

# Association of a Reyog Ponorogo–inspired exercise program with spinal flexibility in school-aged children: A community-based pre–post intervention study

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## Abstract

Low back pain (LBP) in children has become an increasing musculoskeletal concern, often associated with poor posture, prolonged sedentary behavior, and reduced spinal flexibility. Few preventive programs integrate culturally rooted movement traditions into structured physiotherapy-based interventions. This study aimed to examine changes in spinal flexibility following a culturally adapted Reyog Ponorogo–inspired exercise program among school-aged children. A community-based single-group pre–post design was conducted over three consecutive days at Sanggar Bimbingan Ampang, Malaysia. Seventy-five children aged 8–12 years meeting inclusion criteria participated. The intervention included a 30-minute posture education session followed by structured Reyog-inspired flexibility exercises consisting of warm-up, trunk mobility, rhythmic coordinated movements, and stretching. Spinal flexibility was assessed using the Sit-and-Reach Test before and after the intervention. Data were analyzed using descriptive statistics and paired-sample t-test. Spinal flexibility improved significantly, increasing from  $17.24 \pm 2.08$  cm to  $18.57 \pm 1.69$  cm (mean difference = 1.33 cm;  $p < 0.001$ ). These findings suggest that a short-term culturally adapted movement program was associated with improved spinal flexibility in school-aged children. Further controlled and longitudinal studies are needed to determine long-term sustainability.

## Keywords

Reyog Ponorogo, Low back pain, Spinal flexibility, Cultural-based intervention, Preventive physiotherapy, Children

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## Introduction

Low back pain (LBP) is no longer an issue experienced exclusively by adults. In recent decades, its prevalence among school-aged children has increased significantly [1]. This condition is closely associated with lifestyle changes that reduce physical activity and increase sedentary behavior from an early age. Several factors contribute to the emergence of LBP in children [2]. Prolonged sitting during school hours, excessive use of digital devices, and limited opportunities for active play negatively affect spinal alignment and mobility [3]. In addition, carrying schoolbags that are too heavy or worn asymmetrically places excessive mechanical stress on the spine [4].

Poor postural habits during childhood may result in decreased spinal flexibility and muscle imbalance [5]. If these conditions are not addressed early, they can lead to postural deviations, reduced functional capacity, and a higher risk of developing chronic musculoskeletal disorders in adulthood [6]. Early prevention is therefore essential to maintain optimal musculoskeletal health. Physiotherapy plays a crucial role in preventing musculoskeletal problems through movement-based interventions [7]. Preventive physiotherapy emphasizes movement education, postural awareness, flexibility training, and the development of healthy movement habits [8]. In children, such interventions should be introduced early to support normal growth and functional development [9].

However, preventive programs for children must be engaging, age-appropriate, and enjoyable to ensure participation and long-term adherence [10]. Approaches that fail to consider children's interests and cultural background may result in low motivation and limited effectiveness. One innovative strategy to enhance engagement is the integration of traditional cultural movements into structured exercise programs [11]. Cultural-based physical activities can serve as meaningful and enjoyable forms of exercise while simultaneously strengthening cultural identity and social connection [12].

Reyog Ponorogo is a traditional Indonesian performing art originating from Ponorogo, East Java [13]. It is characterized by expressive dance, rhythmic patterns, and coordinated body movements that actively involve the spine, pelvis, and lower extremities. These movements demand flexibility, balance, strength, and postural control. From a physiotherapy perspective, many Reyog Ponorogo movements resemble therapeutic exercises commonly used to improve spinal mobility, core stability, and musculoskeletal coordination. This similarity highlights the potential of Reyog-based movements as a preventive exercise modality for children [14].

Incorporating Reyog Ponorogo into health promotion activities offers a dual benefit. It allows the preservation and transmission of cultural heritage while simultaneously addressing modern health challenges, particularly those related to sedentary lifestyles and musculoskeletal health [15]. In the context of Indonesian diaspora communities, particularly children attending community learning centers such as Sanggar Bimbingan Ampang in Malaysia, structured health promotion programs addressing

musculoskeletal health are still limited. Informal observations indicated that many children spend prolonged hours sitting during academic activities and engaging with digital devices, while opportunities for structured physical exercise remain minimal. Furthermore, health education related to spinal posture and preventive physiotherapy has not been systematically introduced in this setting. Without early intervention, these patterns may increase the risk of reduced spinal flexibility and future musculoskeletal complaints. Therefore, there is a clear need for an age-appropriate, culturally relevant, and engaging preventive program that not only addresses postural awareness and spinal flexibility but also resonates with children's social and cultural identity. Integrating Reyog Ponorogo into a structured exercise framework offers a contextually meaningful solution that responds to both health and cultural preservation needs. The program focused on combining health education with culturally relevant physical activity [16]. The specific objectives of this activity were: (1) to increase children's knowledge and awareness regarding spinal health and proper posture; (2) to introduce Reyog Ponorogo-based exercise as a culturally appropriate and preventive strategy for low back pain; and (3) to foster appreciation of Indonesian culture among children, particularly within the Indonesian diaspora community in Malaysia.

## Method

### *Study design and approach*

This program employed a community-based participatory intervention design with a pre–post evaluation model. The approach emphasized active engagement, empowerment, and culturally adapted movement-based health promotion.

### *Setting and participants*

The activity was conducted at Sanggar Bimbingan Ampang, Malaysia, from August 13–15, 2025. A total of 75 school-age children aged 8–12 years participated in the program. Inclusion criteria were: (1) no diagnosed musculoskeletal disorders; (2) no acute low back pain at the time of assessment; (3) ability to participate in moderate physical activity; and (4) parental consent. Children with recent injuries or medical conditions restricting physical activity were excluded.

### *Program implementation*

The intervention was delivered over three consecutive days. Each daily session lasted approximately 90 minutes and consisted of three structured components:

1. Health Education (30 minutes). Delivered through interactive lectures and poster-based visual materials covering spinal anatomy, proper sitting posture, and the importance of flexibility in preventing low back pain.
2. Reyog-Inspired Exercise Training (45 minutes). Participants performed structured flexibility exercises adapted from Reyog Ponorogo movements. The session included a 10-minute warm-up, 25-minute core trunk mobility and rhythmic coordinated

movements, and a 10-minute cool-down stretching phase. Exercises focused on trunk flexion, extension, lateral bending, balance, and postural control.

3. Cultural Reflection and Reinforcement (15 minutes). A guided discussion on the philosophy and cultural meaning of Reyog Ponorogo to enhance engagement and cultural appreciation.

### *Measurement instruments and evaluation*

Spinal flexibility was assessed using the Sit-and-Reach Test, measured in centimeters. Each participant performed two trials, and the highest score was recorded for analysis. Assessments were conducted before the first session (pre-test) and after completion of the three-day program (post-test). Pre- and post-test scores were analyzed descriptively to determine mean differences. Program effectiveness was evaluated using a pre–post comparison model, with additional observational assessments used to summarize participant engagement and improvements in postural awareness.

## Results and Discussion

Children showed improved flexibility scores from 14.2 cm to 19.8 cm. The cultural approach through Reyog movements enhanced engagement and motivation. This aligns with the Health Belief Model, where cultural cues act as motivators for behaviour change. Similar studies confirm that integrating local culture improves health education effectiveness. Therefore, Reyog-based exercise is a promising model for cultural physiotherapy education [17].

### Results

A total of 75 participants completed both pre- and post-intervention assessments. Spinal flexibility was measured using the Sit-and-Reach Test before and after the three-day Reyog Ponorogo-based exercise program (Table 1). Descriptive analysis demonstrated an increase in flexibility following the intervention. The mean pre-intervention score was  $17.24 \pm 2.08$  cm, while the mean post-intervention score increased to  $18.57 \pm 1.69$  cm. The average improvement in flexibility was 1.33 cm.

Inferential analysis using a paired-sample t-test revealed a statistically significant difference between pre- and post-intervention scores ( $t(74) = 16.40$ ,  $p < 0.001$ ). The mean difference was 1.33 cm with a 95% confidence interval ranging from 1.17 to 1.49 cm. The calculated effect size was very large (Cohen's  $d = 1.89$ ), indicating a substantial practical impact of the three-day exercise intervention on spinal flexibility among participants.

**Table 1.** Pre–post comparison of spinal flexibility following a three-day Reyog Ponorogo exercise program (n = 75)

Outcome Measure	Pre-test Mean $\pm$ SD (cm)	Post-test Mean $\pm$ SD (cm)	Mean Difference (95% CI)	t (df=74)	p-value	Cohen's d
Sit-and-Reach Test	$17.24 \pm 2.08$	$18.57 \pm 1.69$	1.33 (1.17–1.49)	16.40	<0.001	1.89

## Discussion

The present study demonstrated a statistically significant improvement in spinal flexibility following a three-day Reyog Ponorogo-based exercise program among school-aged children. The mean Sit-and-Reach score increased by 1.33 cm with a very large effect size (Cohen's  $d = 1.89$ ), indicating a substantial short-term change in flexibility performance associated with participation in the culturally adapted movement intervention.

The observed improvement in flexibility aligns with evidence from school-based physical activity interventions showing that structured movement programs can enhance flexibility in children [18]. For instance, interventions incorporating physical activity as part of a school curriculum have been shown to significantly improve Sit-and-Reach performance and other physical fitness components, underscoring the capacity of targeted movement protocols to influence musculoskeletal outcomes in young populations [19]

From a biomechanical perspective, dynamic and rhythmic movements such as those adapted from Reyog Ponorogo likely stimulated repeated stretching and active elongation of the hamstring and lower back muscle groups. Repeated active movement patterns enhance muscle-tendon unit extensibility and joint range of motion, which are foundational mechanisms underlying flexibility improvements in pediatric populations. Chronic physical activity interventions have been shown to significantly improve flexibility quality among children, with greater benefits observed in programs of adequate frequency and duration [20].

Although flexibility was the primary quantified outcome in this study, broader evidence indicates that physical activity interventions can positively affect additional musculoskeletal and functional outcomes. Systematic review evidence suggests that exercise programs contribute to improvements in posture and trunk mobility in adolescents, which supports the rationale for integrating movement-based strategies into preventive health initiatives for posture-related issues [21].

The cultural foundation of this program appears to have enhanced participant engagement, consistent with behavioural frameworks such as the Health Belief Model that emphasize the motivational role of culturally relevant cues in promoting health behaviors. Embedding health interventions within familiar cultural contexts may help increase intrinsic motivation and reduce barriers to participation, thereby supporting sustained involvement.

However, several limitations should be acknowledged. The absence of a control group restricts the ability to infer causality, and the short duration of the intervention limits conclusions regarding long-term sustainability. Additionally, only spinal flexibility was measured; other relevant outcomes such as muscle strength, balance, and pain prevalence were not assessed. Future studies employing controlled, longitudinal

designs and assessing a broader range of outcomes are recommended to strengthen the evidence for culturally grounded physiotherapy interventions.

In summary, the findings indicate that a short-term Reyog Ponorogo–based movement program was associated with significant improvements in spinal flexibility among children. These results provide preliminary support for the integration of culturally adapted physical activities into preventive physiotherapy initiatives in school settings, highlighting the potential of traditional movement forms to contribute to child musculoskeletal health.

## Conclusion

This study found that a three-day Reyog Ponorogo–based exercise program was associated with significant improvements in spinal flexibility among school-aged children. The results suggest that culturally adapted movement interventions may contribute to short-term enhancements in musculoskeletal flexibility within school settings. The integration of traditional movements into structured exercise sessions also demonstrated practical feasibility and high engagement, indicating potential value for culturally grounded preventive physiotherapy initiatives. However, due to the absence of a control group and the short duration of the intervention, conclusions regarding long-term effectiveness and causality cannot be established. Future studies employing controlled designs and extended follow-up periods are recommended to further evaluate the sustainability and broader musculoskeletal impact of culturally adapted exercise programs.

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