



# Improving physical performance in children with congenital clubfoot

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## Summary

**Introduction.** Pre-school period is one of the most crucial periods of human life in the formation of physical health and cultural skills to ensure the improvement, strengthening and preserving the future.

**Materials and methods.** The study involved 68 pre-school children with congenital clubfoot: control group 1 (n = 34) and main group (n = 34) and healthy children (n = 34), who are the control group 2. At the beginning of the study the average age of children was 4-5 years. Children of the main group were constantly engaged in physical rehabilitation under the developed program. Participants of the control group were massaged and had a medical gymnastics twice a year.

**Results.** The study improved physical performance in the main group: high at 14,71%, good in 52,94%, 32,35% in average. There was no significant increase in physical performance in the control groups. In the control group (number 2) good physical performance in the beginning of the study was 32,35% and it increased to 41,18% at the end of the study. In the control group (number 1) a good physical performance was at the beginning of 26,47%, and went up to 29,41%. Minor improvement of physical performance in children of control groups may have occurred even by reducing heart rate at rest.

**Conclusion.** Average physical performance in the main group at the end of the study was  $5,76 \pm 0,28$  ( $p < 0,05$ ), corresponding to a good level of physical performance and demonstrates the effectiveness of the use of physical rehabilitation.

**Key words:** physical performance, congenital clubfoot, children, physical rehabilitation

## Streszczenie

**Wstęp.** Wiek przedszkolny jest jednym z najbardziej przełomowych okresów życia człowieka w kształtowaniu zdrowia fizycznego i nawyków zdrowotnych, zapewniających poprawę, wzmocnienie i zachowanie zdrowia w przyszłości.

**Materialy i metody.** W badaniu udział wzięło 68 dzieci z wrodzoną stopą końsko-szpotawą, (które podzielono na 2 grupy; podstawową i kontrolną 1 – liczące po 34 osoby) i 34 dzieci zdrowych (grupa kontrolna 2). Dzieci grupy podstawowej przez cały okres obserwacji poddane były zabiegom rehabilitacyjnym według opracowanego programu. Dzieci grup kontrolnych miały zabiegi masażu i ćwiczenia usprawniające jedynie 2 krotnie w ciągu roku. Do oceny wyników użyto metoda Rufye.

**Wyniki.** Badanie sprawności fizycznej u dzieci grupy podstawowej wykazało znaczącą poprawę po zakończeniu terapii: wysoką u 14,71%, dobrą u 52,94%, średnią u 32,35% dzieci. W grupie kontrolnej 2 – dzieci zdrowych nie było znaczącego wzrostu sprawności fizycznej, która była dobra na początku badania u 32,35%, pod koniec badania uległa poprawie do 41,18%, u dzieci ze średnią sprawnością na początku wynoszącą 38,24% uległa ona poprawie do 41,18%, zaś ocena dostateczna, którą stwierdzono na początku u 29,41% z nich, w badaniu końcowym zmalała do poziomu 17,65%. U dzieci grupy kontrolnej 1 dobra sprawność fizyczna na początku stwierdzana była u 26,47%, zaś pod koniec badań u 29,41%, sprawność średnia na początku stwierdzano u 41,18%, pod koniec badania u 55,88%, sprawność dostateczna z początkowej 29,41%, w badaniu końcowym wyniosła 14,71%.

**Wnioski.** Średni wskaźnik sprawności fizycznej w grupie podstawowej w badaniu końcowym wynosił  $5,76 \pm 0,28$  ( $p < 0,05$ ), co odpowiada poziomowi wysokiemu i potwierdza skuteczność zastosowanego postępowania rehabilitacyjnego ocenianego metodą Rufye'go. Natomiast nieistotną poprawę sprawności dzieci grup kontrolnych należy wiązać z ich dorastaniem.

**Słowa kluczowe:** sprawność fizyczna, wrodzona stopa końsko-szpotawa, dzieci, rehabilitacja

## INTRODUCTION

Pre-school period is one of the most crucial periods of human life in the formation of physical health and cultural skills to ensure the improvement, strengthening and preserving the future. It is proved nowadays that: 40% of diseases, that the adults have, were „embedded” in childhood, at the age of 5-7 years. Therefore, pre-school physical education should form a health level and principles of physical education of the future adult. It is important to improve the overall children’s performance, taking into account the peculiarities of the child’s body development. Tasks have the concrete form: to promote the correct and timely ossification, the formation of the spine curvature, promotion of the proper development of thermoregulation, improvement of the activity of the central nervous system: to promote balance of excitation and inhibition, their mobility, and improve of motor analyzer senses.

Clubfoot is a combined foot deformity in which the foot is tuck inside, is in the position of plantar flexion, the forefoot is in significant reduction. Skin of the foot surface is greatly thickened, the inner surface is more delicate and soft. Among congenital orthopedic deformities the clubfoot along with hip dysplasia takes the leader place. The clubfoot is twice as common for boys (62%) on 1000-1100 births and it is more often bilateral (59%) than unilateral.

In 10% clubfoot is combined with other disabilities (webbing, amniotic constriction, torticollis, etc.). There are many factors that could be the cause of such cases: genetic, endogenous and exogenous.

According to most authors deformations are considered as a deviation of the normal development of the fetus. The congenital clubfoot is characterized by changes in forms of foot bones, mainly of the astragalus. Because of the foot deformity after birth soft tissues, tendons and ligaments are changed, bone changes appeared much later. As a result of the foot reduction, flexion and supination the development of the talus is breached – cervix is being extended and turns inside, heel bone pulls up, its inner surface is closer to the medial malleolus. Thickened deltoid ligament and plantar flexion are the significant obstacle to correct deformity. Neglected clubfoot affects the physical, social, psychological and financial state of children and their families. On the global scale, neglected clubfoot is the most serious case of physical disability among congenital musculoskeletal defects. In severe degrees of clubfoot the surgery operations are essential, after such measures there are complications and they further disturb patients.

## METHODS

The study involved 68 pre-school children with congenital clubfoot: control group 1 (n = 34) and main group (n = 34) and healthy children (n = 34), who are the control group 2. At the beginning of the study the average age of children was 4-5 years old. Children of the main group were constantly engaged in physical rehabilitation under

the developed program. Participants of the control group were massaged and had a medical gymnastics twice a year.

Children of the main group were trained according to the integrated ongoing program of physical rehabilitation and included various exercises: physical (for development of mobility and functional status of shin joint), rehabilitative, therapeutic also included physiotherapy procedures, therapeutic massage and orthopedic products (varieties of tutors, Brace, orthopedic shoes). Physical rehabilitation program was aimed at correcting the incorrect position of the foot, increase joint mobility, improve the function of feet, strengthening the muscles of the legs, correction of foot wrong when walking to develop general physical health of children, prevention of recurrence, to improve the anthropometric foot indices (ratio of the height to the length of the foot, the ratio of the foot length to its). To teach parents of the practical skills of physical rehabilitation at home, different methods of therapeutic massage and exercises for stretching were used. Parents were actively involved to the recovery process.

During the survey the parents were actively involved to the process of physical rehabilitation of children with congenital clubfoot, parents were treated as partners, so we always conducted the information work with parents. The psychological work with parents was actively conducted.

In the *introductory period* of physical rehabilitation we focused on correcting of abnormal foot position, mastering of skills to fulfill different exercises in walking, running, jumping, exercises on balance, the formation of motor skills, pre-study exercises.

In the *main period* of physical rehabilitation it was focused on increasing of mobility and improving of ankle joint functional status, strengthening the muscles of the lower extremities, promotion of good general physical development of children, improving of anthropometric indicators of the foot, the development of physical disability.

In the *final period* of physical rehabilitation we focused on consolidation of acquired skills of physical exercises, improving skills and motor actions, prevention of recurrence.

Methods of training: individual and group.

Forms of physical rehabilitation: trainings were aimed at: the development of mobility and improving of the ankle joint functional status, correcting of abnormal foot position, strengthening of the muscles of the lower extremities, correcting of the wrong moves, running, jumping, promotion of the general physical development of children, prevention of recurrence, improving of the anthropometric foot indexes (ratio of height to height to the foot length, the ratio of the foot length to its width), stretching: Achilles tendons, muscles and ligaments of the lower limbs (stretching exercises), physiotherapy, therapeutic massage, orthopedic products (varieties of tutors, brace, orthopedic shoes).

Forms of the work with parents: the open sessions for parents, parents' meetings, „round tables”; conversations (collective, group, individual), visiting parents at home (by the parents wish); conference on experience of conducting studies in physical rehabilitation, holding, consultation of the specialists who worked with the child; training classes for parents in physical rehabilitation, special work with a group of parents, who had problems in conducting classes at home.

Means of physical rehabilitation: general developmental exercises, corrective exercises (on the development of mobility and improving of ankle joint functional status), exercises to strengthen the muscles of the lower limbs, correcting of the wrong moves, running, jumping, promotion of the general physical development, outdoor games, physiotherapy, massage, stretching exercises.

During the study it was defined the initial level of physical performance of preschool children. One of the objective criteria of the child's health is the level of physical performance. High performance is an indicator of good health and vice versa, its lowest values are considered as a risk factor for health.

To determine the physical performance in pre-school children the metoda Rufye was used considering the children's age. The parameter of metoda Rufye is the sum of three heart rates: at rest, during exercises and after the recovery. According to the authors, is linear transformation of HR [2], and the formula is:

$$R = (4 \times (P1 + P2 + P3) - 200) / 10 \quad (1)$$

P1 – number of heartbeat in 15 sec. at rest;  
 P2 – number for the first 15 sec. of the first min. after squats,

P3 – number of the last 15 sec. of the first minute, so, the formula is:

$$R = (f-200) / 10 \quad (2)$$

where

$$f = 4 \times (P1 + P2 + P3) \quad (3)$$

Parameter of correction is the ratio:

$$k = HRp / HRa \quad (4)$$

where HRp and HRa is a normal heart rate at rest of the definite patient's age group and adult. Taking into account the formula (2) we have developed the formula for calculating the index values of metoda Rufye:

$$Rk = (f / k - 200) / 10 \quad (5)$$

The norm of heart rate for children age 4 to 6 is 106 beats/min., (marginal rate is 86-126 beats/min). For adults (age 15 to 50), it is 70 beats/min., (marginal rate is 60-80 beats/min). According to statistical data k (parameter adjustment) was calculated for the group age 4 to 6:

$$k = 106/70 = 1.51 \quad (6)$$

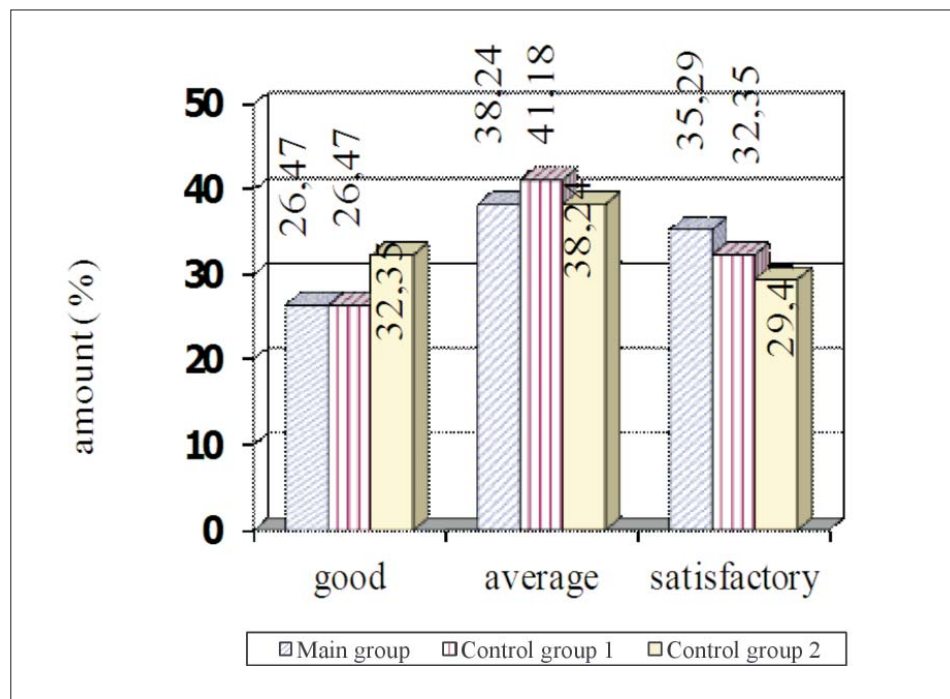
**RESULTS**

To determine the physical performance of pre-school children it was used metoda Rufye sample, taking into account the children's age.

Results of metoda Rufye index were evaluated: less than 3 – high, 4-6 – good, 7-9 – average, 10-14 – satisfactory, 15 – bad performance.

The initial level of the physical performance of children is presented in Fig. 1.

**Fig. 1.** Physical performance at the beginning of the study



At the beginning of the study it was defined:

- good physical performance: in 11 (32.35%) healthy children, and 9 (26.47%) children in the two groups with congenital clubfoot;
- average physical performance: in 13 (38.24%) healthy children, 13 (38.24%) children of the main group and in 14 (41.18%) children of the control group 1;
- satisfactory physical performance: in 10 (29.41%) healthy children, 12 (35.29%) children of the main group and in 11 (32.35%) children of the control group 1.

Test results indicate a slight difference in the level of physical performance of healthy children and children with congenital clubfoot.

Physical rehabilitation of children with congenital clubfoot was aimed not only at this pathology, also had a systematic impact on the body of the child to improve the morphological and functional state, health promotion, the formation of motor skills, improving of the physical performance. Physical development in the preschool years is particularly rapid. So, physical rehabilitation should be timely, methodically organized.

Physical rehabilitation of children with congenital clubfoot cannot be spontaneous, haphazard and conservative on the used forms and techniques. It was organized on the following conditions:

- protection of the nervous system of the child, the rational duty activities, and recreation;
- favorable conditions for the positive emotional state;
- absence of factors that depress the nervous system of the child;
- planning and maintenance, according to the sanitary standards, the premises where the physical rehabilita-

tion is held, therapeutic massage, physiotherapy;

- necessary equipment.

In Fig. 2 the results of determination of physical performance of children of all groups at the end of the study are showed:

At the end of the study children's physical performance was improved in the main group:

- high physical performance had 5 (14.71%) children – at the beginning of the study there was no child with the high physical performance;
- good physical performance: in 18 (52.94%) children – at the beginning of the study there was only 9 (26.47%) children;
- average physical performance: in 11 (32.35%) children.

The children of the control group 1 and control group 2 had no significant increase in physical performance.

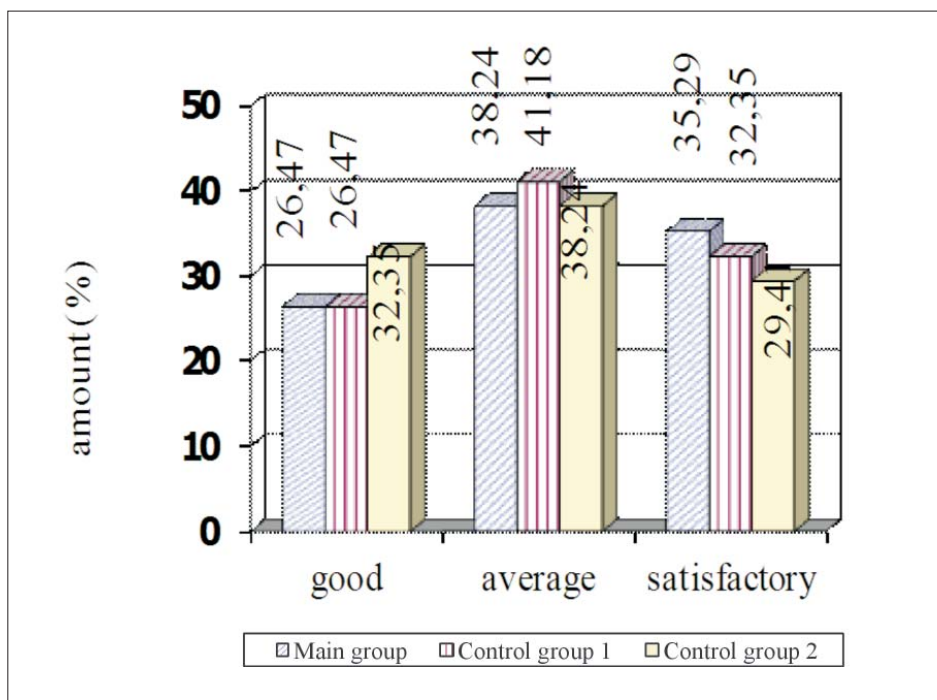
Physical performance of children in the control group 1:

- good physical performance at the beginning of the study was in 9 (26.47%) of the children, at the end of the study – 10 (29.41%) children;
- average physical performance at the beginning of the study was in 14 (41.18%) of the children, at the end of the study – 19 (55.88%) children;
- satisfactory physical performance at the beginning of the study was in 10 (29.41%) of the children, at the end of the study – 5 (14.71%) children.

Physical performance of the healthy children in the control group 2:

- good physical performance at the beginning of the study had 11 (32.35%) children, at the end of the study – 14 (41.18%) children;

Fig. 2. Physical performance at the end of the study



- average performance at the beginning of the study had 13 (38.24%) children, at the end of the study – 14 (41.18%) children;
- satisfactory physical performance at the beginning of the study had 10 (29.41%) children, at the end of the study – 6 (17.65%) children.

Slight improvement of physical performance of the children in the control group 1 and control group 2 was because of children’s growth and reducing of the heart rate.

In Table 1 the average values of metoda Rufye at the beginning and end of the study are given.

At the beginning of the study the average indicator of physical performance in the main group was  $8,69 \pm 0,40$ , in the control group 1 –  $8,37 \pm 0,38$ , in the control group 2 was  $8,20 \pm 0,37$ , in all groups it corresponded to the average level of physical performance.

At the end of the study the average indicators of physical performance in the control group 1 ( $7,79 \pm 0,34$ ) and in the control group 2 ( $7,58 \pm 0,36$ ) did not significantly changed and correspond to the average level of physical performance. Average indicators of physical performance in the main group at the end of the study were  $5,76 \pm 0,28$  ( $p < 0.05$ ), and they respond to a good level of physical performance and prove the efficiency of the use of physical rehabilitation to improve children’s physical performance.

**SUMMARY AND CONCLUSION**

The study was aimed to analyze the comprehensive effects of congenital The study was aimed to analyze the comprehensive effects of congenital clubfoot on the children’s body and to prove the positive impact of in-

tegrated programs of physical rehabilitation of children with congenital clubfoot.

It was also proved the usage of physical rehabilitation to improve physical performance of children. The results of the level of physical performance determining proved that at the beginning of the study there was a slight difference in the level of physical performance of healthy children and children with congenital clubfoot. At the end of the study in the control group 1 and control group 2 there was no significant improvement. After applying of the physical rehabilitation the children of the main group had much higher physical performance (from the average level to the good level), and it proves the efficiency of physical rehabilitation to improve the physical performance.

**CONCLUSIONS**

The study proves the significant dynamics of the improvement of the children’s physical performance in the main group at the end of the study: high physical performance had 5 (14.71%) children – at the beginning of the study there was no child with high physical performance, good physical performance – 18 (52.94%) children (at the beginning of the study – 9 (26.47%) children.

The children of the control group 1 and control group 2 had no significant increase of physical performance.

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**Tab. 1.** Results of determination of children’s physical performance, ( $\bar{x} \pm m$ )

Metoda Rufye		Main group (n=34)	Control group 1 (n=34)	Control group 2 (n=34)
		$\bar{x} \pm m$	$\bar{x} \pm m$	$\bar{x} \pm m$
At the beginning of the study	index	8,69±0,40	8,37±0,38	8,20±0,37
	level	Average	average	Average
At the end of the study	Index	5,76±0,28*, **, ***	7,79±0,34	7,58±0,36
	level	Good	average	Average

Notes. \* – An indicator of reliability of divergence  $p < 0.05$  between the rates at the beginning and end of the study within the group; \*\* – An indicator of reliability of divergence  $p < 0.05$  between the main group and control group 1; \*\*\* – An indicator of reliability of divergence  $p < 0.05$  between the main group and the control group 2.

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