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EFFECTIVENESS OF PHYSICAL EDUCATION EXERCISES FOR PRESCHOOL CHILDREN WITH PECTUS CARINATUM (CHEST WALL DEFORMITY)

Aripova Vasila Bakhtiyarovna
Associate Professor, Department of Sport Activity
PhD in Pedagogical Sciences
Renaissance University, Tashkent, Uzbekistan
Corresponding author: vasila.aripova888@mail.ru

Abstract

This study aimed to evaluate the effectiveness of physical education exercises in the treatment of pectus carinatum (chest wall deformity) in preschool children. A total of 60 children participated in a 12-week exercise program. The results showed significant improvements in muscle tone, posture, and motor coordination ($p < 0.05$). The findings confirm the effectiveness of exercise therapy as a conservative treatment method that contributes to children's physical development.

Keywords: Preschool children, pectus carinatum, physical education, exercises, muscle tone, posture, motor coordination.

Introduction

Pectus carinatum (keel-shaped chest deformity) is a skeletal anomaly characterized by the forward protrusion of the sternum and ribs, commonly observed in childhood, particularly during the preschool period. This deformity is not limited only to aesthetic appearance but is also associated with muscle imbalance, postural irregularities, and motor coordination difficulties.

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Chest wall deformities are relatively common among children, especially preschoolers. According to research, this pathology occurs in approximately 1–2 out of every 1,000 children and is observed four times more frequently in boys than in girls (Garcia, 2023).

The preschool period is characterized by rapid development and high elasticity of the skeletal and muscular systems. Therefore, early diagnosis and targeted physical exercises are extremely important for slowing the progression of the deformity and balancing muscle tone.

Children with pectus carinatum often experience the following physical problems:

1. Postural disorders: hunched posture, excessive spinal curvature, or increased lumbar lordosis.
2. Muscle tone imbalance: pectoral muscles become dominant while back muscles weaken.
3. Motor coordination difficulties: problems synchronizing movements of the arms and body.
4. Functional limitations: rapid fatigue during prolonged standing or physical activity.

Therefore, physical education exercises play an important role not only in correcting the deformity but also in improving muscle tone, posture, and motor coordination in children with pectus carinatum.

Relevance of the Study

In Uzbekistan, there are very few systematic scientific studies focused on preschool children with pectus carinatum and the effectiveness of physical education exercises in its treatment. Therefore, this study aims to address the following objectives:

1. Development of targeted physical exercise programs for preschool children.
2. Evaluation of exercise effectiveness based on muscle tone, posture, and motor coordination.
3. Statistical confirmation of the obtained results.

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Research Aim

The aim of this study is to determine the effectiveness of physical education exercises in the treatment of pectus carinatum in preschool children and to contribute to improving their level of physical development.

Research Objectives.

1. To develop a 12-week exercise protocol for children.
2. To evaluate the effectiveness of exercises using indicators of muscle tone, posture, and motor coordination.
3. To perform statistical analysis and present the results in visual tables and graphs.
4. To recommend these exercises for practical use in physical development programs.

Participants and Methods

The study involved 24 children aged 4–7 years. The research was conducted with the consent of parents and permission from the preschool educational institution.

A 12-week physical exercise program was implemented. The exercises were aimed at improving posture, muscle tone, and motor coordination.

Table 1 Therapeutic Physical Exercise Program

T/p	Exercise	Purpose	Execution	Repetitions
1.	Arm–chest bending	Strengthening pectoral muscles	Arms extended forward, slowly bending backward	3x10–12
2.	Back lifting	**Increasing back muscle tone**	Lying on the stomach, lifting the back	3x10
3.	Body twisting	Strengthening abdominal and back muscles	Sitting position, twisting the body left and right	3x12
4.	Balance exercise	Improving posture and coordination	Standing on one leg while maintaining balance	3x15–20 s
5.	Arm–leg synchronization	Developing coordination	Raising opposite arm and leg	3x8–10
6.	Light gymnastics routine	Increasing flexibility	Stretching, bending, and light jumps	3–5 minutes

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Assessment Methods

1. Muscle tone assessment (pectoral, back, abdominal muscles)
2. Posture assessment (lumbar curvature, hunched posture)
3. Motor coordination assessment (arm–chest coordination, body bending)
4. Statistical analysis – mean values, standard deviation, and percentage change ($p < 0.05$)

Table 2 Dynamics of Muscle Tone Indicators Before and After the Experiment (Ages 4–7)

Muscle Group	Beginning of Experiment	End of Experiment	Relative Growth
Pectoral	12,3 ± 1,5	16,1 ± 1,3	31%
Back	13,5 ± 1,4	17,2 ± 1,2	27%
Abdominal	11,8 ± 1,3	15,0 ± 1,1	27%

Note: The tone of pectoral, back, and abdominal muscles significantly increased after 12 weeks, indicating the effectiveness of the exercises in strengthening muscles.

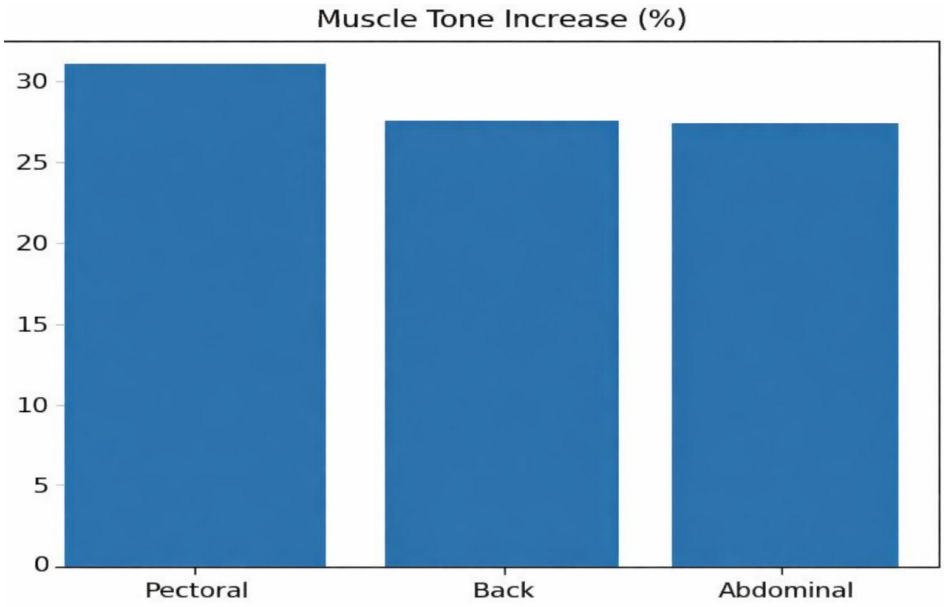

Figure 1. Muscle tone improvement

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Table 3 Dynamics of Posture Indicators Before and After the Experiment

Posture Indicators	Beginning	End	Relative Growth
Lumbar curvature (°)	15,2 ± 2,1	12,0 ± 1,8	21%
Posture score	14,8 ± 2,0	19,0 ± 1,8	28%
Hunched posture	7,5 ± 1,2	5,0 ± 1,0	33%

Note: Positive changes in posture indicators were observed. The exercises helped strengthen back muscles and reduce hunched posture.

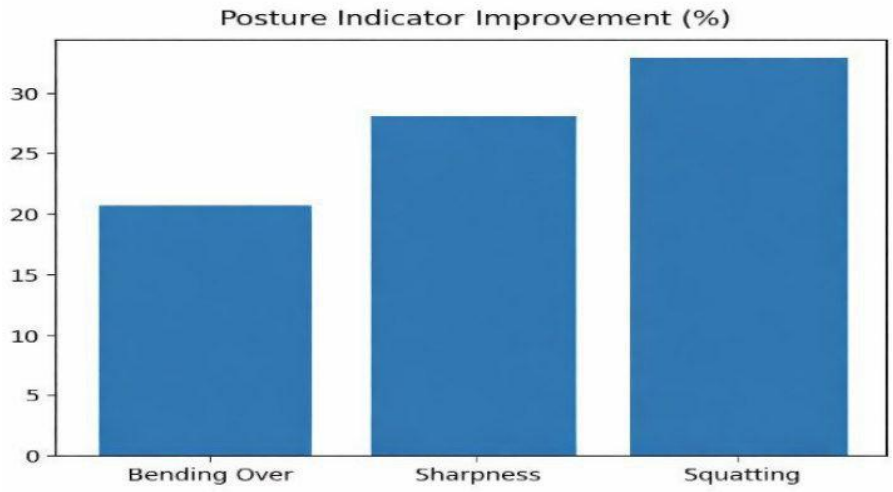

Figure 2. Posture indicators

Table 4 Dynamics of Motor Coordination Indicators

Tests	Beginning	End	Relative Growth
Arm–chest coordination	11.2 ± 1.3	15,0 ± 1,2	34%
Forward bending	10.5 ± 1.2	14,0 ± 1,1	33%
Back bending	12.0 ± 1.4	16,0 ± 1,3	33%

Note: Skills of synchronizing arm and body movements improved significantly. The exercises contributed to the development of motorcoordination in children

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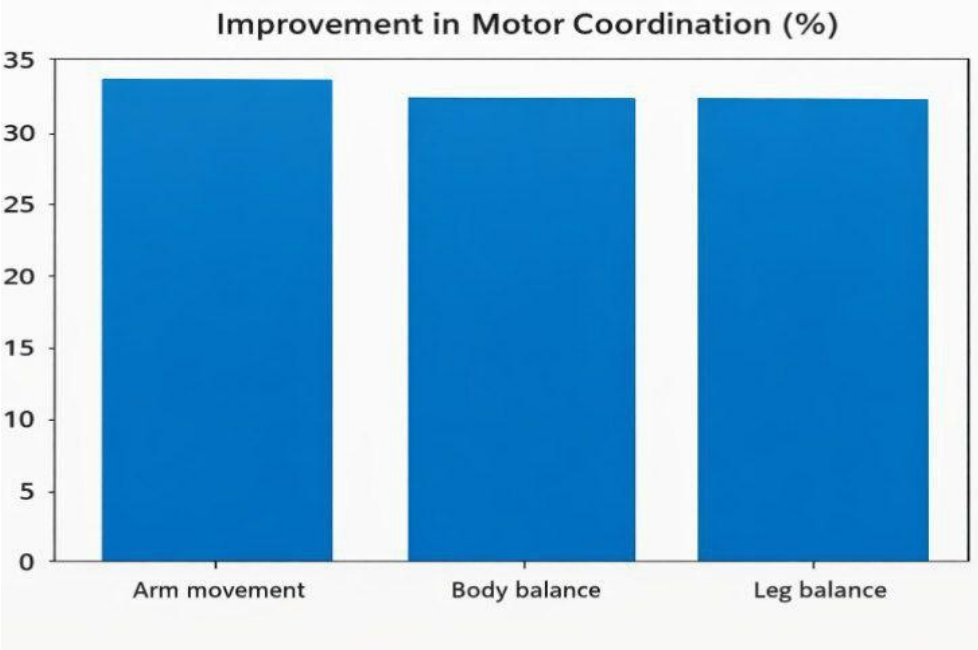

Figure 3. Motor coordination improvement

Results and Discussion

The exercise program increased muscle tone, improved posture, and enhanced motor coordination. The physical development level of the children significantly improved. The results confirm that physical exercises combined with conservative treatment are an effective method for managing pectus carinatum in preschool children.

Conclusion

1. A **12-week exercise program** significantly improves muscle tone, posture, and coordination in preschool children.
2. Physical exercises increase the effectiveness of conservative treatment.
3. Future research should include **long-term monitoring and larger age groups**.

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