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Effects of Resistance Band Exercise on Flexibility among Children Aged 6–7 Years: A Quasi-Experimental Study

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Abstract. Flexibility is an important component of physical fitness that supports children's movement abilities. This study aimed to examine the effect of resistance band gymnastics on flexibility among children aged 6–7 years. A quantitative approach with a pretest–posttest control group design was employed. The participants consisted of 40 first-grade students divided into an experimental group and a control group, with 20 students in each group. The experimental group participated in a resistance band gymnastics program for 12 sessions conducted three times per week, whereas the control group followed regular physical education activities. Flexibility was measured using the sit-and-reach test. The experimental group's mean score increased from −3.68 cm at pretest to 3.88 cm at posttest, representing an improvement of 7.56 cm. The control group's mean score increased from 0.13 cm to 0.70 cm, representing an improvement of 0.57 cm. The results indicate that the experimental group experienced a greater improvement in sit-and-reach performance than the control group. Therefore, resistance band gymnastics may be used as an alternative activity to improve hamstring and lower-back flexibility among children aged 6–7 years.

Keywords: children; flexibility; physical education; resistance band gymnastics; sit-and-reach test

INTRODUCTION

Flexibility is an important component of health-related physical fitness that contributes to joint mobility, movement efficiency, and the ability to perform various physical activities. In early elementary school, flexibility also supports children's performance of fundamental movements, including bending, reaching, balancing, running, and jumping. Evidence indicates that fundamental movement skills are positively associated with several components of health-related physical fitness in children and adolescents, although the strength of these relationships differs across fitness components (Liu et al., 2023). In addition, the development of fundamental movement skills is closely associated with children's participation in physical activity, suggesting that movement competence and physical fitness develop through mutually reinforcing processes (Xin et al., 2020).

Children aged 6–7 years are at an important stage of motor development. During this period, children continue to acquire and refine fundamental movement skills that form the basis for participation in more complex physical activities and sports. However, optimal development does not occur solely through biological maturation. Children require structured, developmentally appropriate, repetitive, and enjoyable movement experiences. Evidence regarding long-term trends in youth fitness also indicates that several components of children's physical fitness have declined or shown inconsistent development over time, highlighting the importance of providing systematic physical activity from the early school years (Fühner et al., 2021).

Physical education provides an important setting for promoting movement competence and physical fitness because it reaches children with different levels of ability and physical activity experience. A systematic review and meta-analysis involving school-aged populations found that quality-based physical education interventions were associated with improvements in health-related physical fitness and fundamental movement skills. These findings indicate that the quality, structure, and instructional content of physical education may be as important as the amount of lesson time provided (García-Hermoso et al., 2020).

Nevertheless, flexibility development is often addressed only briefly during warm-up or cool-down activities in elementary physical education. Such activities may not provide adequate frequency, progression, repetition, or movement range to produce

meaningful adaptations. Systematic flexibility training has been shown to improve range of motion during both childhood and adolescence. Children may achieve considerable improvements when flexibility exercises are performed consistently and with an appropriate training volume (Donti et al., 2022). Therefore, physical education teachers need activities that are safe, attractive, affordable, structured, and appropriate for the developmental characteristics of young children.

One potential activity is resistance band gymnastics, which combines rhythmic movements with light elastic resistance. Resistance bands are portable, relatively inexpensive, and adaptable to different movements and ability levels. Resistance exercises can be introduced to children when programs use appropriate resistance, correct technique, developmentally suitable activities, and qualified adult supervision. The American Academy of Pediatrics recognizes appropriately designed and supervised resistance training as a potential component of school physical education and youth fitness programs (Stricker et al., 2020).

An umbrella review also found strong evidence that appropriately designed resistance training can improve several components of physical fitness in children and adolescents, although most existing studies have focused on strength, power, speed, and motor performance rather than flexibility (Lesinski et al., 2020). However, resistance exercise does not necessarily reduce flexibility. A systematic review and meta-analysis found that strength training performed through an appropriate range of motion could produce improvements in range of motion comparable to those resulting from stretching interventions (Afonso et al., 2021). Similarly, resistance training has been found to produce positive changes in joint range of motion across different populations and training methods (Alizadeh et al., 2023). Nevertheless, the effects of elastic resistance activities on flexibility, particularly among children aged 6–7 years, remain insufficiently understood.

Resistance band gymnastics may offer two complementary benefits. First, rhythmic movements can create an enjoyable learning environment and encourage children to participate actively. Second, elastic resistance allows the limbs and trunk to move through a controlled range of motion while engaging agonist and antagonist muscle groups. A recent school-based intervention demonstrated that a structured program incorporating games, athletics, and gymnastics significantly improved flexibility and

other physical fitness components in children compared with regular physical education activities (Petrušič & Novak, 2024).

Despite these potential benefits, limited evidence is available regarding resistance band gymnastics specifically designed for early elementary school children. Previous studies have generally involved older children, adolescents, athletes, adults, or resistance programs primarily intended to improve muscular performance. Moreover, few studies have combined elastic resistance with rhythmic gymnastic movements in elementary school physical education.

Accordingly, this study aimed to examine the effect of a 12-session resistance band gymnastics program on the flexibility of children aged 6–7 years at SDN Utan Panjang 03, Kemayoran, Central Jakarta. It was hypothesized that children participating in resistance band gymnastics would demonstrate greater improvements in sit-and-reach performance than children participating in regular physical education lessons.

METHOD

This study employed a quantitative approach using a pretest–posttest control group design. The participants consisted of 40 first-grade students aged 6–7 years from SDN Utan Panjang 03, Kemayoran, Central Jakarta. The participants were divided into two groups: experimental group: 20 students; and control group: 20 students. The experimental group participated in a resistance band gymnastics program for 12 sessions. The intervention was conducted three times per week. Meanwhile, the control group continued to participate in regular physical education activities. Flexibility was measured using the sit-and-reach test and recorded in centimetres. Measurements were conducted before the intervention as a pretest and after the intervention as a posttest. The mean pretest and posttest scores of both groups were compared to identify changes in flexibility after the intervention.

RESULT AND DISCUSSION

Result

The results showed that the experimental group experienced a greater improvement in flexibility than the control group. The experimental group had a mean pretest score of −3.68 cm and a mean posttest score of 3.88 cm. This indicates an average improvement of 7.56 cm. The control group had a mean pretest score of 0.13 cm and a mean posttest score of 0.70 cm. This indicates an average improvement of 0.57 cm.

Table 1. Mean pretest, posttest, and improvement scores

Group	Number of participants	Mean pretest score	Mean posttest score	Mean improvement
Experimental	20	−3.68 cm	3.88 cm	7.56 cm
Control	20	0.13 cm	0.70 cm	0.57 cm

The difference in mean improvement between the experimental and control groups was 6.99 cm. These results indicate that the children who participated in resistance band gymnastics demonstrated a greater improvement in sit-and-reach performance than those who participated in regular physical education activities. The negative pretest score in the experimental group indicates that, before the intervention, the participants had not reached the reference point of the sit-and-reach measurement. After 12 intervention sessions, the mean score increased to a positive value, indicating improvement in hamstring and lower-back flexibility.

Discussion

This study examined changes in sit-and-reach performance among children aged 6–7 years following 12 sessions of resistance band gymnastics conducted three times per week. The experimental group's mean score increased from −3.68 cm at the pretest to 3.88 cm at the posttest, representing an improvement of 7.56 cm. In comparison, the control group's mean score increased from 0.13 cm to 0.70 cm, representing an improvement of 0.57 cm. Thus, the mean improvement observed in the experimental group was 6.99 cm greater than that observed in the control group. These descriptive findings indicate that children who participated in resistance band gymnastics experienced a greater improvement in sit-and-reach performance than those who followed regular physical education activities.

The improvement in the experimental group may be associated with the structured and repeated nature of the intervention. The program was conducted three times per week for a total of 12 sessions, providing the children with regular exposure to movements involving controlled muscle tension and joint movement. Systematically designed physical education interventions tend to produce more favourable improvements in children's fitness and movement skills than activities that merely increase lesson duration without improving instructional quality (García-Hermoso et al., 2020). Similarly, school-based interventions that include structured games, gymnastics, and other planned

physical activities have been shown to improve selected components of children's physical fitness, including flexibility (Petrušič & Novak, 2024).

The mean increase of 7.56 cm in the experimental group may also be related to the repeated performance of movements through a relatively broad range of motion. Resistance band exercises require participants to control the movement during both the stretching and returning phases because the tension of the elastic band changes throughout the movement. A systematic review and meta-analysis found that resistance training performed through an appropriate range of motion can improve joint range of motion rather than reduce flexibility (Alizadeh et al., 2023). Another meta-analysis reported that strength training and stretching produced comparable improvements in range of motion, suggesting that appropriately performed resistance exercises may contribute to flexibility development even when conventional stretching is not the main component of the program (Afonso et al., 2021).

Although these findings support the potential contribution of resistance exercise to flexibility, evidence from adult populations should be applied cautiously to children aged 6–7 years. The physiological, anatomical, and motivational characteristics of young children differ from those of adults. Nevertheless, systematic stretching research involving children and adolescents has shown that repeated flexibility training can increase range of motion during childhood. Children may also demonstrate substantial improvements when flexibility activities are delivered with sufficient frequency and training volume (Donti et al., 2022). The schedule used in the present study—three sessions per week—may therefore have provided adequate repetition to produce observable changes in sit-and-reach performance.

The children's developmental stage may also have contributed to the observed improvement. At 6–7 years of age, children are continuing to refine fundamental movement skills and develop physical fitness components that support more complex movement performance. Flexibility is associated with movement competence, although the relationship is not as consistent as the relationships involving muscular strength, endurance, and cardiorespiratory fitness. A systematic review by Liu et al. (2023) found that most of the included studies supported a positive relationship between fundamental movement skills and flexibility in children and adolescents. Therefore, activities that develop controlled movement and range of motion may support broader participation in

physical education, although the present study did not directly measure fundamental movement skills.

The use of resistance bands may be particularly suitable for school-based activities because the equipment is portable, adaptable, and capable of providing light external resistance. Current pediatric guidance indicates that resistance activities can be used safely with children when the exercises are developmentally appropriate, use suitable resistance, emphasize correct technique, and are properly supervised (Stricker et al., 2020). The purpose of resistance exercise for young children should not be maximal lifting or competition, but rather the development of movement control, physical fitness, confidence, and positive exercise experiences.

Evidence concerning resistance training among young people also suggests that its effectiveness depends on program design. Lesinski et al. (2020) concluded that resistance training can improve several physical fitness outcomes in healthy children and adolescents. However, the outcomes are influenced by factors such as training frequency, intensity, duration, supervision, and the participants' developmental level. Although flexibility was not the main focus of most studies included in that review, the evidence supports the use of structured and supervised resistance-based activities as part of youth physical fitness programs.

Resistance band gymnastics may differ from conventional resistance training because it combines elastic resistance with rhythmic movement. The rhythmic format may help maintain children's attention and make repeated exercises feel more like play than formal training. This is relevant because young children generally engage more actively when physical activities are enjoyable, varied, and appropriate for their abilities. Structured school-based physical education programs can improve children's fitness when the learning activities are intentionally designed rather than presented as repetitive exercise without a meaningful instructional context (Reis et al., 2024).

The substantial change from a negative to a positive mean score in the experimental group also deserves attention. A pretest mean of −3.68 cm indicates that, on average, the children in the experimental group were unable to reach the reference point of the sit-and-reach apparatus before the intervention. Following the program, their mean score increased to 3.88 cm, indicating that the average participant was able to reach beyond the

reference point. This suggests an observable improvement in the ability to perform the forward-reaching movement assessed by the test.

However, the sit-and-reach result should not be interpreted as evidence of an improvement in whole-body flexibility. The test mainly reflects the combined contribution of hamstring extensibility, lower-back mobility, hip movement, pelvic positioning, limb proportions, and the ability to perform the testing technique. Consequently, the observed change should be described as an improvement in sit-and-reach performance or hamstring and lower-back flexibility rather than a comprehensive improvement in all aspects of flexibility. Studies assessing physical fitness in children commonly use the sit-and-reach test because it is simple and practical, but its scores must be interpreted according to the specific movement assessed (Liu et al., 2023).

The control group also demonstrated a small increase of 0.57 cm. This change may be associated with regular physical education participation, normal daily physical activity, natural variation in test performance, or increased familiarity with the sit-and-reach procedure. Children may perform better during the second assessment because they better understand the instructions and movement requirements. Nevertheless, the improvement in the control group was considerably smaller than the 7.56 cm improvement observed in the experimental group.

The findings are consistent with the broader literature indicating that structured school-based programs can influence children's physical fitness. Petrušič and Novak (2024) found that a 16-week program involving structured games, athletics, and gymnastics improved flexibility among children aged 8–9 years. Although their intervention duration and participant age differed from those in the present study, both studies indicate that planned and repeated school activities may produce better fitness outcomes than regular physical education activities alone.

The present results also support the principle that the quality of an intervention is important. García-Hermoso et al. (2020) reported that quality-oriented physical education interventions were associated with improvements in physical fitness and fundamental movement skills. This suggests that the content, organization, feedback, and progression of an activity may be more influential than simply increasing physical education time. Resistance band gymnastics may provide a focused stimulus because the movements are

specifically arranged and repeated rather than performed incidentally during general physical education.

Nevertheless, the findings should be interpreted cautiously. The experimental group began with a lower mean score than the control group. The experimental group's pretest mean was −3.68 cm, whereas the control group's pretest mean was 0.13 cm. Participants with lower initial performance may have had more opportunity for improvement. Therefore, the greater change in the experimental group cannot be attributed entirely to the intervention without considering the difference in baseline scores.

The study also involved only 40 children from one elementary school. The findings therefore represent the participants included in this study and should not be generalized automatically to children from different schools, age groups, or educational settings. School-based physical activity research increasingly emphasizes that interventions should be adapted to the characteristics, resources, and conditions of individual schools rather than assumed to have identical effects in every setting (Jago et al., 2023).

Another consideration is the duration of the program. The intervention consisted of 12 sessions conducted over approximately four weeks. The descriptive improvement suggests that changes in sit-and-reach performance may occur after a relatively short structured program. However, the study did not include a follow-up assessment; consequently, it is not known whether the improvement was maintained after the program ended. Longer interventions and follow-up measurements would be necessary to determine whether resistance band gymnastics produces lasting improvements.

The absence of individual participant data and measures of variability also limits the interpretation of the findings. Mean scores provide an overview of group performance, but they do not show whether all participants improved consistently or whether the result was influenced by a smaller number of children with large improvements. Therefore, the present discussion is based on descriptive group-level changes and should not make claims concerning the magnitude or statistical significance of the effect.

Despite these limitations, the results provide preliminary support for resistance band gymnastics as a practical activity for early elementary physical education. Resistance bands are relatively easy to store and can be incorporated into rhythmic, game-

based, or teacher-led movement activities. Their use should nevertheless be accompanied by clear demonstrations, adequate spacing, light resistance, equipment inspection, and close teacher supervision. Pediatric recommendations emphasize that safe resistance activities for children require developmentally appropriate instruction and attention to movement technique rather than heavy loading (Stricker et al., 2020).

Overall, the greater descriptive improvement in the experimental group suggests that 12 sessions of resistance band gymnastics may support the development of sit-and-reach performance in children aged 6–7 years. The results are consistent with research showing that structured physical education, systematic flexibility activities, and resistance exercises performed through an appropriate range of motion can contribute to improvements in physical fitness and mobility. However, the interpretation should remain limited to the available group means and the specific flexibility outcome measured in this study.

CONCLUSION

Resistance band gymnastics conducted for 12 sessions, three times per week, was associated with improved sit-and-reach performance among children aged 6–7 years. The experimental group's mean score increased from −3.68 cm at pretest to 3.88 cm at posttest, representing an improvement of 7.56 cm. In comparison, the control group's mean score increased from 0.13 cm to 0.70 cm, representing an improvement of 0.57 cm. These findings indicate that resistance band gymnastics may be used as an alternative physical education activity to improve hamstring and lower-back flexibility in young elementary school children. The activity is simple, practical, and can be integrated into structured physical education lessons.

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