expressed that additional face-to-face contact may be valuable, with one highlighting, "… it's a shame there weren't weekly workshops. Some of them don't work for everybody. But I've found that it's probably more reflection upon oneself than anything else that … things tend to go by the wayside. Even just having that touch point, just to keep on going over and iterating, like the last session I found the most useful. And it wasn't actually, it wasn't actually the workshop, it was questions." Instructors also saw benefit in scheduling more regular sessions. As one commented, "it would have been good to go do the workshop, put into practice what you had learned, then halfway through comeback and talk about what worked, what hadn't".

Table 2
Preliminary efficacy of 10-week physical literacy intervention on child outcomes (n = 28).

Variable	*Mean diff (SD)*	*95% confidence intervals*				
		Lower	Upper	t	df	p
Physical competence						
Flexibility (cm)	0.04 (4.46)	−1.80	1.88	0.04	24	0.965
Muscle strength (kg)	1.68 (3.04)	0.46	2.91	2.82	25	0.009
RTSBc	3.81 (5.18)	1.71	5.9	3.74	25	<0.001
Anaerobic power (watts)	10.80 (27.49)	0.14	21.46	2.08	27	0.047
Aerobic Fitness (mins)	1.17 (1.29)	0.67	1.68	4.81	27	<0.001
Self-perceptions						
Exercise motivation						
RAI score	−0.02 (4.08)	−1.60	1.56	−0.02	27	0.982
Amotivation				0.39	27	0.702
Perceived competence	−0.28 (1.15)	−0.72	0.17	−1.27	27	0.213
Perceptions of parent PA support						
Autonomy support	−0.14 (0.87)	−0.48	0.19	−0.87	27	0.391
Competence support	−0.01 (0.89)	−0.36	0.33	−0.06	27	0.950
Relatedness support	0.02 (0.56)	−0.20	0.24	0.20	27	0.841
Parent logistic support	0.06 (0.54)	−0.15	0.27	0.57	27	0.575

Note: RTSBc = resistance training skill battery for children, PA = physical activity, RAI = relative autonomy index, Mean diff = post-pre.

Table 3
Preliminary efficacy of 10-week physical literacy intervention on parent outcomes (n = 19).

Variable	*Mean diff (SD)*	*95% confidence intervals*				
		Lower	Upper	t	df	p
Motivation to support children's PA						
RAI score	−1.16 (2.45)	−2.34	0.03	−2.00	18	0.055
Amotivation	0.08 (0.84)	−0.34	0.50	0.42	18	0.681
Knowledge	0.56 (0.78)	0.18	0.94	3.14	18	0.006
Confidence	0.44 (0.74)	0.09	0.80	2.63	18	0.017
Parent logistic support for PA	−0.03 (0.47)	−0.26	0.19	−0.33	18	0.749

Note: PA = physical activity, RAI = relative autonomy index, Mean diff = post-pre.

4.3. Quantitative and qualitative preliminary efficacy data

Examination of effect sizes indicated evidence of moderate to large changes for aerobic fitness ($M_{pre} = 10.11$, $SD_{pre} = 1.90$; $M_{post} = 11.28$, $SD_{pre} = 1.84$; $d = 0.63$), muscle strength ($M_{pre} = 13.63$, $SD_{pre} = 3.44$; $M_{post} = 15.31$, $SD_{pre} = 4.39$; $d = 0.43$), and resistance training skill competency ($M_{pre} = 46.81$, $SD_{pre} = 5.04$; $M_{post} = 50.61$, $SD_{pre} = 3.97$; $d = 0.84$), along with evidence of a small effect for changes in levels of perceived competence ($M_{pre} = 4.86$, $SD_{pre} = 1.43$; $M_{post} = 4.59$, $SD_{pre} = 0.85$; $d = 0.23$). Inspection of effect size estimates for anaerobic fitness ($M_{pre} = 226.11$, $SD_{pre} = 93.38$; $M_{post} = 236.92$, $SD_{pre} = 94.51$; $d = 0.11$), flexibility ($M_{pre} = -4.36$, $SD_{pre} = 8.26$; $M_{post} = -4.32$, $SD_{pre} = 8.55$; $d = 0.00$) and, self-perception indices of RAI ($M_{pre} = 3.98$, $SD_{pre} = 3.55$; $M_{post} = 3.96$, $SD_{pre} = 3.11$; $d = 0.00$) and amotivation ($M_{pre} = 0.98$, $SD_{pre} = 1.19$; $M_{post} = 0.78$, $SD_{pre} = 0.88$; $d = 0.10$) revealed little evidence of meaningful change. See Table 2 for paired sample t-tests examining changes on child physical competence outcomes.

In terms of qualitative data on the effect of the program on children's physical literacy outcomes, parents commented that they had observed improvements in elements of their child's physical literacy across the course of the program. For example, one parent highlighted, "it's just brilliant. I just think it's such a good program. I don't know where [my child] would be without it. She's a lot physically stronger, but I've also sorted out gut issues with her, and food issues, that all, everything combined has just made her physically stronger and more confident". Another parent reflected on the effects of the program on her daughter's confidence and motivation for PA, commenting, "all of it together, the workshops and the home activities, the program … all of it together has really helped my daughter because, yeah, she's now getting involved more in the school. Like, she's just started doing athletics club. She gave it a go yesterday and that's something that she just never would have done." With regards to greater PA participation outside the program, one parent also commented, "his mates are more [physically] capable than he is, but he is getting more keen to go around bike riding around the neighbourhood now that he's getting stronger". For additional meaning unit examples to illustrate program efficacy, see supplementary A.4.

5. Discussion

Children faced with neurodevelopmental, emotional, or behavioural challenges experience difficulties finding tailored and enjoyable PA options, meeting PA recommendations, and building long-term PA habits (Hickingbotham, Wong, & Bowling, 2021; Must et al., 2015). For that reason, it is important that researchers and practitioners seek to develop and deliver effective interventions that are tailored to children's needs and support positive PA experiences (Carl et al., 2022). The concept of physical literacy holds value for understanding and predicting individuals' engagement in exercise and PA; as such, this concept provides an important conceptual 'scaffold' for interventions of this kind. In this investigation, we reported on the development and preliminary evaluation of the Thriving Families program—a multi-component physical literacy intervention specifically for children with neurodevelopmental, emotional, or behavioural challenges. This study addressed key gaps in the literature highlighted in the review by Carl et al. (2022), calling for interventions that are a multi-component in nature linking to clear theoretical constructs and for the inclusion of qualitative views on physical literacy interventions. Our findings revealed that Thriving families was feasible, was consider valuable and useful to families and may be responsible for positive downstream effects on aspects of children's physical literacy.

The primary 'active ingredients' (e.g., programmed exercise sessions, the education workshops, MAGIC framework) within the Thriving Families intervention were delivered as planned and—on the basis of quantitative and qualitative feedback—were well received by participants. Demonstrating that multi-component theory-based interventions are efficacious in a community setting and for children with specific PA-related needs and challenges. In addition, from a health and physical activity promotion perspective, heart rate and GPS data regarding the programmed exercise sessions indicated that children were, on average, working at a moderate-to-high level of intensity—such levels of engagement would be expected over time to elicit positive physiological adaptations (Faigenbaum, Lloyd, & Myer, 2013). Contrary to previous findings by Bremer and colleagues and despite the relatively short-term nature of the program (i.e., 10 weeks), it was interesting that we observed notable improvements over time in objective indicators of children's physical competence (Bremer et al., 2020). Specifically, moderate-to-large effect sizes were apparent for aerobic fitness, muscle strength and resistance training skill competency. It is important to caution that without a suitable control cohort, these findings may be due to influences other than the program alone. However, for children aged 8 to 12, we would not expect that maturation effects in isolation would account for changes of such magnitude in these outcomes over a 10-week period. It was also interesting to note that despite improvements in objective indicators of physical competence, these effects did not translate into similar improvements in children's perceived competence for PA. In terms of potential program refinements in the future, it is possible that more detailed and frequent feedback to children about their objective (physical) development would help shift perceptions of competence during (and following) the program. Additionally, it is well documented that children with lower motor competence tend to hold relatively low self-perceptions in this domain (Wright et al., 2018); it may, as a result, take longer than 10 weeks to bring about changes to long-held perceptions of self. Parenthetically, the same notion may be true with respect to the negligible change we observed for children's PA motivation quality (i.e., RAI scores). If these children have a history of largely negative PA experiences, (Cairney, Hay, Faught, Mandigo, & Flouris, 2005) it may take a significant amount of time to stimulate changes to the way in which children view exercise.

Literature has demonstrated that a significant proportion of physical literacy interventions fail to incorporate intervention content targeted towards the motivation/confidence and the knowledge/understanding domains (Carl et al., 2022). The findings from this trial emphasises not only feasibility, but a potential novel mechanism of action, with parents demonstrating noteworthy improvements across the program in their knowledge about building children's motivation and confidence for PA, as well as their confidence to provide a need-supportive PA environment. The moderate or large effects observed for these variables indicates that the intervention may hold value in shaping important mediators of PA promotion for children. It has been shown, for example, that parental support for PA is a key predictor of children's PA participation (Trost et al., 2003). It would be valuable to determine in the future trials whether, given sufficient time, these changes translate into improved PA support behaviours among parents and enhanced PA levels and experiences for children. Additionally, from an instructor perspective, qualitative data revealed that despite all instructors having a tertiary education (e.g., exercise science degree) incorporating foundational knowledge in motivation science and behaviour change, on the whole they reported that the MAGIC framework provided an important frame of reference for effective service delivery. The value that instructors saw in these practical and theoretical principles—and the reinforcement of this perspective by parents in their interviews—points toward the potential scalability and effectiveness of the program in the future.

Despite documenting evidence that supported aspects of program feasibility and potential efficacy, there were a number of instances where we observed no change on relevant variables, and as a result there appeared to be important refinements and program improvements that could be made. With parents, for example, we observed negligible pre-to-post-program change on their provision of logistic support for PA and motivation for supporting PA. These patterns were supported by children's reports of their parents' change in supportive behaviour (or

lack thereof)—we witnessed negligible change in children's perceptions of their parents' need-supportive and logistic support behaviours regarding PA. In light of these findings, it is possible that the relatively short intervention period did not provide parents with sufficient time to learn, internalise, and/or implement changes in this respect. Similarly, it is also possible that greater contact time (e.g., increased workshop activity, increased follow-up) would have enabled parents to demonstrate more meaningful (or positive) change on these key PA support behaviours. Indeed, during interviews, parents and instructors independently highlighted that greater contact time would aid their implementation of the MAGIC principles and would enable them to seek more detailed and frequent feedback about their experiences. Second, it is important to note that there were several behaviour change techniques embedded in the program, and the primary aim of those techniques was to facilitate long-term self-management of PA support (for parents) and engagement (for children) following the completion of the program. The timing of outcome assessments (i.e., immediately upon completion of the program), however, precluded any inferences regarding the lasting effectiveness of these techniques. It would be worthwhile in the future, in addition to making the programming changes outlined above, to also modify the assessment protocol so as to include a 'retention' measurement (e.g., another 10 weeks later) and provide insight into (a) the sustainability of any program-induced changes, or (b) whether the program may have stimulated changes that only fully 'emerge' following completion (e.g., ongoing use of behaviour change strategies, developments in children's motivation and confidence, changes in parent support).

The strengths of this study include the development of a novel intervention program aimed at promoting a key lifestyle behaviour among a disadvantaged cohort, the recruitment (and retention) of children, parents, and instructors into a 10-week PA program, and the collection of comprehensive (qualitative and quantitative) feasibility data. It is important to reiterate, though, that in light of the study aims and design we did not 'power' the study to detect (statistical) change on any measured variables. In addition, although the concept of 'grit' or resilience was included as one of the principles in the MAGIC framework, we did not include any assessment of this specific variable. As such, whether or not children improved in their capacity to deal with PA challenges through the program can only be inferred from other outcome measures (i.e., objective competence, motivation, confidence) or from parents' qualitative data. With the continued development of the field of physical literacy, it would be valuable in any future randomised controlled trial based on this program to build on the key learnings from this trial and consider further refinement. Firstly, inclusion of an assessment of children's resilience relating to PA challenges and setbacks (Jefferies, Ungar, Aubertin, & Kriellaars, 2019). Secondly, whilst use of the chosen objectively measured physical literacy components in this trial was considered a strength with respect to appropriateness and applicability in the study population. It is balanced against an important limitation that a validated physical literacy tool was not used, limiting the authors ability to provide an overall physical literacy score. Future iteration of the trial should look to incorporate a validated tool such as the Physical Literacy in Children Questionnaire which aligns to the conceptual structure of the Australian Physical Literacy Framework (Barnett, Mazzoli, Bowe, Lander, & Salmon, 2022; Sport Australia, 2019). Finally, it is worth highlighting that the sample consisted of families (i.e., parents) who self-referred to the program, and in the future it is necessary to determine the extent to which desirable program outcomes (and retention rates) can be achieved among a sample of families referred into the program from a third party.

6. Conclusion

Despite an abundance of community-based PA programs and offerings for children, those with neurodevelopmental, emotional or behavioural challenges continue to experience difficulties finding enjoyable, engaging, and supportive ways to be regularly active. By focusing on the concept of physical literacy and adopting a multi-faceted approach to intervention, in this study we demonstrated important feasibility evidence for a community-based PA program for children with identified barriers to participation. From a practical perspective, these findings provide evidence to support the continuation of the Thriving Families program and offer valuable insight into methods for program optimisation. An important next step from a community programming standpoint is to 'scale up' this intervention and explore delivery effectiveness in other sites and locations. From a research perspective, meanwhile, this study provides the platform (and necessary information) to support a future randomised controlled trial in which long-term health- and PA-related outcomes for children (e.g., PA levels, socialisation processes, physical and mental health indices) and their parents (e.g., PA supportive behaviours) are examined.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

Acknowledgements

Thank you to the parents, children and instructors who volunteered their time to assist this research study. This study was partially supported by Clinical Exercise Physiology Research Grant from Exercise Sport Science Australia (ESSA).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.mhpa.2023.100558.

References

Achenbach, T. M., & Rescorla, L. A. (2001). *Manual for the ASEBA school-age forms & profiles*. University of Vermont, Research Center for Children, Youth & Families.

Barnett, L. M., Mazzoli, E., Bowe, S. J., Lander, N., & Salmon, J. (2022). Reliability and validity of the PL-C Quest, a scale designed to assess children's self-reported physical literacy. *Psychology of Sport and Exercise, 60*, Article 102164. https://doi.org/10.1016/j.psychsport.2022.102164

Bebich-Philip, M. D., Thornton, A. L., Reid, S. L., Wright, K. E., & Furzer, B. J. (2016). Adaptation of the resistance training skills battery for use in children across the motor proficiency Spectrum. *Pediatric Exercise Science, 28*(3), 473–480. https://doi.org/10.1123/pes.2015-0216

Belanger, K., Barnes, J. D., Longmuir, P. E., Anderson, K. D., Bruner, B., Copeland, J. L., et al. (2018). The relationship between physical literacy scores and adherence to Canadian physical activity and sedentary behaviour guidelines. *BMC Public Health, 18*(Suppl 2), 1042. https://doi.org/10.1186/s12889-018-5897-4

Beld, W. A. van den, Sanden, G. A. C. van der, Sengers, R. C. A., Verbeek, A. L. M., & Gabreëls, F. J. M. (2006). Validity and reproducibility of the Jamar dynamometer in children aged 4 – 11 years. *Disability & Rehabilitation, 28*(21), 1303–1309. https://doi.org/10.1080/09638280600631047

Braun, V., & Clarke, V. (2021). *Thematic analysis: A practical guide*. SAGE Publications. https://books.google.com.au/books?id=mToqEAAAQBAJ.

Bremer, E., Graham, J. D., & Cairney, J. (2020). Outcomes and feasibility of a 12-week physical literacy intervention for children in an afterschool program. *International Journal of Environmental Research and Public Health, 17*(9), 3129. https://doi.org/10.3390/ijerph17093129

Cairney, J., Dudley, D., Kwan, M., Bulten, R., & Kriellaars, D. (2019). Physical literacy, physical activity and health: Toward an evidence-informed conceptual model. *Sports Medicine, 49*(3), 371–383. https://doi.org/10.1007/s40279-019-01063-3

Cairney, J., Hay, J., Faught, B., Mandigo, J., & Flouris, A. (2005). Developmental coordination disorder, self-efficacy toward physical activity, and play: Does gender matter? *Adapted Physical Activity Quarterly, 22*(1), 67–82. https://doi.org/10.1123/apaq.22.1.67

Cairney, J., Hay, J. A., Faught, B. E., Wade, T. J., Corna, L., & Flouris, A. (2005). Developmental coordination disorder, generalized self-efficacy toward physical

activity, and participation in organized and free play activities. *The Journal of Pediatrics, 147*(4), 515–520. https://doi.org/10.1016/j.jpeds.2005.05.013
Cairney, J., Veldhuizen, S., & Szatmari, P. (2010). Motor coordination and emotional–behavioral problems in children. *Current Opinion in Psychiatry, 23*(4), 324–329. https://doi.org/10.1097/yco.0b013e32833aa0aa
Carl, J., Barratt, J., Töpfer, C., Cairney, J., & Pfeifer, K. (2022). How are physical literacy interventions conceptualized? – a systematic review on intervention design and content. *Psychology of Sport and Exercise, 58*, Article 102091. https://doi.org/10.1016/j.psychsport.2021.102091
Cooper, A. R., Goodman, A., Page, A. S., Sherar, L. B., Esliger, D. W., van Sluijs, E. M., et al. (2015). Objectively measured physical activity and sedentary time in youth: The international children's accelerometry database (ICAD). *International Journal of Behavioral Nutrition and Physical Activity, 12*(1), 113. https://doi.org/10.1186/s12966-015-0274-5
Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., Petticrew, M., et al. (2008). Developing and evaluating complex interventions: The new medical research council guidance. *BMJ, 337*, a1655. https://doi.org/10.1136/bmj.a1655
Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Plenum.
Dimmock, J. A., Gagné, M., Proud, L., Howle, T. C., Rebar, A. L., & Jackson, B. (2016). An exercise in resistance: Inoculation messaging as a strategy for protecting motivation during a monotonous and controlling exercise class. *Journal of Sport & Exercise Psychology, 38*(6), 567–578. https://doi.org/10.1123/jsep.2016-0146
Edwards, L. C., Bryant, A. S., Keegan, R. J., Morgan, K., & Jones, A. M. (2017). Definitions, foundations and associations of physical literacy: A systematic review. *Sports Medicine, 47*(1), 113–126. https://doi.org/10.1007/s40279-016-0560-7
Eldridge, S. M., Chan, C. L., Campbell, M. J., Bond, C. M., Hopewell, S., Thabane, L., et al. (2016). CONSORT 2010 statement: Extension to randomised pilot and feasibility trials. *BMJ, 355*, i5239. https://doi.org/10.1136/bmj.i5239
Faigenbaum, A. D., Lloyd, R. S., & Myer, G. D. (2013). Youth resistance training: Past practices, new perspectives, and future directions. *Pediatric Exercise Science, 25*(4), 591–604. https://doi.org/10.1123/pes.25.4.591
González-Víllora, S., Sierra-Díaz, M. J., Pastor-Vicedo, J. C., & Contreras-Jordán, O. R. (2019). The way to increase the motor and sport competence among children: The contextualized sport alphabetization model. *Frontiers in Physiology, 10*, 569. https://doi.org/10.3389/fphys.2019.00569
Halvorsen, M., Mathiassen, B., Myrbakk, E., Brøndbo, P. H., Sætrum, A., Steinsvik, O. O., et al. (2019). Neurodevelopmental correlates of behavioural and emotional problems in a neuropaediatric sample. *Research in Developmental Disabilities, 85*, 217–228. https://doi.org/10.1016/j.ridd.2018.11.005
Hebestreit, H., Mimura, K., & Bar-Or, O. (1993). Recovery of muscle power after high-intensity short-term exercise: Comparing boys and men. *Journal of Applied Physiology, 74*(6), 2875–2880. https://doi.org/10.1152/jappl.1993.74.6.2875
Henderson, S. E., & Sugden, D. A. (2007). *Movement assessment battery for children* (2nd ed.). Psychological Corporation Ltd.
Hickingbotham, M. R., Wong, C. J., & Bowling, A. B. (2021). Barriers and facilitators to physical education, sport, and physical activity program participation among children and adolescents with psychiatric disorders: A systematic review. *Translational Behavioral Medicine, 11*(9), 1739–1750. https://doi.org/10.1093/tbm/ibab085
Jefferies, P., Ungar, M., Aubertin, P., & Kriellaars, D. (2019). Physical literacy and resilience in children and youth. *Frontiers in Public Health, 7*. https://doi.org/10.3389/fpubh.2019.00346, 346–346.
Kotte, E. M. W., Groot, J. F. D., Bongers, B. C., Winkler, A. M. F., & Takken, T. (2015). Validity and reproducibility of a new Treadmill protocol. *Medicine & Science in Sports & Exercise, 47*(10), 2241–2247. https://doi.org/10.1249/mss.0000000000000657
Lancaster, G. A. (2015). Pilot and feasibility studies come of age. *Pilot and Feasibility Studies, 1*(1), 1. https://doi.org/10.1186/2055-5784-1-1
Mandich, A. D., Polatajko, H. J., & Rodger, S. (2003). Rites of passage: Understanding participation of children with developmental coordination disorder. *Human Movement Science, 22*(4–5), 583–595. https://doi.org/10.1016/j.humov.2003.09.011
Markland, D., & Tobin, V. (2004). A modification to the behavioural regulation in exercise questionnaire to include an assessment of amotivation. *Journal of Sport & Exercise Psychology, 26*(2), 191–196. https://doi.org/10.1123/jsep.26.2.191
McAuley, E., Duncan, T., & Tammen, V. V. (1989). Psychometric properties of the intrinsic motivation inventory in a competitive sport setting: A confirmatory factor analysis. *Research Quarterly for Exercise & Sport, 60*(1), 48–58. https://doi.org/10.1080/02701367.1989.10607413
Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., et al. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine, 46*(1), 81–95. https://doi.org/10.1007/s12160-013-9486-6
Must, A., Phillips, S., Curtin, C., & Bandini, L. G. (2015). Barriers to physical activity in children with autism Spectrum disorders: Relationship to physical activity and screen time. *Journal of Physical Activity and Health, 12*(4), 529–534. https://doi.org/10.1123/jpah.2013-0271
Ntoumanis, N., Quested, E., Reeve, J., & Cheon, S. H. (2017). Need-supportive communication. In B. Jackson, J. Dimmock, & J. Compton (Eds.), *Persuasion and communication in sport, exercise, and physical activity* (pp. 155–169). Taylor & Francis Group.
Reiersen, A. M., Constantino, J. N., & Todd, R. D. (2008). Co-Occurrence of motor problems and autistic symptoms in attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child & Adolescent Psychiatry, 47*(6), 662–672. https://doi.org/10.1097/CHI.0b013e31816bff88
Rhodes, R. E., Spence, J. C., Berry, T., Deshpande, S., Faulkner, G., Latimer-Cheung, A. E., et al. (2016). Understanding action control of parental support behavior for child physical activity. *Health Psychology, 35*(2), 131–140. https://doi.org/10.1037/hea0000233
Rivilis, I., Hay, J., Cairney, J., Klentrou, P., Liu, J., & Faught, B. E. (2011). Physical activity and fitness in children with developmental coordination disorder: A systematic review. *Research in Developmental Disabilities, 32*(3), 894–910. https://doi.org/10.1016/j.ridd.2011.01.017
Sparkes, A. C., & Smith, B. (2014). *Qualitative research methods in sport, exercise and health: From process to product*. Routledge.
Sparks, C., Lonsdale, C., Dimmock, J., & Jackson, B. (2017). An intervention to improve teachers' interpersonally involving instructional practices in high school physical education: Implications for student relatedness support and in-class experiences. *Journal of Sport & Exercise Psychology, 39*(2), 120–133. https://doi.org/10.1123/jsep.2016-0198
Sport Australia. (2019). *The Australian physical literacy framework*. Retrieved from https://www.sportaus.gov.au/_data/assets/pdf_file/0019/710173/35455_PhysicalLiteracy-Framework_access.pdf.
Stewart, D. W., & Shamdasani, P. N. (2014). *Focus groups: Theory and practice* (3rd ed.). Sage.
Tremblay, M. S., Longmuir, P. E., Barnes, J. D., Belanger, K., Anderson, K. D., Bruner, B., et al. (2018). Physical literacy levels of Canadian children aged 8-12 years: Descriptive and normative results from the RBC learn to play-CAPL project. *BMC Public Health, 18*(Suppl 2), 1036. https://doi.org/10.1186/s12889-018-5891-x
Trost, S. G., Sallis, J. F., Pate, R. R., Freedson, P. S., Taylor, W. C., & Dowda, M. (2003). Evaluating a model of parental influence on youth physical activity. *American Journal of Preventive Medicine, 25*(4), 277–282. https://doi.org/10.1016/s0749-3797(03)00217-4
Wright, K. E., Furzer, B. J., Licari, M. K., Dimmock, J. A., Jackson, B., & Thornton, A. L. (2020). Exploring associations between neuromuscular performance, hypermobility, and children's motor competence. *Journal of Science and Medicine in Sport*. https://doi.org/10.1016/j.jsams.2020.06.007
Wright, K. E., Furzer, B. J., Licari, M. K., Thornton, A. L., Dimmock, J. A., Naylor, L. H., et al. (2018). Physiological characteristics, self-perceptions, and parental support of physical activity in children with, or at risk of, developmental coordination disorder. *Research in Developmental Disabilities, 84*, 66–74. https://doi.org/10.1016/j.ridd.2018.05.013