The effectiveness of Bobath technique in treating children with cerebral palsy: A systematic review

***Shahid Mohd Dar, MPT.**
Department of Physical Rehabilitation Sciences,
Kulliyyah of Allied Health Sciences,
International Islamic University Malaysia,
Jalan Sultan Ahmad Shah,
Bandar Indera Mahkota,
25200 Kuantan, Pahang
shahiddar@iium.edu.my

Nur Atiqah Johari, BSc.
Department of Physical Rehabilitation Sciences,
Kulliyyah of Allied Health Sciences,
International Islamic University Malaysia,
Jalan Sultan Ahmad Shah,
Bandar Indera Mahkota,
25200 Kuantan, Pahang
nuratiqahjohari98@gmail.com

***Corresponding author:** Shahid Mohd Dar, shahiddar@iium.edu.my

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Abstract:

Aim: To assess how Bobath therapy affects motor function and functional independence. **Method:** This systematic review was conducted following PRISMA guidelines. All randomized control trials (RCTs) that recruited cerebral palsy children and applied the Bobath approach as an intervention were collected through a comprehensive online database search. For quality assessment, the revised Cochrane risk-of-bias tool for randomized trial (RoB 2) was used. **Results:** Six eligible articles including five RCTs and one quasi-experimental study were retrieved from PEDro, MEDLINE, COCHRANE, EBSCO and PubMed since 2010, and all studies had low risk of bias. The Bobath therapy had shown positive effects on gross motor function, balance, upper extremity function and functional independence with no significant effects on gait parameters and disability involvement. **Conclusion:** The Bobath technique would not be effective on its own but may give more advantages if it is used as an adjunct to other conventional physiotherapy treatments.

Keywords: Neurodevelopmental therapy, Bobath, Cerebral palsy, Randomized control trials

Introduction:

Cerebral palsy (CP) is a type of persistent, though not unchanging, disease of movement and/or posture and motor function that is attributed to the developmental or immature brain's non-progressive disturbance, injury, or abnormality (Sadowska et al., 2020). This definition is following Dr. Bobath, who defined cerebral palsy as the outcome of a laceration or underdeveloped part of the brain, non-progressive in nature and present since birth. The motor discrepancy results in atypical patterns of posture and movement, in relation to an abnormal postural tone. Due to the abnormalities faced by cerebral palsy (CP) children, there is an essential need for ongoing treatment to optimize their physical abilities, functional independence and their quality of life.

There are several interventions established in treating CP children, such as botulinum toxin-A injection (Multani et al., 2019), electromyographic feedback (Flux et al., 2023), heat-reinforcing needling (Zhang et al., 2014), Adeli suit therapy (AST) (Mahani, et al., 2011) and Bobath technique (Acar et al., 2016), to name a few. According to Vaughan-Graham et al., (2019), the Bobath concept is one of the most used techniques by physiotherapists in neurorehabilitation. The concept of treatment is that it is personalized according to the patient's condition and may involve manual contact and verbal commands, that provide facilitation and inhibit abnormal postural tone to achieve successful movements and task performance in terms of postural orientation, components of

movement, task recognition and motivation to complete any task. Even though the Bobath concept has been applied for more than 50 years, its effectiveness is still questionable, and a lot of studies have been conducted to determine whether there is evidence to accept it as an effective approach (Paci et al., 2003).

A lot of research is available regarding the effectiveness of the Bobath technique on neurological conditions and the results are inconsistent. For instance, Gray et al., (2018) reported significant improvement in the upper extremity function of patients compared to non-intervention group. On the other hand, studies also reported that physical functioning, trunk impairment scale and the 10-meter walk test did not improve significantly after the Bobath therapy compared to standard exercises. Due to these contradicting results, this review sought to assess the effectiveness of the Bobath approach towards cerebral palsied children by reviewing recent studies.

Methodology:

Identification

A systematic and broad search of the literature was performed to identify any randomized clinical trials that would meet the inclusion criteria. There were no imposed restrictions related to the publication status, language, or date of publication. Literature searches were performed in online databases such as MEDLINE, COCHRANE, PubMed, PEDro and EBSCO. The Boolean operators such as 'AND' or 'OR' and relevant keywords such as 'effectiveness' OR 'efficacy' OR 'effects OR 'evaluation' AND 'bobath concept' OR 'bobath technique' OR 'bobath approach' or 'neurodevelopment' AND 'cerebral palsy' OR 'cp' were used for searching processes. This systematic review followed strictly all recommendations from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement in preparing this article (Moher et al., 2009).

Screening and Eligibility

The inclusion criteria were full text, English-published randomized controlled trials (RCT) and quasi-experimental studies limited to human studies, not older than 2010, and studies performed on cerebral palsy (CP) children, aged 0-15 years and Bobath (neurodevelopmental therapy -NDT) as a main treatment. Any RCT that compared Bobath to no treatment or conventional physiotherapy approaches was accepted. Studies that applied Bobath in conjunction with other treatments were also considered for inclusion. The exclusion criteria would be non-randomized trials or quasi-experimental, non-full text, non-published, non-English articles, articles related to animal study, articles older than 2010, and articles that were not related to CP children and Bobath therapy. The results from the studies would be narratively synthesized.

Assessment of Risk of Included Studies

The selected articles were assessed for bias using the revised Cochrane risk-of-bias tool for randomized trials (Rob 2) (Sterne et al., 2019).

Results:

Study selection

A total of 90 articles were yielded from online databases. After removing 20 duplicate articles, the articles were further screened by the title and abstract. Then, the remaining 38 articles were assessed based on the inclusion and exclusion criteria. Thirty-two references were excluded for reasons mentioned in Figure 1. Finally, six full-text articles were included in the systematic review.

Reporting results

The results obtained were illustrated in a table format (Table 1) adopted from the systematic review guidelines by the American Occupation Therapy Association, updated in March 2020.

Study Characteristics

There were five randomized controlled trials (RCTs) and one quasi-experimental included in this research. The number of participants in the articles included in this systematic review ranged from 17 to 36, with ages ranging from 0 to 15 years old. All the studies recruited both male and female participants. All the participants recruited were diagnosed with cerebral palsy, not under the treatment of botulinum toxin, not candidates for surgery or other interventions, and researchers had obtained parents' consent for randomized assignment of their children into either group. The participant characteristics, intervention, outcome measures and results of the included articles were summarized in Table 1.

Discussion:

The Effects of Bobath in Terms of Motor Function

Labaf et al., (2015) presented positive results in the

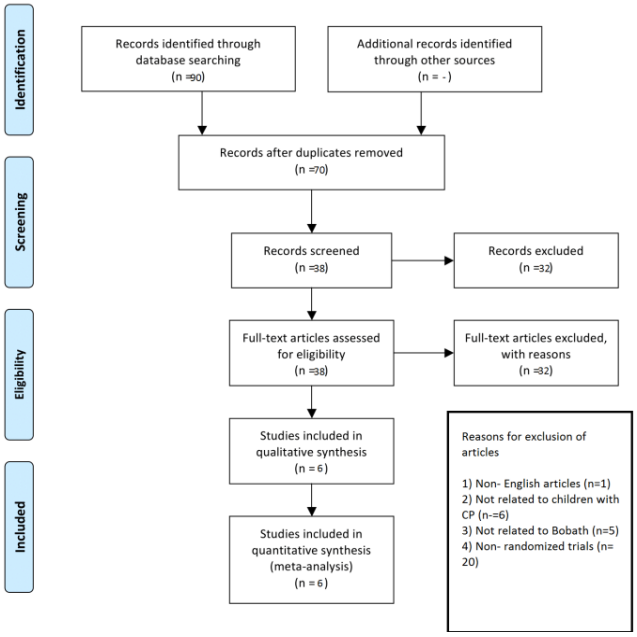

Figure 1: The Processes of Identification, Screening, Eligibility and Included by using PRISMA Guideline.

Discussion:

The Effects of Bobath in Terms of Motor Function

Labaf et al., (2015) presented positive results in the Bobath group in terms of gross motor function (GMF) domains of lying and rolling, sitting, crawling, kneeling and standing abilities, but not in the domains of walking, running and jumping abilities. It was important to note that dynamic activities such as walking, running and jumping were far more difficult to be executed because they dealt with great core muscle strength to maintain their balance. Therefore, it was reasonable that no improvements were recorded in walking, running and jumping abilities.

In addition, there was not much difference in the GMF no matter how frequently the Bobath technique was applied to the children (Besios et al., 2018). This might be because of the inaccurate techniques applied by the therapists or probably the outcome gained during the treatment period was not assimilated into the children's daily lives.

Mahani et at., (2010) revealed superior improvements with modified Adeli suit therapy (AST), which was the combination of AST and Bobath. However, this idea contradicted another study by Kim et al., (2016) who claimed AST was as effective as Bobath in improving GMF. The varying results probably may be due to different ways of applying the Bobath treatment.

Additionally, a home program should be added to Bobath because it may encourage parents to supervise and motivate their children during rehabilitation. Behzadi et al., (2014) reported better results of GMF when children were treated with Bobath and were given a home program afterwards.

A study done by Kim et al., (2016) reported that the Bobath technique did not show any improvements in gait parameters. Walking is a complex activity that requires strength of muscles of the whole body, especially core muscles. If the children had abnormal movement patterns, which was a common problem in CP, their line of gravity and base of support would alter, so walking, even sitting or standing could be difficult. Kim et al., (2016) suggested that spatiotemporal parameters might improve with another treatment alongside Bobath as an adjunct. Their combination of treatment using Bobath or neurodevelopmental therapy (NDT) and AST presented significant improvement in the spatiotemporal parameters.

The upper extremity (UE) function was important for children to reach for things, for self-care and learning. A study by Acar et al, (2015) demonstrated significant improvements only if NDT acted as an adjunct to the main treatment. The treatment with NDT still showed progress in the Jebsen Taylor Hand Function Test (JTHFT), ABILHAND-Kids test and Quality of Upper Extremity Skills Test (QUEST) scores but only in the 'dissociated movements' domain. The significant increase in QUEST scores in NDT/NW (Neurodevelopmental Treatment/Nintendo Wii) group may be related to the children's effort to move their arms to better grasp and use the Nintendo Wii game console, which was proven through post-treatment clinical observation. The study also showed that children in the NDT/NW group improved their hand speed after the treatment period. Not only the Nintendo Wii was more attractive and entertaining to children, but some studies proved that outcome gained during the virtual environment treatments might be transmitted to real life.

The Effect of Bobath in Terms of Functional Independence

Besios et al., (2018) had used PEDI (Pediatric Evaluation of Disability Inventory) measure in their study and the results showed no significant effect on the PEDI scores regardless of the frequency of its application. The possible explanation for this outcome was because of most of the areas of assessment in PEDI such as behaviour, cognition, communication, language, problem-solving, and social relationships were not within the domains of Bobath therapy. The Bobath technique focuses on influencing the quality of motor response by applying therapeutic handling, facilitation and inhibitory techniques with specific key

points of control. So, Bobath was not effective in reducing the children's disability over time.

According to Acar et al., (2016), both Bobath (NDT) and NDT/Nintendo Wii groups revealed similar developments in terms of eating, care, bathing and upper and lower trunk dressing domains. The reason for the similar results was perhaps the outcome gained during the treatment was not immediately transmitted to their daily lives. Also, without the presence of the Nintendo Wii, the children would be less motivated and reluctant to perform regular exercises. This signified that Bobath alone was effective in improving functional independence through therapeutic handling together with the facilitation and inhibitory techniques which would progressively correct the abnormal postural tone in CP children.

Functional independence was essential because it was related to the quality of life (QOL). Compared to their normal developing peers, CP children's progressive limitations in the activities of daily living (ADLs) and participation restrictions might reduce their QOL, especially in their physical health and independence in basic functional activities (Chulliyil et al., 2014).

Future research should include more RCTs on Bobath effects on parameters such as spasticity, muscle activity, muscle strength and the QOL because it is crucial to know to what extent Bobath might impact the life of children with CP. Future research should also use consistent outcome measures to improve the validity of results. Researchers should experiment applying the Bobath technique as an adjunct therapy instead of a major treatment. Studies. The effects of Bobath (NDT) technique on different types of CP (spastic, ataxic & dyskinetic) and different topographical distributions (hemiplegia, diplegia & quadriplegia) could be addressed in future studies.

Conclusion:

Overall, the Bobath technique was effective in improving cerebral palsy (CP) children's GMF, balance, UE function and functional independence. However, other aspects such as gait parameters and disability involvement did not show significant progression with it. Perhaps, the improvements might be observed if the Bobath technique becomes an adjunct to assist the main treatment, instead of becoming the main sole player. This research might benefit future therapists in terms of determining and choosing the right treatment combination for children with CP.

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Table 1: Description of included studies

Author/Year	Level of Evidence Study Design Risk of Bias	Participants Inclusion Criteria	Intervention	Outcome Measures	Results
Behzadi, et.,al (2014)	Level 1B RCT Low risk	*N*= 30 (19 girls & 11 boys) *Inclusion criteria* Children age range 0-2 years old having motor dysfunction due to CP	n=15 (9 girls & 6 boys) , traditional Bobath group n=15 (10 girls & 5 boys) , home-based group Physiotherapist applied one-hour NDT-Bobath technique for 12 sessions. The traditional Bobath group received inhibitory and facilitation techniques.	*GMF* GMFCS level	Bobath group showed significant improvements than home-base group (*p*= 0.007)
Besios et al.,(2018)	Level 1B RCT Low risk	*N*= 20 (age= 4.85±2.49 years *Inclusion criteria* Children diagnosed with CP	n=10, Low frequency intervention group (LFICP) n=10, High frequency intervention group (HFICP) The participants underwent two dissimilar intervention protocols with Bobath technique. LFICP group received only one session of (Bobath) a week that lasted for one hour. HFICP group received three intensive one-hour sessions each week.	*GMF* GMFM-88 *Disability Involvement* PEDI *Fall Risk* TUG	*GMF* There were significant changes in GMFM-88 scores for both groups (p<0.001). *Disability Involvement* Participants from both groups showed no improvement in PEDI scores. *Fall Risk* Both groups revealed significant improvements in TUG scores (p<0.001).
Kim, et al.,(2016)	Level 1B RCT Low risk	*N*=17 (8 girls & 9 boys; mean age= 5.64 years) *Inclusion criteria* Children age range 4-7, diagnosed with CP, no history of orthopaedic surgery or spasticity-	n= 8(2 boys, 6 girls), AST/NDT n= 9 (6 boys, 3 girls), NDT Participants in the AST/NDT group received NDT for 30 minutes per session, 2 sessions per day, for 5 days per week. They also received Adeli suit treatment for 30 minutes per session for 5 times a week. The participants in the NDT group received only NDT with the duration same as received by AST/NDT group.	*GMF* GMFM-88 *Functional Mobility* TUG *Balance* PBS *Gait Analysis* GAITRite walkway system	*GMF* Paired t tests revealed statistically significant improvements in GMFM in both AST and NDT groups (p<0.05). *Functional Mobility and Balance* TUG test and PBS disclosed significant improvements in all groups (p < 0.05). *Gait* The AST/NDT group displayed more significant effects on walking speed, cadence, and stride length (p<0.05) as compared to NDT group.
Mahani, et al.,(2010)	Level 1B RCT Low risk	*N*= 36 (11 girls & 25 boys; mean age=7.55 years) *Inclusion criteria* Children diagnosed with CP, no history of orthopaedic surgery or spasticity reduction intervention in the last 6 months, classified in level 1-4 of GMFCS.	n=12 (9 boys, 3 girls), MAST n=12 (8 boys, 4 girls), AST n=12 (8 boys, 4 girls), NDT All children in the three groups received daily treatment for 2 hours, for 5 days per week for total of 20 sessions. The AST group underwent preparation session and wearing the Adeli suit. The NDT group underwent 2 hours of active and passive movements according to the NDT concept. The MAST group included passive stretching, followed by facilitation of normal movement patterns, then, the children wore Adeli suit and the loading system was applied.	*GMF and Functional Status* GMFM-66	All groups displayed positive effects in GMFM after treatment sessions (p<0.01). However, there were also significant differences between groups in the GMF scores after the treatment as well as at follow-up (p<0.01).
Acar, et al., (2015)	Level 1B RCT Low risk	*N*= 30 (16 girls & 14 boys) *Inclusion criteria* Children aged between 6 and 15 years, classified in level 1–3 of the MACS, level 1or 2 of the GMFCS, able to grasp and release an object, and no history of surgery or botulinum toxin injection to UE in the previous 6 months.	n=15 (7 girls, 8 boys), NDT/NW n=15 (9 girls, 6 boys), NDT The NDT group received standard NDT for 45 minutes per session, twice a week for 6 weeks. Participants in NDT/NW group played virtual reality games of tennis, baseball, and boxing (each game 5 minutes) for 15 minutes in addition to the standard NDT in each treatment session, which focused on the hemiplegic hand.	*Upper Extremity Function* QUEST *Hand Function and Speed* JTHFT *Hand Disability* ABILHAND-Kids test *Functional Independence* WeeFIM	Both groups showed significant improvements in all aspects (except quality of function) after 6 weeks of treatment (all p<0.05). However, there is also significant difference in JTHFT scores between NDT/NW and NDT group. (p<0.001). The study revealed that NDT/NW showed more prominent results than NDT.
Labaf, et al., (2015)	Level 1B Quasi-Experimental	*N*= 28 (14 girls & 14 boys; mean age= 4.65 years)	n=15(7 girls, 8 boys), NDT n=13(7 girls, 6 boys), home exercise The treatment group received standard	*GMF* GMFM-88	The groups were significantly different in lying, rolling, sitting, crawling, kneeling, and standing abilities (all p<0.05). However,

	Low risk	*Inclusion criteria* Children aged 2-6 years, diagnosed with CP, no other severe impairments such as seizure, no participation in other rehabilitation programs except for OT, and referred to the OT clinic of children with disabilities for a 3 month course of therapy.	NDT. In this study, the control group received home exercise, which included stretching, PROM, and AROM by the parents and controlled by an OT. Both groups received treatment for an hour, three sessions per week.		there were no significant changes in walking, running, and jumping abilities between the two groups (p=0.09).

Note: ABILHAND-Kids= Manual Ability Measure for CP Children; AROM= Active Range of Motion; AST= Adeli Suit Therapy; CP= Cerebral Palsy; GMF= Gross Motor Function; GMFM-88= Gross Motor Function Measure-88; GMFCS= Gross Motor Function Classification System; HFICP= High Frequency Intervention for Cerebral Palsy; JTHFT= Jebsen Taylor Hand Function Test; LFICP= Low Frequency Intervention for Cerebral Palsy; MACS= Manual Ability Classification System; MAST= Modified Adeli Suit Therapy; NDT= Neurodevelopmental Treatment; NW=Nintendo Wii; OT= Occupational Therapist; PBS= Pediatric Balance Scale; PEDI= Pediatric Evaluation of Disability Inventory; PROM= Passive Range of Motion; QUEST= Quality of Upper Extremity Skills Test; RCT= Randomized Controlled Trial; TUG= Time-up and Go; UE= Upper extremity; WeeFIM= Functional Independence Measure.