DOI 10.26773/smj.220205

ORIGINAL SCIENTIFIC PAPER

# Bobath Therapy for Cerebral Palsy: An Efficacy Study

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**Abstract**

Cerebral palsy is among the most severe perinatal lesions in the central nervous system and a leading cause of childhood disability. Aim to assess how Bobath therapy affects the motor functions and physical development of preschool children with spastic diplegia cerebral palsy. The study includes 42 (46.7%) boys and 48 (53.3%) girls aged four diagnosed with spastic diplegia. All patients were divided into two comparison groups of 45 children based on the method of physical rehabilitation: children enrolled in a conventional rehabilitation program (control group) and children receiving standard rehabilitation together with Bobath therapy (treatment group). After a course of integrated physical rehabilitation, patients demonstrated an improvement in motor skills: 15 (33.3%) children ($p<0.05$) with GMFCS level 2 improved to level 1, and 16 (35.6%) children ($p<0.05$) with GMFCS level 3 improved to level 2. In the control group, only 6 (13.3%) children ($p<0.05$) with GMFCS level 2 improved to level 1, and 11 (24.4%) children ($p<0.05$) with GMFCS level 3 improved to level 2. The conventional physical rehabilitation combined with Bobath therapy has a positive effect on the motor skills and physical development of children with spastic diplegia cerebral palsy.

***Keywords:*** *physical rehabilitation, cerebral palsy (CP), motor dysfunctions, impairment of the nervous system, Bobath therapy*

## Introduction

At present, perinatal lesions in the central nervous system (CNS) represent an urgent problem in childhood neurology (Bendix, Hadamitzky, Herz, & Felderhoff-Müser, 2019). They are associated with high mortality and disability in children (Novak, Ozen, & Burd, 2018). In general, around 10% of children worldwide experience neuropsychiatric disorders (Bakulski, Halladay, Hu, Mill, & Fallin, 2016; Murden et al., 2019). Brain and spinal cord injuries account for 23% of newborn deaths (Murden et al., 2019).

The most severe perinatal damage to CNS is associated with cerebral palsy (Vitrikas, Dalton, & Breish, 2020), which occurs in 2-3 per 1000 newborns (Stavsky et al., 2017; Maitre et al., 2020). Cerebral palsy (CP) is the leading cause of childhood disability: out of all cases of newly diagnosed childhood disabilities, about 57% are linked to CP (Horber et al., 2020).

The primary etiopathogenetic factors of cerebral palsy are hypoxia and cerebral ischemia, which lead to destructive processes in the central nervous system and cause the development of irreversible changes (MacLennan, Thompson, & Gecz, 2015). The key mechanisms of rapid damage to the CNS in cerebral palsy encompass the intensifying lipid peroxidation with inhibition of the antioxidant defense system, decompensated oxidative stress, endotoxicosis, mitochondrial dysfunction, and activation of cytokines and caspases, resulting in the death of neurons (Panfoli et al., 2018; Magalhaes et al., 2019; Singh-Mallah, Nair, Sandberg, Mallard, & Hagberg, 2019).

The clinical manifestations of cerebral palsy range from subtle to extremely severe symptoms (Michael-Asalu, Taylor, Campbell, Lelea, & Kirby, 2019). Depending on the neurological symptoms, there can be dyskinetic, ataxic and spastic (mono-, hemi-, di- and tetraplegia) forms of CP (Glader, Barkoudah, & Armsby, 2018; Vitrikas, Dalton, & Breish, 2020). Patients with CP can also have epilepsy (41% of the cases), mental retardation (45% of the cases), and autistic disorders (6.9% of the cases); sometimes, such patients experience problems with hearing, vision, speech, etc. (Jonsson, Eek, Sunnerhagen, & Himmelmann, 2019). CP causes impaired movement associated with patho-

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logical movements and postures, rising (or decreasing) muscle tone, psychomotor issues, and decreased spatial sensation. Almost 30% of children with CP cannot maintain their body in an upright position independently (Michael-Asalu, Taylor, Campbell, Lelea, & Kirby, 2019). Very often, such children experience physical fatigue, pain, and abnormal functioning of organs and systems. Hence, they are at high risk of developing associated conditions and need lifelong medical care (Glader, Barkoudah, & Armsby, 2018; Vitrikas, Dalton, & Breish, 2020).

Until now, the treatment of cerebral palsy has been among the most difficult and unresolved problems in medical rehabilitation (Sadowska, Sarecka-Hujar, & Kopyta, 2020). It calls for an integrated interdisciplinary approach, including pediatric care, physical and occupational therapy, speech and language therapy, neurorehabilitation, assistance of narrow specialists (e.g., psychiatrist, gastroenterologist, nutritionist, orthopedist, audiologist, ophthalmologist, and a surgeon) and social assistance (Stavsky et al., 2017; Ryan, Wright, & Levac, 2020).

Non-drug therapies occupy a central place in the treatment of cerebral palsy (Das, & Ganesh, 2019). In the United States, the most common choice is physiotherapy, accounting for 37.1% of cases, followed by exercise therapy in 29.9% (Pulgar et al., 2019).

The effectiveness of CP treatments and rehabilitation depends on the age of a patient: the most effective scenarios are with patients aged three, owing to greater neuroplasticity at this age (Das, & Ganesh, 2019; Ryan, Wright, & Levac, 2020). A timely non-drug rehabilitation increases the level of functional and psychological independence of a disabled child and significantly improves the quality of patient's life (Das, & Ganesh, 2019). That is why there is an urgent need to develop new, efficient, and cost-effective non-drug therapeutic measures for the treatment and rehabilitation of children with cerebral palsy and other perinatal lesions in the CNS.

In recent years, scientists have drawn their attention to Bobath therapy, which is aimed at restoring systems that are most affected by the damage to the CNS (Kavlak, Ünal, Tekin, & Altuğ, 2018; Zanon et al., 2019). According to the Bobath concepts, a child is a passive recipient, and the Bobath approach itself focuses on the mechanisms of postural control, motor memory, sensorimotor control of muscles, and normalization of muscle tone (Farjoun, Mayston, Florencio, Fernández-De-Las-Peñas, & Palacios-Ceña, 2020). Today, one can find many works devoted to the effectiveness of Bobath therapy (Besios et al., 2018; Kavlak, Ünal, Tekin, & Altuğ, 2018; Zanon et al., 2019), but they cannot boast large samples and do not investigate the possibility of using this technique to treat children with different severities of CP. The aim of the study is to assess how Bobath therapy affects the motor functions and physical development of preschool children with spastic diplegia cerebral palsy.

## Methods

The study includes 90 children (48 (53.3%) girls and 42 (46.7%) boys aged four) with spastic diplegia, a form of cerebral palsy (ICP). The patients were divided into two groups: a control group (n=45) and a treatment (study) group (n=45). Children in the control group were assigned to traditional physical rehabilitation, whilst children in the treatment group underwent neuro-developmental treatment. The rehabilitation period in both groups was 6 months (3 courses of 10 days). During the neuro-developmental treatment, anatomical and physiological characteristics of children, the levels of motor disorders, and the type of general nonspecific adaptive response were considered. The physical rehabilitation program of the control group included treatment with physiotherapy equipment, kinesio taping, sensory integration, and exercises. The program of the treatment group included treatment with physiotherapy equipment, kinesio taping, sensory integration, remedial gymnastics with two motor modes according to Bobath (training, gentle training). The means of Bobath therapy were applied differentially depending on the level of motor disorders (according to the GMFCS system): a gentle training mode was used for children of 1st-3rd GMFCS levels during the first course of physical rehabilitation, further a training mode was used for 1st-2nd levels, while children of 3rd level continued gentle training.

Inclusion criteria: spastic diplegia as a form of cerebral palsy; 1st-3rd level of motor disorders by GMFCS; age of 4 years; examination by a neuropathologist and permission to be included into the child in the study; an informed consent signed by the parents to participate in the study.

Exclusion criteria: other (except for spastic diplegia) forms of cerebral palsy; 4th-5th levels motor disorders by GMFCS; severe congenital malformations; somatic symptom disorder or chronic somatic illnesses.

All children included in the study underwent physical examination by a neurologist and anthropometry (body weight, height, head and chest circumference). Anthropometric indices were assessed using centile tables with regard to gender and age. The data obtained was compared with the average statistical indices. The motor function was evaluated with the help of "Card-test assessment of children's motor abilities" according to B. and K. Bobath. Each of the test points was set up on a 5-point scale: 5 points - normal movements, 4 points – independent-imperfect movements, 3 points – independent-abnormal movements, 2 points – independent but supported in spine position, 1 point - passive movements with the help of a rehabilitation specialist, 0 points - complete inability to take a specific position. The levels of motor disorders were determined according to the GMFCS (Gross Motor Functional Classification System). These levels can be described as follows. Level 1: Children are able to sit on the floor with both hands free to manipulate objects. Children can sit up from lying down and walk without support. Level 2: Children floor sit but may have difficulty with balance when both hands are free to manipulate objects. Children crawl on hands and knees and move around the house holding onto furniture. Level 3: Children can floor sit but may require assistance to maintain sitting. Children crawl on hands and knees and can walk short distances holding onto furniture and using adult assistance. Level 4: Children need additional equipment and assistance for sitting and standing. Children can walk small distances within a room and perform non-reciprocal crawling. Level 5: Complete physical disability restricts volitional control of movement and the ability to maintain head posture. Children are not able to move independently (National Guideline Alliance, 2017).

Statistical data processing was performed with Student's t-test, Fisher's F-test using the SPSS 13.0 software package and Microsoft Excel 2013 (Microsoft, USA). The differences were considered statistically significant at $p < 0.05$. To compare qualitative indicators between the groups, the Fisher's test $2 \times 2$ was used.

## Results

As regards physical development, the analysis revealed an increase in the following parameters: the average body weight in control group increased by 3.58% ($p > 0.05$), in treatment group

- by 4.86% (p>0.05), height - by 1.88% (p>0.05) and 1.94% (p>0.05), head circumference - by 0.95% (p>0.05) and 1.97% (p>0.05), chest circumference - by 0.83% (p>0.05) and 2.24% (p>0.05). There were no a statistically significant intergroup differences (p>0.05).

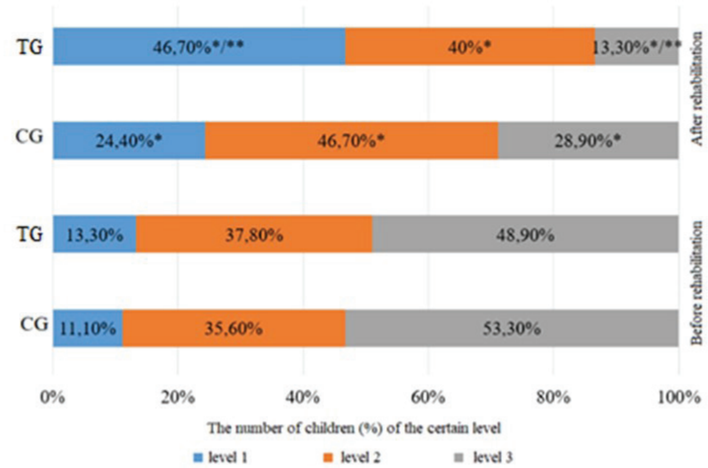
Changes in the motor function are shown in Table 1. Children in the control and treatment groups had significant improvements in the sitting function (improved by 9.1% and 15.5%, respectively, p<0.05). Furthermore, improvements were recorded in all parameters, such as motor performance in prone position (6.0% vs 14.7%, p<0.05), motor performance in supine position (6.7% vs 13.2%, p<0.05), kneeling (13.78% vs 16.3%, p<0.05), half-kneeling (13% vs 23.6%, p<0.05), and standing (7.8% vs 21%, p<0.05) for both groups.

**Table 1.** Changes over time in the motor function of children with spastic diplegia

| Indicators | Group | Before rehabilitation | After rehabilitation |
|---|---|---|---|
| | | M±SD | M±SD |
| Sitting position, points | CG (n=45) | 3.52±0.08 | 3.84±0.03* |
| | TG (n=45) | 3.61±0.07 | 4.17±0.05*/** |
| Prone position, points | CG (n=45) | 4.02±0.07 | 4.26±0.063* |
| | TG (n=45) | 4.15±0.06 | 4.76±0.07*/** |
| Spine position, points | CG (n=45) | 4.03±0.085 | 4.30±0.04* |
| | TG (n=45) | 4.17±0.09 | 4.72±0.036*/** |
| Turns on the abdomen, points | CG (n=45) | 3.75±0.08 | 4.08±0.09 |
| | TG (n=45) | 3.83±0.095 | 4.16±0.07 |
| Turns on the side, points | CG (n=45) | 3.85±0.09 | 4.15±0.068 |
| | TG (n=45) | 3.90±0.07 | 4.37±0.18 |
| Kneeling, points | CG (n=45) | 3.34±0.04 | 3.80±0.04* |
| | TG (n=45) | 3.54±0.068 | 4.15±0.05*/** |
| Half-kneeling, points | CG (n=45) | 3.22±0.057 | 3.64±0.05* |
| | TG (n=45) | 3.31±0.072 | 4.09±0.043*/** |
| Standing, points | CG (n=45) | 2.95±0.03 | 3.18±0.03* |
| | TG (n=45) | 3.14±004 | 3.80±0.05*/** |

Legend: *-the difference is statistically significant comparing to the indicator before treatment (p<0.05); **-the difference is statistically significant comparing to the indicator after treatment in the control group (p<0.05); CG - control group; TG – the treatment group

The study of motor function (according to the GMFCS system) showed an improvement in motor skills in both groups at the end of rehabilitation (Figure 1). Before rehabilitation, there were 5 (11.1%) children with GMFCS level 1 in the control group, 16 (35.6%) with level 2, and 24 (53.3%) with level 3. The treatment group consisted of 6 (13.3%) children with level 1, 17 (37.8%) with level 2, and 22 (48.9%) with level 3. At the end of treatment, there were 11 (24.4%) children with level 1, 21 (46.7%) with level 2, and 13 (28.9%) with level 3 in the control group. The treatment group included 21 (46.7%) children with level 1, 18 (40%) with level 2, and 6 (13.3%) with level 3. Hence, with a traditional rehabilitation program, 6 (13.3%) children improved from level 2 to level 1 (p<0.05), and 11 (24.4%) children improved from level 3 to level 2 (p<0.05). Changes in




Legend: CG-control group; TG-the treatment group; *-the differences are statistically significant compering to the indicator before treatment (p<0.05); **-the differences are statistically significant compering to the indicator after treatment in the control group (p<0.05)

FIGURE 1. Changes over time in GMFCS levels of children with *spastic diplegia*

the treatment group were more significant comparing to the control group ($p<0.05$). For instance, there were 15 (33.3%) children in the treatment group ($p<0.05$) who improved from level 2 to level 1, and 16 (35.6%) children who improved from level 3 to level 2 ($p<0.05$). There were no statistically significant differences ($p>0.05$) in GMFCS levels between groups before rehabilitation. After rehabilitation, however, the number of children with level 1 was statistically higher ($p<0.05$) in treatment group than in the control group. On the other hand, the number of children with level 3 in treatment group was significantly lower than in the control group ($p<0.05$). There were no statistically significant differences in level 2 between groups ($p>0.05$), since only 6 children in the control group improved from level 2 to level 1, whereas in the treatment group, the amount of children who improved their GMFCS level was nearly 3 times larger.

## Discussion

This study examined two types of physical rehabilitation strategies for children with spastic diplegia cerebral palsy: a conventional strategy and an improved program integrating the Bobath therapy. A positive tendency was observed among children of both groups at the end of physical rehabilitation. However, changes in anthropometric parameters (height, body weight, head and chest circumference) were not significant for both groups. There were no statistically significant differences ($p>0.05$) in the initial and intergroup indicators ($p>0.05$), due to a relatively short follow-up period (only 6 months). The significant changes may occur with a longer rehabilitation period.

The rehabilitation programs of both comparison groups were effective, as evidenced by a statistically significant ($p<0.05$) difference in motor activity before and at the end of rehabilitation. The motor performance of children in the treatment group significantly improved comparing to that in control group ($p<0.05$, Table 1). At the end of rehabilitation, 13.3% of children in treatment group belonged to GMFCS level 3 compared to 28.9% in control group ($p<0.05$). Thus, the Bobath concept was proven effective. Meanwhile, the number of children of the 1st level by GMFCS significantly increased ($p<0.05$) (46.7% in treatment group vs 24.4% in control group). Such a positive effect on the motor skills is due to the influence on 'key points of control': head, shoulders, palms, trunk, pelvis, and feet (Grazziotin dos Santos et al., 2015; Kavlak, Ünal, Tekin, & Altuğ, 2018).

The study results are comparable with data of other studies in the field (Besios et al., 2018; Tekin, Kavlak, Cavlak, & Altug, 2018; Zanon et al., 2019). For example, the study of a 8-week Bobath therapy among 5-15-years old children with cerebral palsy, showed a statistically significant improvements in general motor function ($p<0.05$), functional independence ($p<0.05$), postural control ($p<0.05$) (Tekin et al., 2018). A research carried out among 70 children aged 3-18 years with spastic diplegia. The study evaluated the influence of Bobath therapy on the activity of neck and trunk muscles. At the end of rehabilitation, there was a significant increase in electroneuromyography of neck and trunk muscles ($p=0.017$). Thus, Bobath therapy increases their activity, improves their functioning in children with cerebral palsy (Grazziotin dos Santos et al., 2015). Another similar study also confirmed a significantly greater ($p<0.05$) effectiveness of the 8-week Bobath therapy in comparison with traditional physical rehabilitation, while exercises aimed at strengthening the muscles of the trunk were the most effective ($p<0.05$) (Keser, Kirdi, Meric, Kurne, & Karabudak, 2013). The systematic review of three randomized trials indicated that there is no statistically significant difference ($p>0.05$) between Bobath therapy and traditional rehabilitation. However, two of these studies had methodological limitations for the use of Bobath therapy, and only one study provided data on the effect of this method on gross motor skills in children with cerebral palsy (Zanon et al., 2019). Most studies of Bobath therapy involved a small number of children. The method has not been sufficiently studied yet and requires further, detailed and in-depth study involving large research samples.

The results of the study suggest that the examined physical rehabilitation technique realizes the basic principles of physical rehabilitation for children with spastic diplegic cerebral palsy (i.e., comprehensiveness, effectiveness, staging, load adequacy, social orientation, emotionality, accessibility, and purposefulness). The proposed rehabilitation program integrating the Bobath therapy also aligns with the basic principles of correctional pedagogy (i.e., individualization, consciousness, consistency, cyclicity, novelty, diversity, moderation of exposure). The Bobath approach allows to improving the physical development, motor functions, and motor skills of children who suffer from spastic diplegia cerebral palsy.

## Conclusion

Using Bobath therapy as part of a complex physical rehabilitation program for children with spastic diplegia cerebral palsy is more effective compared with traditional treatment. Children treated according to the Bobath approach showed greater improvement in motor abilities in a sitting position (15.5 versus 9.1% under conventional program), kneeling (16.3 versus 13.8%), standing (21.0 versus 7.8%), when lying on the stomach (14.7 versus 6.0%) and back (13.2 versus 6.7%), and in a half-kneeling position (23.6 versus 13.0%, $p<0.05$). Improvements were also noticed in motor skills and physical development. Therefore, Bobath therapy can be recommended for spastic diplegia cerebral palsy.

### *Prospects for further research*

The future research can focus on the effect of Bobath therapy on cerebral circulation in children with spastic diplegia, a form of cerebral palsy.

**Acknowledgements**
There are no acknowledgements.

**Conflict of Interest**
The authors declare that there are no conflicts of interest.

**Received:** 11 January 2021 | **Accepted:** 07 March 2021 | **Published:** 01 February 2022

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