

Review

Postural Education Programmes with School Children: A Scoping Review

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Abstract: Spinal deformities and back pain are growing problems in childhood and adolescence, due to unhealthy habits. This study undertook a scoping review to identify scientific studies with children and adolescents, focusing on the methodologies used, implementation of key factors and gaps, and results of postural education programmes to promote sustainable healthy habits. The methodological tool PRISMA-ScR was used. Five online databases were used to identify papers published since 2013. Eligibility criteria were defined, and the search strategies were drafted. A total of 86 publications were initially identified; after screening and applying eligibility criteria, 11 papers were included in this study for detailed analysis. The postural education programmes in these papers mainly focused on adolescents' postures and postural learning acquisition, using different teaching methodologies; only one study was conducted with children between 5 and 6 years old enrolled in preschool. Follow-up studies revealed inconsistent results. However, developing and measuring the effectiveness of young children's postural education programmes, to enhance experiences of movement variability and strategies for postural control in playful activities, is of great relevance for children's healthy development, and can also have positive impacts on environmental and social sustainability by promoting healthy and conscious lifestyles.

Keywords: postural education; child health; health promotion; school



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1. Introduction

Body posture is the relationship between the body segments inherent in the ability to maintain postural control [1]. It is also defined as a set of interactions between the musculoskeletal system with afferent and efferent pathways of the central nervous system, whose main purpose is maintaining body stability and protecting the musculoskeletal structures [2].

The postural control system is the ability to control postures with variability, in a space that requires complex interactions between neurological, sensory and musculoskeletal systems [3]. Moreover, postural control is defined as a neural process inherent to the relation between the body's stability and gravity, by maintaining or returning to the centre of pressure (CoP) on the base of support (BoS) [4].

The coordination between posture and movement depends on the dynamic control of the CoP within the BoS, allowing the gradual development of patterns of coordination, which enables the child to respond and interact with the environment's demands in an active sensorimotor learning process [3,5]. Additionally, muscular synergies related to movement are associated with postural adjustments, which allow stability to perform a task with the necessary adaptability to achieve a given goal [6]. Furthermore, the stability is related to the postural control system's dynamic rather than biomechanical stability [7].

Basic motor skills refer to the fundamental skills that involve the body's movement, and are developed throughout childhood, starting from the first months of life. Therefore, they allow the development of more complex motor skills, and are essential for children's

physical, cognitive and social development [8,9]. Furthermore, postural control is closely related to body posture, which is crucial for motor skills improvements [10], and for the child to develop more complex motor skills [11].

Opportunities for motor action depend on the state of the body, environmental variations, and social and cultural influences [12]. Thus, through activities such as sports, music and arts, the child develops skills in motor coordination, agility, balance, resistance, manual dexterity, body language, rhythm, breath control, and promotion of body awareness [13,14]. Consequently, new motor competencies create new opportunities for motor experiences and learning [12]. Indeed, authors suggested that a child's gross motor development (bilateral coordination, balance and coordination of upper limbs) is essential for academic performance in activities such as letter knowledge, reading, and spelling [15].

During development, the child learns new movement sensations, which emerge to respond to tasks in interactions with the natural environment. Therefore, through new sensations, the child can experience different motor strategies, and select the most efficient ones [16,17], creating new neural networks which facilitate larger variability in postural skills [17], promoting the progressive construction of an internal action model [18], and the development of body schema [17]. In this sense, the child's postural interactions with the natural environment will influence the internal action model for body schema, and postural control in the central nervous system to adapt to environmental demands through the coordination and cooperation between visual, vestibular and proprioceptive systems [19]. Moreover, information from these three systems is collected and processed by the brainstem, cerebellum and, later, the cerebral cortex, to maintain postural control [20]. The development of postural control is a non-linear process [21,22]. This fact is explained by associating the improvement of level, the type of muscle activity, and selecting effective strategies based on sensory information. Hence, there are sensitive periods for the development of postural control. The researchers [22,23] point out that, up to age 10, children have significant development of the visual and proprioceptive systems, but this development is only seen in the vestibular system by age 15; up to 14–16 years, young people cannot select, and process distorted visual information and use information from the vestibular system as adults do [24]. Therefore, postural control is not fully developed at this age. Between the ages of 16 and 18, young people effectively and dynamically adjust to sensory input for optimal postural control [22,23,25]. On the other hand, musculoskeletal and body structure change [24]; height, weight, and body mass [22] are the factors that most influence postural control. Consequently, postural control strategies depend on the central nervous system's assessment and control of many variables [26].

In children with typical development, the improvement in postural control is explained by the varied postural experiences throughout the age. The trunk is the first reference for postural control, and is crucial in its development [3,5,17,27]. Trunk postural stability is essential for limbs to perform specific tasks, and trunk mobility skills are also important during transitions, while upper limbs give postural stability through arm support [3,5]. The development of trunk postural control continues between ages 6 and 11, and is only fully matured by early adolescence [28].

Changes in motor planning due to lack or inadequate motor experiences interfere with the performance of and participation in daily activities [29]. Motor planning is defined as implicit when only the objective and constraints of the desired task are considered, and explicit when the decision for the action is considered [30]. Therefore, motor planning competencies are essential for sustainable postural control development. Additionally, the critical period for developing adult-like motor planning is between ages 8 and 11, which is due to the maturation of cognitive and motor processes that occur in this age group [31].

Spinal deformities and back pain have been a growing problem in childhood and adolescence, because backpacks exceed the maximum recommended weight [32], because of excessive exposure to technologies with exaggerated flexion of the cervical and dorsal spine, or due to excessive periods of sitting in unadjusted chairs and tables [33–35]. Fur-

thermore, a study [36] reveals that low back pain is frequent in school children aged 10 to 12 years, and that the average pain intensity is 3,4 on a scale of 0 to 10.

According to new guidelines released by the World Health Organization (WHO), “regular physical activity may contribute to addressing the global learning crisis, as it is associated with better brain health, which includes cognitive development, classroom behaviour (e.g., time spent on tasks) and academic performance” [37]. Indeed, it has been suggested that solid physical activity promotion programmes are needed to promote the practice, both within the school environment and after school, considering families as potential influencers on children’s lifestyles [38]. Promoting postural health in children, focused on developing capacities related to improvements in knowledge, competencies and commitment of all community members [29], benefits children’s individual well-being, and can positively impact environmental and social sustainability by promoting healthy and conscious lifestyles.

This study is in line with the United Nations Sustainable Development Goals (SDG), namely SDG 3 (good health and well-being) and SDG 4 (quality education). It describes the outcomes of a scoping review to map the evidence identifying scientific studies with school children, focusing on methodologies used, the implementation key factors and gaps, and results of postural education programmes to promote sustainable healthy habits. The papers included in this scoping review are not focused on therapeutic intervention programmes at school. Instead, they address postural education programmes, mainly focused on acquiring knowledge (theoretical and practical).

2. Methodology

In the present study, a scoping review was conducted following the methodologic PRISMA-ScR protocol for research developed by the EQUATOR (enhancing the quality and transparency of health research) Network [39].

2.1. Eligibility Criteria

To be included in the scoping review, the papers needed to focus on or measure postural education programmes at school. Reviewed journal papers were included if published between 2013 and 2022, written in English, Portuguese or Spanish, and involved 3–16 year-old children or adolescents with typical development. Furthermore, longitudinal, randomised, controlled and quasi-experimental studies were included, to consider the different aspects and methodologies in implementing the postural education programmes.

Papers were excluded if they did not address this study’s framework, presented other intervention programmes, were reviews or backpack studies, or studies with children and adolescents with spine disease (Figure 1).

2.2. Searching Process

In order to identify potentially relevant papers, the following bibliographic databases were searched between September and October 2022: b-on portal, Scopus, Pubmed, Web of Science, and SciELO. The key terms used in the databases were: (“postural education program” and child* and postur*); (“postural education program” and child* and literacy); (“postural education program” and child* and school*); (“postural education program” and child* and pre-school*); (“postural education program” and child* and “health literacy”); (“postural education program” and child* and “health education”); (“postural education program) and child* and “health promotion”); and (“postural education program” and child* and “health prevention”). In addition, the corresponding translated terms in Portuguese and Spanish were also searched. Moreover, the search was restricted to peer-reviewed papers from academic journals. Finally, the papers were exported to Mendeley Reference Manager, and the duplicates were removed. The flow diagram of the scoping review process (PRISMA-ScR) is shown in Figure 1.

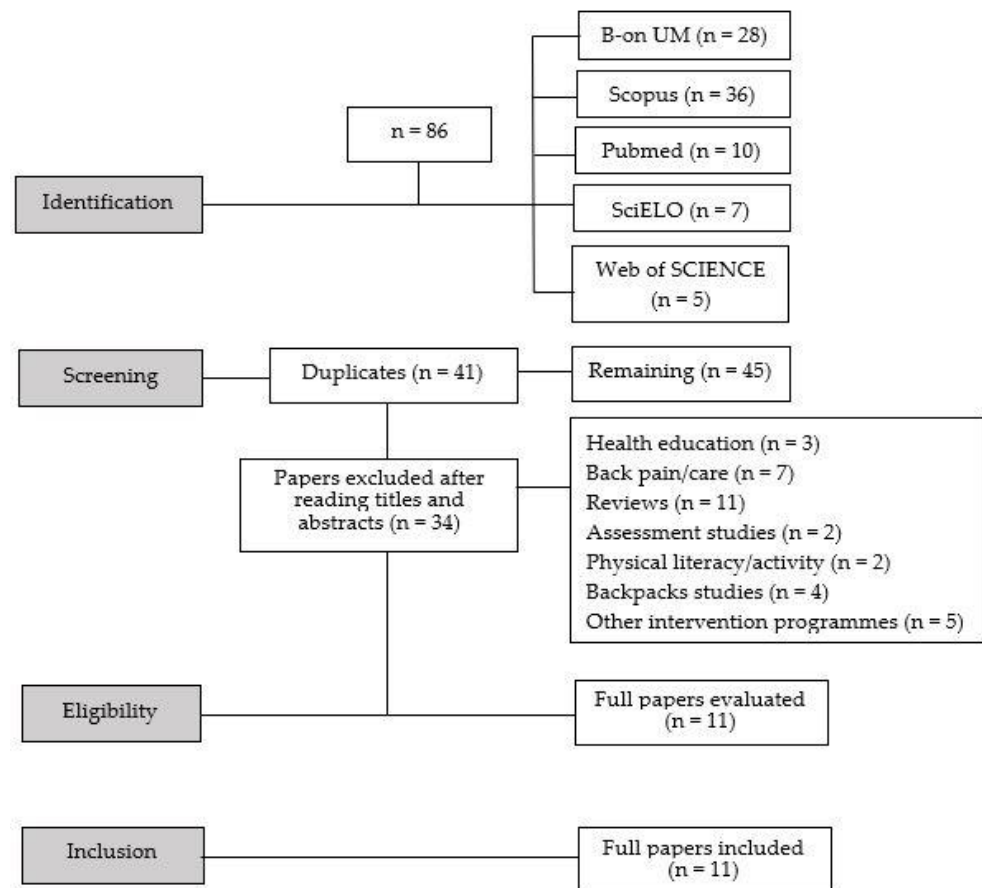


Figure 1. Flow diagram of the scoping review process (PRISMA ScR).

2.3. Selection of Sources of Evidence

To increase the consistency among reviewers, two researchers screened the 45 publications obtained after removing duplicates (Figure 1) to decide on their inclusion in the study. Initially, either researcher worked separately and evaluated the titles and abstracts in the screening process. Then, the disagreements on paper selection were solved by consensus and discussion with the third researcher. Finally, the 11 selected publications potentially relevant to the study were fully read and, according to the inclusion criteria, they were all included in the study (Figure 1).

2.4. Data Charting Process

A data-charting form was developed to determine which variables to extract. Then, the researchers independently charted the data, discussed the results and, in an iterative process, updated the data-charting form. This tool collected relevant information about the objectives, participants, key features, detailed information, and methods used in the papers to implement the school postural education programmes. The main issues from the data-charting form are presented in the results.

2.5. Data Items

The data were extracted based on paper characteristics and contextual factors in the implementation of the school programmes, to define variables for subsequent analysis: year of publication, objective, number of participants, school grade, age of participants, type of postural education programme, measuring instruments, follow-up evaluation, results, and conclusions.

2.6. Synthesis of the Search Outcomes

The analysed papers were published between 2013 and 2022. They were grouped into:

- Objective (knowledge changes, changes in postural habits, comparison between two groups, back pain reduction);
- Age of participants (5–6 years old, between 7 and 9 years old, and between 10 and 16 years old);
- School grade (pre-school age, school age, and high school age);
- The type of postural education programme (theoretical, practical, or both);
- Number of sessions of the postural education programme (1 session, 2–3 sessions, 4–6 sessions, 7–10 sessions, and more than 10 sessions);
- The type of measurements (theoretical test, practical and theoretical tests, motivation scale, back pain questionnaire, video image);
- Time of follow-up (1 week, 1–5 months, and 1 year);
- Professionals who implemented the postural education programme.

3. Results

3.1. Eligible Papers

As mentioned in the Methodology (Section 2.3 and Figure 1), 11 papers were qualified to be thoroughly analysed in this study. They were coded P1 to P11 and are the following:

- P1. [40]
- P2. [41]
- P3. [42]
- P4. [43]
- P5. [44]
- P6. [45]
- P7. [46]
- P8. [47]
- P9. [48]
- P10. [49]
- P11. [50]

3.2. Characterisation of the Eligible Papers and Analysis

Of the 11 obtained papers, the majority (6) were published between 2020 and 2021 [40–45]. Most of them (7) aimed to improve knowledge about spine anatomy, back injury, healthy postures and backpack transportation [40,42–47] and 5 papers aimed to measure changes in postural habits [44,46,47,49,50] (Table 1).

Furthermore, the participants of most papers (10) were children and adolescents between 10 and 16 years old [40–42,44–47,49,50], and only two [43,49] had 5 and 6 year-old children. The majority of participants in the papers (10) were enrolled in elementary school and secondary school, and in only one paper [48] they were in preschool (Table 1). This paper, [48], is the one which is closer to our research work area.

In addition, all the programmes used theoretical and practical learning strategies to achieve the objectives. Furthermore, the number of programme sessions varied among the 11 studies, from one to more than eleven sessions per postural education programme. Indeed, the majority of papers (8) made follow-up studies, but the time was variable: four did a 1–5 month follow-up study [44,46,47,50] and three did one year [40,42,49] (Table 1).

Some papers [40,42] reported a learning increase immediately after the programme was implemented and over one year. Others [44,47,50] reported from 1 to 5 months, indicating that theoretical and practical learned knowledge was maintained during the follow-up periods. However, in contrast, in the [46] follow-up study, the learning declined over time after the educational programme ended, and in [49], students did not maintain high scores after one year. In addition, studies that promoted six sessions reported that the programme permits achieving educational objectives either through the game immediately [41] or

after three months of a follow-up study on healthy backpacking habits [50]. On the other hand, one study that promoted 7 sessions revealed that one month of follow-up learning achieved declines over time as the educational programme ended [46]; in another work that promoted 20 sessions, the students did not maintain their high scores after one year of follow up [49] (Table 1).

These inconsistent results on the association between the number of sessions and knowledge acquisition may be related to the fact that the programmes, teaching strategies and/or measurement instruments were different. Two papers [47,49] used video recording to measure changes in postural habits, and four used questionnaires to measure musculoskeletal symptoms [40,42,46,50]. The paper [41] compared two groups, one with the game strategy and the other with the theoretical strategy, and concluded that the application of educational interventions through the game, guided by teachers, can be an interesting strategy to increase students' levels of motivation and effort; however, no statistically significant differences were found between the methodologies used [41] (Table 1).

Moreover, one of the eligible papers [44] found that most adolescents adopted an inadequate posture to perform some tasks at school and home, advising that this can lead to the development of musculoskeletal disorders in the long term. The selected papers demonstrate the concern and the need for research on children's and adolescent's postural education, as felt by professionals in three areas: physical education [41,46,47,49,50], physical therapy [40,42–45], and nursing [48] (Table 1).

Table 1. Synthesis of results by characteristics of sources of evidence.

Characteristics	n	Code
Year of publication	2013–2016	P11 2013
		P10 2015
	2017–2019	P9 2017
		P8 2017
		P7 2018
	2020–2021	P6 2020
		P5 2020
		P4 2021
		P3 2021
		P2 2021
		P1 2021
Objective	7	P1, P3, P4, P5, P6, P7, P8
	5	P5, P7, P8, P10, P11
	6	P1, P2, P4, P7, P10, P11
	4	P1, P3, P7, P11
Age of participants	2	P4, P9
	3	P4, P8, P9
	10	P1, P2, P5, P6, P7, P8, P9, P10, P11
	4	P1, P3, P5, P10

Table 1. *Cont.*

Characteristics	n	Code	
School grade	Pre-school grade	1	P9
	School grade	8	P1, P2, P3, P4, P6, P7, P8, P9
	High school grade	6	P1, P3, P5, P6, P10, P11
Type of the postural education programme	Theoretical	11	All papers
	Practical	11	All papers
Number of sessions of the postural education programme	1 session	3	P5, P6, P9
	2–3 sessions	2	P1, P3
	4–6 sessions	2	P2, P11
	7–10 sessions	2	P7, P8
	11 or more sessions	2	P4, P10
Type of measurements	Theoretical test	9	P1, P2, P3, P4, P5, P6, P7, P8, P9
	Practical test	11	All papers
	Musculoskeletal symptoms questionnaire	4	P1, P3, P7, P11
	Video image	2	P8, P10
	Other measurements	2	P2, P10
Time of follow up	None	3	P2, P4, P9
	1 week	1	P6
	1–2 months	2	P5, P7
	3–5 months	2	P8, P11
	1 year	3	P1, P3, P10
Professional who implemented the postural education programme	Physical education teacher	5	P2, P7, P8, P10, P11
	Physiotherapist	5	P1, P3, P4, P5, P6
	Nurse	1	P9

4. Discussion

This scoping review identified 86 papers, but only 11 were included after screening and applying the eligibility criteria (see Section 2.6), focusing on postural education programmes with children and adolescents at school. The findings indicate that developing health promotion strategies through postural education programmes in school can increase children's and adolescents' learning to improve their theoretical and practical knowledge, contributing to increasing healthier postural habits in daily living activities and decreasing musculoskeletal pain symptoms, such as low back pain. Thus, some papers suggest that promoting these strategies in the school context in early childhood contributes to the sustainable prevention of spinal disorders, disabilities, and postural problems. Accordingly, some researchers consider that future studies in low back pain prevention should focus on school programmes, since schools are the most appropriate institutions for health promotion and sustainable healthy habits [36]. Furthermore, the WHO highlights the importance of health promotion in schools as a healthy setting to provide sustainability for life, learning and work [37]. Results showed an agreement on the use of practical and theoretical learning strategies. In general, the practical strategies of postural education programs analysed were centred on experiences by the students about the sitting and standing posture, the carrying of the backpack, the lifting and carrying of loads, the use of cell phones, and exercises for strengthening and stretching the spine. Regarding the theoretical concepts, they were related to the anatomy of the spine, the differentiation between correct and incorrect postures, and the transporting in adequate and inadequate ways of loads. The studies highlighted that healthy practices in postural habits during the development of activities with schoolchildren allow the acquisition of real back care learning.

Nevertheless, the programmes of the analysed papers have a wide range of variability regarding the timeframe of the project's implementation, the number of sessions, and the timing of the follow-up studies. Therefore, it is important to improve the consistency of the methodologies in implementing postural education programmes in the future, to obtain more consistent results.

An immediate increase in practical and theoretical knowledge is described, and some studies show it even after 3 to 5 months or one year of follow-up. However, one paper reported that many students do not have body awareness. Therefore, despite knowing, in theory, about the best posture (after learning it in the programme), they do not adopt a correct posture when sitting. Thus, postural education programmes that promote children's postural interactions with the natural environment, facilitating greater variability in postural skills [17], can promote the progressive construction of internal action models [18] and the development of body schema [17] for better postural control outcomes. Accordingly, programmes that involve a more practical component through the performance of activities such as sports, music and arts [13,14] might provide better long-term outcomes [51].

Only one of the papers obtained from this scoping review (P9) was very close to our research work area, as it was conducted with young children between 5 and 6 years old enrolled in preschool. Although children's postural control depends on the interactions between sensory information and motor performance, it is also conditioned by the maturation of the structures involved and acquisitions related to motor experiences [25]. Indeed, it has been reported that young children can use sensory information and modify motor behaviour in response to the challenges of the environment, learning through experiences [16], and that physical activity programmes must be carried out from early childhood in children aged 3 to 6 years old, and not wait until primary education, to establish sustainable healthy lifestyle habits [38].

In addition, it is crucial to promote the development of postural control at an early age, through movement variability and intensity in the children's natural environment, to increase body awareness. Contrastingly, continuous loss of opportunities to interact with the environment through postural variability can impact various areas of development [16]. Moreover, since the trunk is the first reference for postural control, implementing postural education programmes in the future must address early experiences with movement variability and strategies for trunk postural control in playful activities between children to prevent spinal deformities and back pain.

As the development of postural control in typically developing children continues between ages 6 and 11 [28], and is not yet fully matured until early adolescence [22,25], it is also relevant to consider the consistency and adaptability of postural education programmes through children's and adolescents' age. Thus, it is also essential to develop more long follow-up studies during children's growing up to measure the effectiveness over time of such studies. For that, it is also crucial that the development of competencies happens with families and teachers, who are the main facilitators of promoting postural control development in daily living activities, within the school environment and after school, considering families as potential influencers on children's lifestyles [37,38]. In this way, it is desired to promote the child's construction of progressive and continuous healthy internal postural model and body schema, to respond to the challenges of the environment (school and home furniture, backpack, transport of objects, among others) with adaptable postural control and healthy postural habits.

Limitations

This scoping review has two main limitations. Firstly, there was an asymmetry in the obtained papers concerning the number of participants in the age ranges; unfortunately, it was not possible to find more papers on postural education programmes with preschool children. Secondly, the wide variability of programmes among the eligible papers could not give high consistency to the gathered information.

5. Conclusions

This scoping review allowed the identification of scientific studies about postural education programmes with children and adolescents at school, focusing on methodologies used, identifying the critical factors and gaps, and results of those implemented programmes.

Developing postural education programmes with young children that enhance their experiences with movement variability and strategies for children's trunk postural control in playful activities, such as sports, music and arts, in their natural preschool environment is essential to prevent spinal deformities and back pain. Furthermore, considering that the development of postural control is a non-linear process, and the trunk postural control is only matured in adolescence and based on the acquisition of motor experiences, it is important to consider the adaptability of postural education programmes through childhood and early adolescence, making families and educational teams feel involved in daily living activities, within the school environment and after school, promoting sustainable and conscious healthy lifestyles.

It is also relevant to improve the consistency of the methodologies in implementing early childhood postural education programmes, to obtain more consistent results. In addition, follow-up studies can be an important sustainable contribution to monitoring and measuring the effectiveness of young children's postural education programmes.

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Data Availability Statement: The data presented in this review are openly available in Data RepositoryUM, at dataset titled "Postural Education Programmes with School Children: A Scoping Review" (<https://doi.org/10.34622/datarepositorium/KSPP04>), accessed on 26 May 2023.

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