






Research

Impact of a fundamental movement skills program on educator practice in early learning centres

Teneale McGuckin¹  · Denise Turner¹  · Tamra Jones³ · Fiona Crowther¹ · Jackie Eagers²  · Jonathan Connor⁴ 

Received: 28 March 2024 / Accepted: 3 July 2024

Published online: 09 July 2024

© The Author(s) 2024 

Abstract

Introduction Early development of fundamental movement skills (FMS) has various health, social, emotional, cognitive, and physical benefits. However, reports indicate children’s motor skill proficiencies are diminishing. Therefore, the early childhood years and early childhood educators are vital for providing opportunities for FMS development, which may enable children to acquire a lifelong positive relationship with physical activity (PA).

Methods Educators at early learning centres (ELC) in a regional city were invited to participate in semi-structured interviews and complete a FMS diary. Following the initial data collection, a university student-led FMS focused PA program was delivered. After the completion of the program, educators were invited to participate in a follow-up interview and to complete another FMS diary. The interviews were thematically analysed and the FMS diaries were descriptively reported.

Results From pre-program interviews, three themes were identified including “educator training and recall”, “environmental moderators”, and “expanding knowledge”. Educators indicated they had some formal training regarding physical education, but their knowledge was limited or difficult to recall. Educators suggested increasing their knowledge would be a valuable future enabler to advance FMS outcomes. After the completion of the program, interviews with the educators identified “program impact on practices” as another surfacing theme and is indicative the program elicited reflection of educators about their practices.

Conclusion A university student-led FMS focused program provoked reflective practices of educators about FMS proficiency and programming. Educators identified challenges, enablers, and opportunities for facilitating FMS activities at ELC.

Keywords Fundamental movement skills · Student-led program · Early childhood education · Educator perspective

1 Introduction

Early childhood is the optimal time to provide routine opportunities to develop fundamental movement skills (FMS), which are the building blocks to develop more specialised movement that facilitate access to a broader range of physical activity (PA) experiences across the lifespan [1]. However, despite agreement in scholarship about their importance, research continues to report children’s motor skill proficiencies are diminishing [2–6]. Early learning centres (ELC) provide

✉ Teneale McGuckin, Teneale.mcguckin@jcu.edu.au; Denise Turner, Denise.turner@jcu.edu.au; Tamra Jones, tamra.jones@jcu.edu.au; Fiona Crowther, Fiona.crowther@jcu.edu.au; Jackie Eagers, Jackie.eagers@jcu.edu.au; Jonathan Connor, Jonathan.connor@jcu.edu.au | ¹Sport and Exercise Science, James Cook University, Townsville, QLD 4814, Australia. ²Occupational Therapy, James Cook University, Townsville, QLD 4814, Australia. ³Education, James Cook University, Townsville, QLD 4814, Australia. ⁴Psychology, James Cook University, Townsville, QLD 4814, Australia.



opportunities for children to practice and acquire FMS through play [7, 8]. ELC educators are arguably well-placed to facilitate these learning experiences [9], however even trained educators may lack the skills to design and deliver a FMS program [10–13]. University student-led FMS focused programs may provide an opportunistic way to up-skill ELC educators through tertiary educator supervised program design and delivery in ELC [14, 15].

Scholarship has validated that the development of FMS is positively related to the likelihood of participating in PA across the lifespan [1, 16–19]. Additionally, higher levels of PA are correlated to bone health, psychosocial and cognitive health, motor skill development, and cardiometabolic health [20]. There is also claim that engagement with PA, enabled by well-developed FMS, may contribute to academic performance [21]. Despite these reported health benefits, most Australian pre-school aged children do not meet the PA guidelines [22] and their motor proficiencies are diminishing [4–6].

Many children attend an early learning centre (ELC) or pre-school in their early childhood years [9, 23]. This creates a unique opportunity to provide PA opportunities [7] and potentially increase FMS development within pre-school aged children [8, 24]. Historically, research [25–28] reports that children who attend ELC settings which provide experiences for structured and unstructured activities (e.g. free play outside) participate in more PA and less sedentary activities. However, it has also been reported that children often choose to participate in stationary activities instead of PA during ‘free outdoor play’ [29]. Further, a critical narrative review by Kreichauf et al. [30] identified that educators influenced children’s PA engagement, whereby children who were passively supervised by educators engaged in less PA. Conversely, children may participate in more strenuous types of PA during unstructured outdoor play if educators are enthusiastic about PA and provide demonstrations of activities [31]. ELC educators play a critical role in facilitating PA of children [9]. For example, their intentional teaching practices for PA can result in children spending greater amounts of time engaged in PA [32], however, there are a number of factors influencing the PA opportunities available in ELC. Previously educators of pre-school aged children have described equipment, insufficient space, daycare requirements, safety concerns and weather as challenges to engaging in PA, whereas resources, music, and the educator themselves being enthusiastic toward PA were facilitators of movement experiences [9]. Additionally, children historically have reportedly more PA at ELC where educators have tertiary qualifications in childcare education [33–36]. While many tertiary educated ELC educators understand the importance of FMS for enabling access to PA across time, these educators have also self-reported a lack of competence to plan, implement, manage and monitor PA in early childhood education settings [10–13].

While ELC appear to provide opportunities to increase PA and FMS, early childhood educators may not have support to teach FMS, overcome logistical challenges, and meet the diverse FMS needs of the children [37, 38]. One approach to addressing these limitations includes providing more structured opportunities for FMS to develop [39]. For example, a structured program might emphasize each skill being demonstrated separately followed by opportunities for children to practice the skills [39]. Therefore, educators would need practical resources and education to effectively instruct FMS to assist children in their ability to master a skill [39]. Bourke et al. [40] suggested capacity building of educators through professional development can improve their attitudes and knowledge surrounding PA and FMS.

Providing staff training can be costly to ELC and previously university student-led programs have been used for specific populations [14, 15] however there is a paucity of literature exploring educators’ experiences with university student-led FMS focused programs. The aims of the current study were 1. to explore educators experiences and practices in relation to FMS in ELCs and 2. to explore educators perceptions about challenges, enablers, and opportunities around facilitating FMS activities in ELCs. Subsequently participating educators were interviewed pre- and post- the FMS intervention. Interview guides and FMS diaries were used to facilitate reflection within the interviews.

2 Methodology

2.1 Ethics

The present study was approved by James Cook University Human Research Ethics Committee (Ethics number H9020). The study was performed in accordance with The National Statement on Ethical Conduct in Human Research 2007 (updated 2018) which was developed jointly by the National Health and Medical Research Council (NHMRC), the Australian Research Council and Universities Australia. Participants were provided with an information sheet and a written consent form was obtained from each participant prior to commencing the interviews.

2.2 Participants

A convenience sample of ELCs from Townsville, Queensland, Australia, were approached to participate in the research project. Four centres agreed to participate with a potential recruitment of fifteen educators. Thirteen educators (see Table 1) volunteered for the project where semi-structured interviews were conducted.

2.3 Pre-intervention interviews

The interviews were scheduled to be no longer than 30 min and were facilitated at the respective ELCs during work hours. The interview guide was developed based on the existing literature and discussions within the research team. Each interview included some demographic questions, with the main focus being on exploring influencing factors regarding the opportunity for children to be active while attending the ELC. Interviews were conducted in a private room either by TM, DT, FC or JE and were audio recorded. Each interview was conducted with a semi-structured script with major questions and prompts. Training of the interview team was completed prior to all interviews. An example of questions asked during interviews included “*what barriers might hinder the implementation of formal physical activities in your room*”, and “*what could help/enable you to implement formal physical activities in your room?*”.

2.4 The intervention

Each of the four ELCs were provided a five-week student-led FMS focused program. Each program was prescribed to address the following 13 FMS as described in the Test for Gross Motor Development (TGMD) [41] and TGMD-2 [42]: jumping, running, galloping, hopping, leaping, skipping, side sliding, catching, stationary dribbling, striking, kicking, underarm throwing, and overarm throwing. Previous research in PA and FMS for children has integrated the TGMD-2 in their programming [8, 43]. Each FMS was prescribed a minimum of twice throughout the program. Coaching cues, demonstrations, and encouragement were provided to the children by students enrolled in a Bachelor of Sport and Exercise Science, who facilitated the delivery of the program. No data was recorded of the children participating in the intervention as this was not the aim of the research project.

2.5 FMS diary

Participants were invited to complete a FMS diary pre- and post- the student-led program. Educators were asked to record the frequency that children were observed engaging in any FMS as per the TGMD and TGMD-2 for each hour of the day, between 8 am and 4 pm, for five days (Monday-Friday). The purpose of this diary was to serve as an educative tool for FMS by way of providing illustrations and descriptions of each FMS. Additionally, it served as an opportunity for educators to reflect on PA opportunities provided at their ELC.

Table 1 Participant characteristics

Demographic	
Age	39.8 ± 11.4 years
Biological sex	13 Female
Highest qualification	4 × Bachelor of Education (early childhood) 7 × Diploma of childhood services 2 × Diploma of childhood services and studying Bachelor of Education (early childhood)
Years of experience	15.4 ± 7.7 years

2.6 Post-interventions interviews

After the completion of the student-led intervention, the educators were invited to complete a post interview which was conducted as outlined in the pre-intervention interviews section, with additional prompts regarding the FMS focused program such as *'can you please tell me more about that?'* which assisted in exploring the questions further. Eleven educators volunteered for the post-intervention interviews.

2.7 Analysis

Each interview was transcribed via Microsoft Word 'Transcribe' and checked for accuracy by the primary author (TM) against the audio file. The transcriptions were thematically analysed using a reflexive thematic analysis [44]. This process was chosen based on the qualitative nature of the data and the ability for the authors to reflect on the data and generate centralised themes. The transcripts were organised in Excel based on initial codes (TM) and were refined after author discussions (TM, DT). The data were reviewed by investigators who have backgrounds in PA, FMS, and behaviour change with authors having previous experience in qualitative research (TM, DT, JE, TJ, JC). Based on the six-phase process outlined by Braun and Clarke [44], the authors familiarized themselves with the data by reading the transcripts (TM, DT, JC), and took initial notes with early discussions surrounding the potential codes that may be generated. Specific codes were then generated and allocated to the relevant data (TM, DT). Following this, themes were generated, with discussions amongst the authors to refine the final theme name (TM, DT, JE, TJ, JC). Finally, the results of the analysis were reported and conceptualised themes were included in the current study.

The FMS diary data are reported as descriptive statistics as the sample size limited the relevance of statistical comparisons.

3 Results

Four overarching themes were identified in this study. Three themes were identified from the pre-intervention interviews "educator training and recall" and "environmental moderators" and "expanding knowledge" and one theme was identified from the post-intervention interviews "program impact on practices."

3.1 Pre-intervention interviews

1. Educator training and recall

Almost all participants (11/13) indicated they had received some formal training regarding physical education, however participants suggested that their knowledge is limited or not easy to recall. When asked about their knowledge and experience with PA and about FMS, participants provided the following remarks:

"It was more observations, and the different varieties of learning in observation, so physical activity is a learning. I forget what it is, I think it's wellbeing and it discusses physical activity being observed. I don't really remember much"
Participant 3

"Probably, but it was a while ago" Participant 6

"It was so long ago... I can remember, it was 14-15 years ago" Participant 11

"I think I did one subject? So that was hands on, we'd go out in the field, and we'd practice different games and gross motor skills. I don't remember much." Participant 13

2. Environmental moderators

When asked about challenges and facilitators for providing opportunities for children to be active or to practice FMS, educators provided distinct responses which have been themed 'use of space/facilities' and 'managing risks'. The themes are described below with direct quotes included.

2.1 Use of space/facilities

Both the limited space and an abundance of space for movement opportunities were described, with most participants referring to outdoor space.

"If it's raining, then we're on the veranda outside." Participant 10.

"In our space. Our side [of the centre] is really good, like we have that big lawn there... and we've got [access to] the oval." Participant 13

"Just thinking about the yards, we have more space over on [the other side of the centre] for more vigorous activities, whereas in [our side], the outdoor space is a bit more limiting" Participant 12

"We can't put an obstacle in the yard because there's just no room. So that has limited a lot of [activities]." Participant 1

All ELC used technology as an opportunity for children to be physically active. The technology was used indoors, mostly for yoga, music and movement, or for specific online apps or YouTube videos.

"[We use a] smart board—Probably 99% [of the children] are engaged in it... They just love it. Yeah, they asked for it... I do have my own speaker that I bring in, we used to do like Fun Friday, and we just have music playing and we just get ribbons and do ribbon dancing and stuff like that." Participant 6

"So we've got, apps that we use like Go Noodle app, Pevan and Sarah, so they're dancing. So, these are just dancing, like move body movements and I also do some yoga [using the smart board]." Participant 9

"We use the smart board. So, on the smart board, we use Go Noodle. Yeah, that's a program that has got dances and meditation. And has different program on there that you can access." Participant 12

2.2 Managing risk

Weather conditions were identified by educators as an influencing factor to offer the opportunity to be physically active outdoors. Generally, participants indicated that the decision to play and be physically active outdoors was influenced by the heat and the rules and regulations such as ground temperature checks.

"So, we have to do a temperature check sample on the concrete every afternoon and in the morning. And if it's above 60 degrees, we can't go outside to play. And being Townsville, it's up to the 70s/80s [degrees]. So, we can hose it down, which cools it a bit, but we don't generally get out till 4pm maybe 4.30pm in the afternoon, which cuts out a lot of that physical time." (Participant 1)

"We've got a space indoor and outdoor. Time is probably a barrier because there are times we can't be outside because of the sun. And the shade is not probably adequate to be out as much as we could. So, we are limited to the time... [The weather] 100% impacts it. Because obviously, it's too hot. It's too wet. So, it impacts the times you can go outside, But the weather [as a barrier] it's huge....We do temperature checks and stuff like that as well" (Participant 6)

"It depends on the weather, so we have to follow the UV rating, we have to ensure that sunscreen is applied to the children 30 minutes before they come outside, and that they have access to water. I think five or six [UV rating] is when it's, like stay in shade. But anything above that, that's when it's like, maybe we should stay inside. We have to do an outdoor checklist before we come outside, and we have to check the UV as well before we come outside. It really affects how we can encourage children to move their bodies, as we are so scared of anything happening to them. They come outside and without even running, their cheeks are red, they're hot, they're sweating, and, I can't be like "go for a run kids"" (Participant 3).

Taking into consideration the rules, regulations, and risks associated with PA at an ELC, participants indicated that it is challenging to overcome some of the imposed barriers.

"Sometimes the boys get a bit rough on the mat or tend to run around a bit, so then we put something else out [e.g., table activity] to keep them busy because we're not supposed to be running inside, [they need to have] quiet voices and all that." Participant 1

"Everything we do here, is on the side of caution and it does limit you to a certain degree. But it's part of that industry. "Be careful."" Participant 2

"[Inside] it's such a small space and a large risk of children getting hurt. I think physical activities, like yoga, are easier to do on a mat. But when it becomes like other things like jumping around, moving, it can become larger, so the children are getting hurt... Like that has a risk assessment [associated with the activity]." Participant 3

"They can't really run around in the room because there's obstacles, you know, [they may] hurt themselves. It's just safety." Participant 9

3 Expanding knowledge

The most prominent topic of discussion surrounding future enablers for providing opportunities for physical activity was increasing the educators' knowledge. The following examples are statements made by participants regarding a future enabler of increasing their knowledge:

"I wouldn't mind doing some PD [professional development], a bit of training, just some fun little things to do. You can do research online as much as you like, but until you actually do any sort of training, [the online research] can be limiting." Participant 8

"I just think for me personally, I learn a lot from watching people. So I suppose if someone was to, teach us, then we could teach the children as well." Participant 12

"Maybe having an official program that you could follow... I'm keen to learn and to grow my skill set." Participant 6

After the completion of the five-week student-led FMS intervention, eleven educators volunteered for a post-intervention interview. It was noted that the eleven educators attended three or more sessions and therefore were exposed to at least one demonstration and delivery of each FMS. For the purposes of coding participant responses, the same participant number was used from the pre-intervention interviews.

3.2 Post-intervention interviews

4 Program impact on practices

The themes that were generated from the post-intervention interviews surrounded the opportunity for educators to observe children's engagement with PA and level of FMS proficiency. Additionally, educators reflected on their programming and resources. While no direct measure of knowledge was included in the study, the ability for the five-week student-led FMS intervention to elicit reflection and potential changes to teaching programming highlights that some level of additional knowledge was achieved. The following examples are statements made by participants regarding their experiences with the intervention and how they have observed the children's skills and engagement and reflected on their teaching programming for providing opportunities to develop FMS and/or increase PA levels:

"I think [the sessions] definitely helped me to see how engaged [the children] were and how small groups were really effective. I thought splitting them up [into smaller groups] and having modelling [of the skill] and then they have a go and really demonstrating how the skill should be done, I think I can definitely do that. It seems more achievable. I just really appreciate your time coming here and demonstrating how to achieve what we can. I think the kids really engaged well with it" Participant 13

"I think there was some things that we noticed, like the other teacher and myself did a little bit of a reflection on our own and we noticed that children really struggled with bouncing and dribbling the ball. So, we talked about how we might go to, [a large cement undercroft area] with the balls and practise bouncing a bit more. [We observed] different levels of ability and we did do a little bit of an assessment on their skills and then we're going to plan some further things to follow up to help them." Participant 10

"We have spoken about looking into some of your activities, for example the pool noodle [for striking FMS]. That's just a simple, getting a pool noodle and chopping it in half and using it, you know?" Participant 12

"I felt like I had a bit of [an idea about FMS/exercise], but after the program, I feel more confident in putting something together for the children. I think you as an educator, you are teaching the children certain things [about being physically active], but you don't, understand how much they need to start building [FMS] that at a younger age. So, my biggest thing was like, yes, we might do [physical activity], not purposely do it, it's just letting them do what they want to do. Whereas now I think that maybe we should be having that 20 minutes or whatever where we go out and we do the same thing [as the program] so that they're active and understanding how to do different things. Like kicking the ball, you know, some people don't know how to do that. Hitting the ball. They don't know how to do that. Catching, bouncing, some of the kids that were doing the dribbling had no idea [how to do the skill]. So, I think that's probably something that would benefit all children. I think if we teach children at a young age, it will hopefully continue. I mean, we've only got the kids, for one year, but hopefully it continues" Participant 4

3.3 FMS diary

Six diaries were collected pre- and post-intervention, from four ELCs. While the sample size did not meet statistical analysis requirements, the educators reported a total number of opportunities for FMS prior to the intervention as 237 across five days, with the number of opportunities increasing post-intervention to 252 across the same time period. Again, while not statistically significant, underarm throwing and overarm throwing opportunities increased from five to fourteen, and three to twelve respectively.

4 Discussion

This qualitative study included a five-week university student-led FMS focused program to explore educator experiences and practices in relation to FMS in ELC as well as their perceptions about challenges, enablers, and opportunities around facilitating FMS activities. The pre- and post-intervention interviews with educators identified four themes including "educator training and recall", "environmental moderators", "expanding knowledge" and "program impact on practices". The analysis indicated that although educators received some formal education, they had difficulty recalling the information or the content provided was limited to observations, safe set up, or instructing games ("educator training and recall"). While use of space/facilities and managing risks were identified as some key influencing factors ("environmental moderators"), the educators indicated that further educative focus on developing FMS would be the most impactful resource to assist them implementing purposeful PA ("expanding knowledge"). The student-led FMS focused program resulted in some thought-provoking reflections from the educators, who suggested the program provided an opportunity to observe their students' FMS and identify areas for improvement, while also considering their programming and resources to increase opportunities to increase FMS ("program impact on practices"). Additionally, the diaries, while not statistically analysed, descriptively indicated that educators provided additional opportunities for their students to develop FMS, with an increased focus on throwing activities.

Our findings align with those of Bruijns et al. [45] who suggested that providing PA training for educators has benefits to PA related confidence and knowledge. Similarly, Kreichauf et al. [30] acknowledged the importance of educators' knowledge regarding PA and their ability to support and encourage children's development of FMS. Additionally, there is a relationship between educators influencing a child's PA behaviours and rationalising an investment in staff training [30]. As each ELC volunteered for the study, the director of each centre placed importance on staff training. By engaging with educative opportunities, educators may increase their professional capability and eagerness to implement FMS programs [46, 47].

Incorporating a university student-led FMS focused program and generally increasing PA levels, during the early childhood years, received positive feedback from educators. These findings suggest that having some coaching, demonstration, and session plans are useful for educative focus. Similar findings by Telford et al. [48] indicated that peer coaching of educators could lead to further opportunities for children to develop motor skills. As educators play a critical role in increasing PA levels [9] and a targeted FMS program may promote higher levels of PA [49], the findings of the current study suggest a university student-led FMS focused program may not only contribute to advancing FMS but could also facilitate more movement opportunities. However further investigation is required to explore FMS proficiency as a result of providing more student-led FMS focused programs in early childhood.

For university students completing health-related degrees which require completion of practicum, student-led services can provide opportunities for students to gain contextually relevant experiences in the client's usual environment [50].

For example, Tsiro et al. [50] reported that a physiotherapy student-led assessment outreach program was a feasible and sustainable model to assess motor skills of children at preschool settings. Those students benefited from delivering their services at the children's usual setting where care-providers, such as parents and preschool staff, were available to provide additional support [50]. Therefore, student-led FMS focused demonstrations and programs at ELC may also provide a cost-effective and practical opportunity for university students completing a PA-related course to gain hands-on experience in a supportive environment while simultaneously providing regular professional development to ELC educators.

The influencing factors that were described in the interviews are similar to those previously identified [9] however weather was a strong focus across both use of space/facilities and managing risks. As Brown et al. [51] reported greater levels of PA when children are outdoors, the climate of towns and cities needs to be considered. The current study was based in North Queensland, Australia, and the regional city of Townsville is in the dry tropics with the average maximum temperature, morning humidity, and rainfall for summer reported as 31.4 °C, 70.7%, 232.3 mm respectively, which indicates hot and humid summer months [52]. With winters being described as warm days and cool nights, with the average maximum temperature, morning humidity, and rainfall for winter reported as 25.6 °C, 64.3%, 17 mm respectively [52]. The current findings indicate that the climate has had considerable impact on the ability for children to be physically active and provides a challenge for educators as there is risk associated with participating in outdoor PA. Consideration should therefore be given to how FMS focused programs can be facilitated in or adapted to indoor settings, especially when outdoor practice is not feasible.

The current study is not without limitation, such that the findings can only be generalised to other locations in tropical environments and regional locations. Additionally, the study is limited to only educator experiences and future research could explore university student experiences as they played a critical role in the intervention. Similarly, no data were collected from the children who were involved in the intervention. The outcomes of the FMS diaries cannot be generalised to all ELC since data were obtained from a small, convenience sample. Further research is required to explore how educative focus for teaching FMS could be improved through conversations and interactions between the university students and educators. In aligning with Petrie [47], the provision of purposeful opportunities for students and educators to extend their health and physical education pedagogies is likely to increase their capability and eagerness to design and deliver quality FMS focused programs. This professional exchange could generate strategies to overcome identified challenges specific to the context of practice in ELC, such as programs that can be delivered indoors or outdoors irrespective of weather conditions. Furthermore, for FMS programs to be sustainable, educational resources and equipment specifically for FMS development (e.g. pool noodles for striking) could be provided to ELC. Further research could explore university student-led FMS focused programs in various settings such as primary school or outside hours school care to provide opportunities for knowledge sharing between university students and educators. Additionally, long-term monitoring of educators' experiences with providing FMS focused programs through PA opportunities is recommended.

5 Conclusion

Use of space/facilities and managing risks were influencing factors for ELC educators' decisions surrounding delivering PA opportunities that enable FMS development. A university student-led FMS focused program to guide ELC educative focus on PA and FMS provided some reflective practices of educators where they reviewed the students' FMS and identified opportunities for children to develop their FMS through PA opportunities.

Acknowledgements We would like to thank the ELCs and students involved in the project.

Author contributions TM, DT, TJ, FC, JE, JC contributed to the study conception and design. TM, DT, TJ, FC, JE, JC contributed to material preparation, data collection and analysis. The first draft of the manuscript was written by TM, and DT, TJ, FC, JE, JC contributed to previous versions of the manuscript. TM, DT, TJ, FC, JE, JC read and approved the final manuscript.

Data availability The data that support the findings of this study are not openly available due to reasons of sensitivity and are available from the corresponding author upon reasonable request. Data are located in controlled access data storage at James Cook University.

Declarations

Competing interests The authors declare no competing interests.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

1. Goodway J, Ozmun JC, Gallahue DL. Understanding motor development: Infants, children, adolescents, adults. Burlington: Jones & Bartlett Learning; 2019.
2. Hands B. How fundamental are fundamental movement skills? Act Healthy Magazine. 2012;19(1):14–7.
3. Jefferson-Buchanan R. Teaching fundamental movement skills through play-based pedagogy. JOPERD. 2022;93(8):28–33. <https://doi.org/10.1080/07303084.2022.2108171>.
4. Bardid F, Rudd JR, Lenoir M, Polman R, Barnett LM. Cross-cultural comparison of motor competence in children from Australia and Belgium. Front Psychol. 2015;6:964–964. <https://doi.org/10.3389/fpsyg.2015.00964>.
5. Hardy LL, Reintein-Reynolds T, Espinel P, Zask A, Okely AD. Prevalence and correlates of low fundamental movement skill competency in children. Pediatrics. 2012;130(2):e390–3398. <https://doi.org/10.1542/peds.2012-0345>.
6. Hardy LL, Mhrshahi S, Drayton BA, Bauman A. NSW schools physical activity and nutrition survey (SPANS) 2015: full report. Sydney: NSW Department of Health; 2017.
7. Telford RM, Olive LS, Telford RD. A peer coach intervention in childcare centres enhances early childhood physical activity: the active early learning (AEL) cluster randomised controlled trial. Int J Behav Nut Phys Activ. 2021. <https://doi.org/10.1186/s12966-021-01101-2>.
8. Ali A, McLachlan C, Mugridge O, McLaughlin T, Conlon C, Clarke L. The effect of a 10-Week physical activity programme on fundamental movement skills in 3–4-year-old children within early childhood education centres. Children (Basel). 2021;8(6):440. <https://doi.org/10.3390/children8060440>.
9. van Zandvoort M, Tucker P, Irwin JD, Burke SM. Physical activity at daycare: issues, challenges and perspectives. Early Years. 2010;30(2):175–88. <https://doi.org/10.1080/09575141003667282>.
10. Buckler EJ, Bredin SSD. Examining the knowledge base and level of confidence of early childhood educators in physical literacy and its application to practice. Early Years. 2021;41(2–3):202–17. <https://doi.org/10.1080/09575146.2018.1514488>.
11. Marinsek M, Kovac M. Beliefs of Slovenian early childhood educators regarding the implementation of physical education. Eur Phy Educ Rev. 2019;25(3):659–74. <https://doi.org/10.1177/1356336X18761538>.
12. Sevimli-Celik S, Johnson JE. Teacher preparation for movement education: increasing pre-service teachers' competence for working with young children. Asia-Pac J Teach Educ. 2016;44(3):274–88. <https://doi.org/10.1080/1359866X.2015.1079303>.
13. Sheridan SM, Edwards CP, Marvin CA, Knoche LL. Professional development in early childhood programs: process issues and research needs. Early Educ Dev. 2009;20(3):377–401. <https://doi.org/10.1080/10409280802582795>.
14. Holdsworth R. Spaces for partnerships. Teach the teacher: student-led professional development for teachers. Forum. 2014;56(1):67–78. <https://doi.org/10.2304/forum.2014.56.1.67>.
15. Shields N, Taylor NF. A student-led progressive resistance training program increases lower limb muscle strength in adolescents with Down syndrome: a randomised controlled trial. J Physiother. 2010. <https://doi.org/10.26181/22200361.v1>.
16. Barnett LM, van Beurden E, Morgan PJ, Brooks LO, Beard JR. Childhood motor skill proficiency as a predictor of adolescent physical activity. J Adolesc Health. 2009;44(3):252–9. <https://doi.org/10.1016/j.jadohealth.2008.07.004>.
17. Fowweather L, Knowles Z, Ridgers ND, O'Dwyer MV, Foulkes JD, Stratton G. Fundamental movement skills in relation to weekday and weekend physical activity in preschool children. J Sci Med Sport. 2015;18(6):691–6. <https://doi.org/10.1016/j.jsams.2014.09.014>.
18. Lloyd M, Saunders TJ, Bremer E, Tremblay MS. Long-term importance of fundamental motor skills: a 20-year follow-up study. Adapt Phys Activ Q. 2014;31(1):67–78. <https://doi.org/10.1123/apaq.2013-0048>.
19. Stodden DF, Goodway JD, Langendorfer SJ, et al. A developmental perspective on the role of motor skill competence in physical activity: an emergent relationship. Quest. 2008;60(2):290–306. <https://doi.org/10.1080/00336297.2008.10483582>.
20. Timmons BW, Leblanc AG, Carson V, et al. Systematic review of physical activity and health in the early years (aged 0–4 years). Appl Physiol Nutr Metab. 2012;37(4):773–92. <https://doi.org/10.1139/h2012-070>.
21. de Waal E. Fundamental movement skills and academic performance of 5- to 6-year-old preschoolers. Early Child Educ J. 2019;47(4):455–64. <https://doi.org/10.1007/s10643-019-00936-6>.
22. Hinkley T, Salmon J, Okely AD, Crawford D, Hesketh K. Preschoolers' physical activity, screen time, and compliance with recommendations. Med Sci Sports Exerc. 2012;44(3):458–65. <https://doi.org/10.1249/MSS.0b013e318233763b>.
23. Leis A, Ward S, Vatanparast H, et al. Effectiveness of the Healthy Start-Départ Santé approach on physical activity, healthy eating and fundamental movement skills of preschoolers attending childcare centres: a randomized controlled trial. BMC Public Health. 2020;20(1):523–523. <https://doi.org/10.1186/s12889-020-08621-9>.
24. Wick K, Leeger-Aschmann CS, Monn ND, et al. Interventions to promote fundamental movement skills in childcare and kindergarten: a systematic review and meta-analysis. Sports Med. 2017;47(10):2045–68. <https://doi.org/10.1007/s40279-017-0723-1>.
25. Bower JK, Hales DP, Tate DF, Rubin DA, Benjamin SE, Ward DS. The childcare environment and children's physical activity. Am J Prev Med. 2008;34(1):23–9. <https://doi.org/10.1016/j.amepre.2007.09.022>.
26. Carson V, Adamo KB, Ogdren N, et al. Sedentary time and physical activity associations between child care educators and children. Am J Prev Med. 2020;58(4):e105–11. <https://doi.org/10.1016/j.amepre.2019.11.016>.
27. Gordon ES, Tucker P, Burke SM, Carron AV. Effectiveness of physical activity interventions for preschoolers: a meta-analysis. Res Q Exerc Sport. 2013;84(3):287–94. <https://doi.org/10.1080/02701367.2013.813894>.

28. Tonge KL, Jones RA, Okely AD. Correlates of children's objectively measured physical activity and sedentary behavior in early childhood education and care services: a systematic review. *Prev Med.* 2016;89:129–39. <https://doi.org/10.1016/j.ypmed.2016.05.019>.
29. Pate RR, Mclver K, Dowda M, Brown WH, Addy C. Directly observed physical activity levels in preschool children. *J Sch Health.* 2008;78(8):438–44. <https://doi.org/10.1111/j.1746-1561.2008.00327.x>.
30. Kreichauf S, Wildgruber A, Krombholz H, et al. Critical narrative review to identify educational strategies promoting physical activity in preschool. *Obes Rev.* 2012;13(s1):96–105. <https://doi.org/10.1111/j.1467-789X.2011.00973.x>.
31. Brown WH, Googe HS, Mclver KL, Rathel JM. Effects of teacher-encouraged physical activity on preschool playgrounds. *J Early Interv.* 2009;31(2):126–45. <https://doi.org/10.1177/1053815109331858>.
32. Veldman SLC, Stanley RM, Okely AD, Jones RA. The association between staff intention and pre-schoolers' physical activity in early childhood education and care services. *Early Child Dev Care.* 2020;190(13):2032–40. <https://doi.org/10.1080/03004430.2018.1555824>.
33. Coleman B, Dymont JE. Factors that limit and enable preschool-aged children's physical activity on child care centre playgrounds. *J Early Child Res.* 2013;11(3):203–21. <https://doi.org/10.1177/1476718X12456250>.
34. Dowda M, Pate RR, Trost SG, Almeida MJ, Sirard JR. Influences of preschool policies and practices on children's physical activity. *J Community Health.* 2004;29(3):183–96. <https://doi.org/10.1023/b:johe.000022025.77294.af>.
35. Martyniuk OJM, Tucker P. An exploration of early childhood education students' knowledge and preparation to facilitate physical activity for preschoolers: a cross-sectional study. *BMC Public Health.* 2014;14(1):727–727. <https://doi.org/10.1186/1471-2458-14-727>.
36. Temple V, O'Connor JP. Constraints and facilitators for physical activity in family day care. *Australas J Early Child.* 2005;30(4):1–9. <https://doi.org/10.1177/183693910503000402>.
37. Iivonen S, Sääkslahti A, Nissinen K. The development of fundamental motor skills of four- to five-year-old preschool children and the effects of a preschool physical education curriculum. *Early Child Dev Care.* 2011;181(3):335–43. <https://doi.org/10.1080/03004430903387461>.
38. Spittle S. An examination of teacher confidence and motivation to teach primary school physical education. Doctoral dissertation, Victoria University; 2015.
39. Hardy LL, King L, Kelly B, Farrell L, Howlett S. Munch and Move: evaluation of a preschool healthy eating and movement skill program. *Int J Behav Nut Phys Act.* 2010;7(1):80–80. <https://doi.org/10.1186/1479-5868-7-80>.
40. Bourke M, Haddara A, Loh A, Saravanamuttoo KA, Bruijns BA, Tucker P. Effect of capacity building interventions on classroom teacher and early childhood educator perceived capabilities, knowledge, and attitudes relating to physical activity and fundamental movement skills: a systematic review and meta-analysis. *BMC Public Health.* 2024;24(1):1409–1409. <https://doi.org/10.1186/s12889-024-18907-x>.
41. Ulrich D. Test for gross motor development. Austin: PRO-ED, Inc; 1985.
42. Ulrich D. Test of gross motor development – 2. Austin: PRO-ED, Inc; 2000.
43. Logan SW, Robinson LE, Wilson AE, Lucas WA. Getting the fundamentals of movement: a meta-analysis of the effectiveness of motor skill interventions in children. *Child Care Health Dev.* 2012;38(3):305–15. <https://doi.org/10.1111/j.1365-2214.2011.01307.x>.
44. Braun V, Clarke V. One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qual Res Psychol.* 2021;18(3):328–52. <https://doi.org/10.1080/14780887.2020.1769238>.
45. Bruijns BA, Johnson AM, Irwin JD, et al. Training may enhance early childhood educators' self-efficacy to lead physical activity in childcare. *BMC Public Health.* 2021;21(1):386–386. <https://doi.org/10.1186/s12889-021-10400-z>.
46. Lander NJ, Barnett LM, Brown H, Telford A. Physical education teacher training in fundamental movement skills makes a difference to instruction and assessment practices. *J Teach Phys Educ.* 2015;34(3):548–56. <https://doi.org/10.1123/jtpe.2014-0043>.
47. Petrie K. Creating confident, motivated teachers of physical education in primary schools. *Eur Phy Educ Rev.* 2010;16(1):47–64. <https://doi.org/10.1177/1356336X10369200>.
48. Telford RM, Olive LS, Telford RD. The effect of a 6-month physical literacy intervention on preschool children's gross and fine motor skill: the active early learning randomised controlled trial. *J Sci Med Sport.* 2022;25(8):655–60. <https://doi.org/10.1016/j.jsams.2022.04.009>.
49. Van Capelle A, Broderick CR, van Doorn N, Ward RE, Parmenter BJ. Interventions to improve fundamental motor skills in pre-school aged children: a systematic review and meta-analysis. *J Sci Med Sport.* 2017;20(7):658–66. <https://doi.org/10.1016/j.jsams.2016.11.008>.
50. Tsiros MD, Ward EJ, Lefmann S, Hillier S. The physiotherapy in preschools program: Describing a student-led assessment service for children with possible motor skill difficulties. *Adapt Phys Activ Q.* 2020;37(3):324–37. <https://doi.org/10.1123/apaq.2019-0121>.
51. Brown WH, Pfeiffer KA, Mclver KL, Dowda M, Addy CL, Pate RR. Social and environmental factors associated with preschoolers' nonsedentary physical activity. *Child Dev.* 2009;80(1):45–58. <https://doi.org/10.1111/j.1467-8624.2008.01245.x>.
52. Bureau of Meteorology. Climate statistics for Australian locations. 2024. http://www.bom.gov.au/climate/averages/tables/cw_032040.shtml. Accessed 06 Mar 2024.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.