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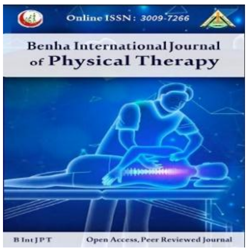

Original research

Bobath Concept on Motor Function in Stroke Patients: A systematic review and meta-analysis.

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Abstract

Background: Bobath therapy, a widely used approach to stroke rehabilitation, was developed in the 1950s. It aims to support purposeful, natural movement by utilizing hands-on techniques. Despite its widespread use globally, clear and consistent evidence supporting its effectiveness is limited. **Purpose:** This extensive systematic review and meta-analysis aimed to assess recent research on how the Bobath approach influences motor function in stroke patients. **Methods:** A systematic search was carried out across Scopus, Web of Science, PubMed and CENTRAL (Cochrane). randomized controlled trials evaluating the effect of Bobath concept on motor function in stroke patients. Primary outcome measures were trunk control, balance, and gait while secondary outcome measure was arm motor function. A meta-analysis was performed were applicable, and the PEDro scale was used to assess the studies' methodological quality. **Results:** Out of 465 screened records, 26 RCTs with 1,513 stroke patients were analyzed to assess the effectiveness of Bobath concept on motor function in stroke patients. Meta-analysis was conducted and revealed significant improvement in balance and gait speed following stroke, However, the inability to draw firm and conclusive results is hindered by methodological weaknesses and the heterogeneity across the included studies. **Conclusion:** This systematic review supports that Bobath concept has a significant enhancement on balance and gait speed in stroke patients. However, there is not enough proof to support its advantage in improving trunk control and abilities of doing activities through daily life. Additional high-quality studies are recommended to strengthen the evidence base.

Keywords: Bobath concept, Rehabilitation, Stroke.

INTRODUCTION:

Stroke occurs when there is disruption of blood flow to the brain, which lead to impaired brain function. This disruption caused from ischemic occlusion or hemorrhagic bleeding which can lead to severe neurological consequences, including brain damage, disability, and even death. Prompt medical attention is crucial for managing stroke and improving patient outcomes [1].

Stroke can cause severe motor deficits, including weakness of muscles, abnormal muscle tone, problems in balance, and walking difficulties. These impairments can have a profound impact on a person's satisfaction and independence in life. Recovering balance and gait is a crucial goal of rehabilitation[2].

Rehabilitation training has proven effective in improving function of limb and reducing disability in patients with stroke.[3].

Initial rehabilitation efforts primarily focused on orthopedic strategies and compensatory movements. Later, during the mid-20th century, therapeutic models such as Bobath, Brunnström, Rood, and PNF emerged, introducing neurophysiological methods that prioritized guided movement with the support of a therapist to stimulate recovery. In the 1980s, the motor learning approach emerged, emphasizing active patient involvement and task-specific practice and highlighting the importance of neuroscience and motor learning principles. However, many physiotherapists continue to rely on specific "named" approaches, such as Bobath, which is widely used in many countries [4].

The Bobath approach, established in the 1950s, is widely employed in post-stroke care. It seeks to encourage coordinated and voluntary movement through carefully applied manual techniques. Although the method has evolved over time, it continues to stress the importance of sensory feedback in enhancing motor control and posture[5]. It employs manual handling techniques, such as compression and distraction of joints, to stimulate proprioceptive responses and improve motor control. Bobath therapy has been acknowledged as a beneficial treatment for patients who have stroke experiencing balance and movement impairments [6].

The Bobath concept adopts a holistic approach, focusing on a thorough analysis of functional deficits and their root causes. It highlights the significance of neural plasticity. For hemiplegic patients, the therapy aims to integrate the more affected and less affected sides of the body, promoting increased stimulation and motivation to use the more affected side[7].

The main aim of this study was to systematically review the latest evidence of the Bobath concept and its impact on motor abilities in patients with stroke and to formulate standardized clinical guidelines that can guide physical therapy practitioners in determining whether to incorporate these methods into their treatment protocols.

METHODS:

This review and meta-analysis designed according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, and it followed the methodological standards outlined in Cochrane Handbook for Systematic Review [8]. The protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO – CRD42024568802).

Data sources and search strategy

A systematic search across several databases, including Scopus, Web of Science, PubMed and CENTRAL (Cochrane) was carried out in addition to hand searching from reference lists of citation and systematic reviews. Publications from January 2014 to July 2024 were covered and were independently conducted by two reviewers.

A search plan for relevant studies used the keywords "Bobath or NDT or neurodevelopmental technique” and "stroke or hemiplegia or hemiparesis or C.V.A” and "motor function or upper limb or lower limb or gait or function or ADL or activities or movement or motor rehabilitation or rehabilitation or executive function".

Study selection:

This review included studies that satisfied the following inclusion criteria: English-language publications of randomized controlled clinical trials (RCTs) from 2014 to 2024, patients of both genders aged 18 years , who had been clinically diagnosed with stroke or cerebrovascular accident (C.V.A), with no restrictions on the type or stage of the lesion, intervention focused on the rehabilitation of motor function in patients with stroke, specifically incorporating Bobath concept., comparisons included any form of control, placebo, standard care, or no intervention. The primary outcome assessed was motor function in stroke patients.

Exclusion criteria comprised studies with designs other than RCTs (e.g., case reports, case series, and review articles), non-English publications, studies not involving Bobath interventions, non-peer-reviewed literature, and studies with participants not diagnosed with stroke. This approach ensured a rigorous and focused selection of relevant studies for analysis.

To find the relevant articles, the titles and abstracts were first filtered. A full-text examination of the retained studies was then conducted in accordance with the previously established eligibility criteria.

The flow of information through the various steps of this systematic review was illustrated using the PRISMA flow diagram. It shows how many records were found, whether they were included or not, and why they weren't[9].

Data Extraction

Two reviewers independently extracted the data. Details of each article (first author, year, nation of study, and PEDro score), participant characteristics (mean age of participants (SD); sample size of each group), interventions, control, and all evaluated outcomes were all documented on a standardized checklist. Consensus was used to settle disagreements.

Quality assessment of methodology

Two independent investigators used PEDro scale to critically evaluate the included studies' quality. Based on scale's overall score, this evaluation divided studies into high- and low-quality categories. Research with a score of six or more was considered high quality (six to seven was good, and eight to ten was excellent), whereas research with a score below six was considered low quality (four to five was fair, and less than four was poor) [10].

Data analysis:

Review Manager version 5.4 was used for the statistical analysis in accordance with the Cochrane Handbook's recommendations. Meta-analyses were conducted when necessary, and pooled continuous outcome data were presented as mean differences (MD) with 95% CI. The I2 statistic was computed in order to evaluate variability among trials. The application of a random-effects model was necessary due to the significant heterogeneity ($I2 > 50\%$, $p < 0.05$). The significance level for all two-sided statistical tests was set at $\alpha = 0.05$ [11].

RESULTS:

The initial electronic database search yielded 465 potentially relevant articles. Following the removal of duplicates, 340 articles underwent screening based on their titles and abstracts. From these, 60 articles were chosen for full-text evaluation, with 26 ultimately meeting the inclusion criteria for this review. The search process is depicted in **(Fig. 1)**, following PRISMA flowchart guidelines [12].

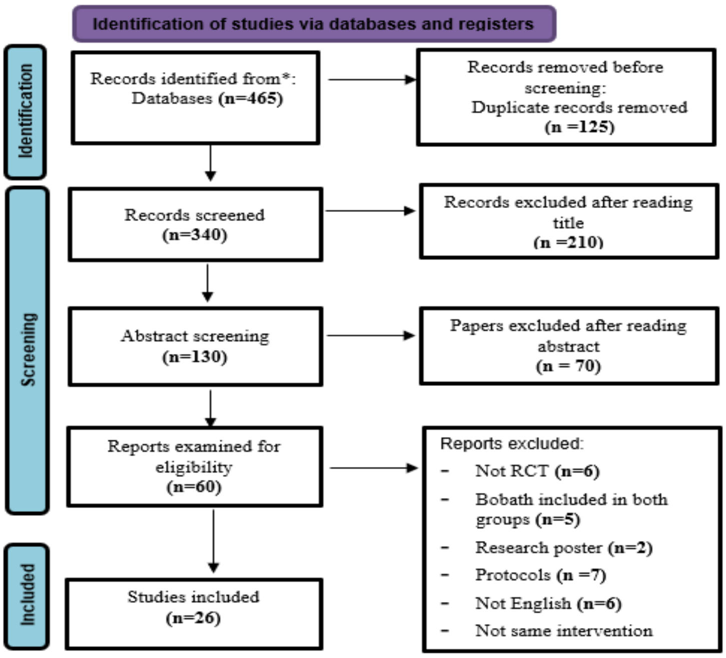

Figure (1). The PRISMA flow chart of the reviewed studies.

This systematic review included a sum of 26 randomized controlled trials (RCTs) involving 1,513 patients are presented in **Table 1**. The studies examined the impact of the Bobath concept compared to various alternative interventions across multiple outcomes. four studies evaluated the Bobath concept versus training using task-oriented, focusing on balance and gait improvement [13-16], while one study assessed its impact on upper limb function ability compared to training using task-oriented [17]and other one assessed its effect on motor abilities, ability of doing activities in daily life and level of satisfaction in life post stroke[18]. Another four articles compared Bobath therapy with proprioceptive neuromuscular facilitation (PNF) in balance and trunk control enhancement. [19-22].

Additional comparisons were made between Bobath training and other specialized interventions. One study examined Bobath versus Feldenkrais training for post-stroke balance improvement [23], while two other articles compared Bobath with modified constraint-induced movement therapy (mCIMT), one assessed balance, postural control, and gait [24]and the other assessed arm and hand dexterity function ability [25]. A further study investigated rhythmic auditory stimulation (RAS) and training using treadmill (TT) versus Bobath in gait rehabilitation [26]**.** Five studies assessed Bobath therapy against conventional physiotherapy, with outcomes including trunk control, balance, gait, and upper limb function. **Fil Balkan** [27] specifically examined their effects on trunk control and balance. Meanwhile**, Mikołajewska** [28]focused on assessing their impact on gait training. Another study by **Kilinç**[29] evaluated the influence of both interventions on trunk control as well as gait performance. The remaining two studies in this comparison investigated upper limb functional outcomes, with **Brock**[30] and **Olczak & Dornowski**[31]and **Danial Baig**[32] analyzing improvements in upper limb function following the different therapeutic approaches.

Two studies explored the impact of Dynamic Neuromuscular Stabilization (DNS) versus Bobath therapy, one focusing on trunk control [33] and the other on both trunk control and gait [34]. Three studies examined the impact of the Motor Relearning Program (MRP) and Bobath therapy[35-37] **.**These investigations focused on distinct outcomes: **Annethattil**[36] analyzed improvements in upper limb function, while **Abrar** [35]measured reductions in upper limb spasticity. Additionally, **Chen**[37] explored the influence of these interventions on post-stroke apathy, providing a broader perspective on neurorehabilitation outcomes. Other unique comparisons included Nintendo Wii versus Bobath for daily living activities and quality of life [38]**.**

The interventions frequency and duration are varied widely across the studies. Therapy sessions ranged from two to six times each week, with each time lasting between 30 and 150 minutes. However, four studies did not specify session duration [19,20,28,33]. The total duration of treatment programs spanned from one week to 24 weeks, reflecting considerable heterogeneity in study designs.

The quality scores of the RCTs graded from three to eight on the PEDro Scale. According to the scale, one study considered to be excellent quality RCT [18],while 14 studies [13,14,16,17,21,24,26,27,29-32,35,37,38]were considered to be good-quality RCTs, while nine studies were considered to be fair-quality RCTs [15,19,20,22,23,32-34,36,39,40] and one poor quality RCT[25]**.** The details of assessment of the risk of bias are presented in **Table 2**.

Table 1. Characteristics of included studies

First author, year, country of study, PEDro Score.	Participant characteristics [mean age, (SD), sample size of each group]	Intervention	Control	Outcome measures	Results
Fil Balkan et al., 2024[27] **Turkey** **8/10**	**Exp**: **M-EG:** 65.81±10.69 (42-77) **S-EG:** 65.31±8.18 (53-78) **Con**: **M-EG:** 66.21±9.20 (43-78) **S-EG:** 66.22±11.24 (50-78) **Exp**: n =40 **Con**: n =41	Bobath concept **Duration:** 5 days / week, about one hour.	conventional program **Duration:** 5 days / week, about one hour.	**Trunk control:** TIS and MAS-T **Balance:** BBS **Functional activity level:** FIM-M	Regardless of disability severity, Bobath- trunk training in acute patients with stroke improved sitting, control of trunk, and balance more compared to conventional physiotherapy.
Younas et al.,2024 [16] **India** **5/10**	**Exp**: NA **Con**: NA **Exp**: n =15 **Con**: n =15	Conventional treatment and task-oriented trunk training. **Duration:** 3 days / week for about 12 weeks, 1 hour.	Convention treatment and Bobath based trunk training. **Duration:** 3 days / week for about 12 weeks, 1 hour.	**Trunk control & balance:** TIS, BBS	Task-oriented exercises were more effective compared to Bobath approach in enhancing balance and function in patients of ischemic stroke.
Olczak et al.,2023[31] **Poland** **7/10**	**Exp**: 65.27 ± 10.56 **Con**: 66.40 ± 10.40 **Exp**: n = 30 **Con**: n = 30	NDT Bobath concept. **Duration:** six days per week, two hours a day.	Classical therapy **Duration:** six days per week, two hours a day.	**Upper limb function:** Armeo®Spring device	Bobath concept significantly improved function in the affected non-dominant UL.

Sütçü et al., 2023[14] **Turkey** **7/10**	**Exp**: 55.13±17.79 **Con**: 49.60±11.91 **Exp**: n = 16 **Con**: n = 16	Exercises build up on Bobath concept. **Duration:** 3 days/ week for about eight weeks, about 1 hour.	Task-oriented exercises. **Duration:** 3 days/ week for about eight weeks, about 1 hour.	**Trunk control:** TIS **Balance:** Bertec Balance **Motor function and movement quality:** STREAM **Gait:** GaitRite **Goal attainment perception:** GAS **Ultrasonographic measurements:** Muscle thickness	Bobath concept and exercises of task-oriented both had positively impacted trunk deficits, motor dysfunction, and problems in balance after stroke. While neither approach proved superior for balance, gait, or trunk function, the Bobath concept showed slightly greater improvement in muscle thickness.
Brock et al., 2022[30] **Australia** **9/10**	**Exp**: 60.8 (15.2) **Con**: 57.4 (15.7) **Exp**: n = 30 **Con**: n = 26	Bobath concept. **Duration:** two weeks, one hour a day, along with their regular care.	The control group received a UL treatment representing additional regular care plus a sham intervention. **Duration:** two weeks, one hour a day, along with their regular care.	**upper limb Directional control:** PreFULT **Active movement of UL:** STREAM CAHAI **Grip strength** Dynamometer	A brief Bobath-based intervention may have improved UL directional control, even in severe post-stroke deficits, and may be more beneficial than usual care.
Simi Hazarika et al., 2022[22] **India** **4/10**	**Exp**: 57.5±4.83 **Con**: 56.53±4.33 **Exp**: n = 15 **Con**: n = 15	PNF and conventional program **Duration:** 5 days / week for about 4 weeks, about 45 minutes.	NDT and conventional program **Duration:** 5 days / week for about 4 weeks, about 45 minutes.	**Trunk control:** TIS **ROM of trunk:** MST	PNF techniques improved trunk stability more than NDT training.
Kuciel et al., 2021 [21] **Poland** **7/10**	**Exp**:63.5 ± 16 **Con**: 73.5 ± 7.6 **Exp**: n = 15 **Con**: n = 15	NDT Bobath concept. **Duration:** 10 days, one hour and a half daily.	PNF concept. **Duration:** 10 days, 90 minutes daily.	**Postural control and balance:** TIS	Both PNF and Bobath improved postural control.
Chitkara et al., 2021[33] **India** **4/10**	**Exp**:59.73 + 7.51 **Con**: 59.27 + 9.07 **Exp**: n = 15 **Con**: n = 15	Bobath concept. **Duration:** six weeks	DNS treatment and standard physiotherapy program. **Duration:** six weeks	**Trunk Impairment:** TIS **Disability:** MRS **Quality of life:** SS-QOL	Both groups' primary and secondary results significantly improved before and after comparisons.

				Walking ability: 10 MWT	It is possible that in hemiplegic stroke, dynamic neuromuscular stabilization—which uses reflex-mediated core stimulation in developmental positions—improved trunk function more successfully than conscious activation with neurodevelopmental therapy.
Khallaf ,2020[13] **Egypt** **8/10**	**Exp**: 58.76 ± 3.51 **Con**: 56.71 ± 3.74 **Exp**: n = 17 **Con**: n = 17	Task-specific training **Duration:** 3 days /week for about 10 weeks., about 1 hour.	Conventional physical therapy based on NDT **Duration:** 3 days /week for about 10 weeks., about 1 hour.	**Trunk control:** TIS **Postural control:** PASS **Balance:** FRT **Trunk ROM:** A laser-guided digital goniometer	Task-specific training showed greater improvements than conventional NDT on TIS, PASS, and functional reach tests.
Yoon et al.,2020[34] **Korea** **5/10**	**Exp**: 58.06 ± 16.44 **Con**: 62.93 ± 12.19 **Exp**: n = 15 **Con**: n = 16	DNS exercises **Duration:** 3 days / week for about 4 weeks, about 30 minutes.	NDT / Bobath concept exercise **Duration:** 3 days / week for about 4 weeks, about 30 minutes.	**Trunk control:** TIS **Balance:** BBS **Gait:** FAC	Postural control and gait were improved by DNS training more than Bobath concept exercise.
Chen et al., 2019[37] **China** **6/10**	**Exp**: 65.69 ± 7.97 **Con**: 65.53 ± 7.20 **Exp**: n = 245 **Con**: n = 243	Motor relearning program **Duration:** 5days / week for about 4 weeks, about 40 minutes.	Bobath approach **Duration:** 5days / week for about 4 weeks, about 40 minutes.	**Disability Level:** NIHSS. **Activities of Daily Living:** BI **Global cognitive functioning:** MMSE **anxiety and Depression:** Hamilton Depression Scale, Hamilton Anxiety Scale	MRP has more impact than Bobath concept in preventing apathy after stroke during acute rehabilitation.

Mainka et al., 2018[26] **Germany** **8/10**	**Exp**: 65.5 ± 8.5 **Con**: 63.7 ± 8.8 **3rd group:** 61.1 ± 8.6 **Exp**: n = 15 **Con**: n = 15 **3rd group:** n = 15	**One group** (RAS-TT) **Second group:** performed only training on the treadmill (TT). **Duration:** 5 times / week for about 4 weeks, all patients were given extra conventional programs for either 30 or 60 minutes.	**A third group** that Received Bobath concept as a control group. **Duration:** 5 times / week for about 4 weeks, all patients were given extra conventional programs, either 30 or 60 minutes.	**Gait:** FGS, LOC, 3MWT **Balance:** IEB	RAS-TT optimizes gait rehabilitation in patients with stroke, supporting the use of functional music with training by treadmill.
Candan & livanelioglu, 2017 [24] **Turkey** **6/10**	**Exp**: 55.13 ± 14.70 **Con**: 57.67 ± 12.20 **Exp**: n = 15 **Con**: n = 15	(mCIMT). **Duration:** 5 days / week for 2 weeks, about 2 hours.	NDT **Duration:** 5 days / week for 2 weeks, about 2 hours.	**Gait:** FAC, 10 MWT, Gait parameters. **Balance:** BBS **Postural control:** postural symmetry ratio.	mCIMT for the LL improved balance, gait, ambulation, and symmetry more than NDT in mild to moderate stroke. All motor functions showed greater enhancement in the study group.
Mikolajewska, 2017[40] **Poland** **5/10**	**Exp**: 54.85 **Con**: 52.5 **Exp**: n = 15 **Con**: n = 15	Bobath concept combined with traditional treatment. **Duration:** 10 times for about 2 weeks (ten days of therapy).	Traditional treatment only. **Duration:** 10 times for about 2 weeks (ten days of therapy).	**Gait:** 10 MWT	With higher gains in gait velocity, cadence, and stride length, the NDT-Bobath approach may be superior to standard therapy for young individuals undergoing gait rehabilitation following a stroke.
Şimşek & Çekok, 2016 [38] **Turkey** **7/10**	**Exp**: 54.15 ± 20.29 **Con**: 61.5 ± 11.63 **Exp**: n = 20 **Con**: n = 22	Nintendo Wii. **Duration:** 3 days / week for about 10 weeks, about 45 – 60 minutes.	(Bobath NDT). **Duration:** 3 days / week for about 10 weeks, about 45 – 60 minutes.	**Functional independence status:** FIM **Quality of life:** NHP	Findings showed no differences between groups in daily functions (FIM) or quality of satisfaction of life.

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Kilinç et al., 2016[29] **Turkey** **6/10**	**Exp**: 55.9+7.9 **Con**: 54.1+13.6 **Exp**: n = 12 **Con**: n = 10	Bobath concept. **Duration:** 3 days / week for about 12 weeks, about 1 hour.	Conventional physiotherapy **Duration:** 3 days / week for about 12 weeks, about 1 hour.	**Trunk control:** TIS **Balance:** BBS **Stability Limits:** FRT **Functional capacity** STREAM **Gait:** 10 MWT **Risk of fall:** TUG	Primary and secondary treatment results showed between groups there were no differences, but the study group had greater internal gains.
Krukowska et al., 2016 [20] **Poland** **5/10**	**Group 1:** 51.72 ±5.95 **Group 2:** 53.64 ± 6.62 **Group 3:** 52.32 ±7.95 **Group 4:** 53.16 ±6.95 **Group 1:** n = 17 **Group 2:** n = 21 **Group 3:** n = 17 **Group 4:** n = 17	**Group 1:** had weakness in the body's right side. The Bobath method was used. **Group 2:** had weakness in the body's left side. The Bobath method was used. **Duration:** daily sessions (35 sessions) for about six weeks.	**Group 3:** had weakness in the body's right side .PNF method was used. **Group 4:** had weakness in the body's left side. The PNF method was used. **Duration:** daily sessions (35 sessions) for about six weeks.	**field support and center of pressure:** Alfa balance platform	Bobath method had proved more successful than PNF in improving balance and decreasing area of support and COP path of length.
Ezema et al., 2018[19] **2018** **Nigeria** **4/10**	**Exp**: 58.36±5.06 **Con**: 57.68±5.74 **Exp**: n = 25 **Con**: n = 25	Bobath concept **Duration:** 2 times / week for about 12 weeks.	PNF patterns **Duration:** 2 times / week for about 12 weeks.	**Balance:** BBS **Activities of Daily Living:** BI	Bobath proved more effective compared to PNF for balance training and improving independence of daily function.
Annethattil et al., 2017[36] **India** **4/10**	**Group A: 40 to 60** **Group B: 40 to 60** **Group C: 40 to 60** **Group A:** n =10 **Group B:** n =10 **Group C:** n =10	**Group A:** Motor relearning program (MRP) **Duration:** five times / week for about four weeks, 45 minutes.	**Group B:** Bobath treatment. **Group C:** combined motor relearning program and Bobath. **Duration:** five times / week for about four weeks, 45 minutes.	**Spasticity:** MAS **Voluntary activity of upper limb** STREAM **Functional recovery - upper limb:** FMA-UE	MRP was more beneficial than Bobath concept alone, but combining both techniques led to greater recovery of upper limb of right MCA patients diagnosed with stroke.
Abrar et al., 2022[35] **Pakistan.** **6/10**	**Exp**: 57.78±7.902 **Con**: 57.65±7.340 **Exp**: n = 40 **Con**: n = 40	Bobath / NDT **Duration:** 3 sessions / week for about 8weeks, about 45 minutes.	MRP **Duration**: 3 sessions / week for about 8weeks, about 45 minutes.	**Spasticity:** MAS	MRP was more effective compared to NDT in reducing UL spasticity in chronic stroke patients.

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Taha et al., 2018[15] **Egypt** **5/10**	**Exp**: 57.67(6.11) **Con**: 58.12(5.42) **Exp**: n = 15 **Con**: n = 15	Specific Bobath-based exercises and task-oriented exercises. **Duration:** 3 days / week for about 8 weeks, about 1 hour.	Task-oriented exercises only. **Duration:** 3 days / week for about 8 weeks, about 1 hour.	**Postural stability:** BBS **Functional stability:** TUG	Bobath exercises combined with task-oriented training reduced muscle imbalance and improved trunk, posture, balance, and walking.
Pratama, 2017[23] **Indonesia** **5/10**	**Exp**: 55,43 **Con**: 52,14 **Exp**: n = 7 **Con**: n =7	Bobath concept **Duration:** 1 hour / day, 3 days /week about 8 weeks.	Feldenkrais Exercise **Duration:** 1 hour / day, 3 days /week about 8 weeks.	**Balance:** Brunel Balance Assessment	Bobath concept had more impact than Feldenkrais for improving balance.
Rehman et al., 2015[25] **India** **3/10**	**Exp**: 40-65 **Con**: 40-65 **Exp**: n = 15 **Con**: n =15	Bobath intervention. **Duration:** 5 days / week for about 4 weeks, about 90 minutes	Repetitive Task Practice and Shaping Program. An arm sling was used to confine the less affected extremity, and CIMT was administered to the affected extremity. **Duration:** 5 days / week for about 4 weeks, about 90 minutes	**Upper limb arm and hand dexterity function:** WMFT, JTHFT.	Not much improvement in arm function, writing (JTHFT), or strength of grip (WMFT) in both groups but in CIMT group is slightly higher improvement.
Firoozeh et al., 2019 [17] **Tehran** **8/10**	**Exp**: 56.5 ± 10.13 **Con**: 61.13 ± 11.04 **Exp**: n = 6 **Con**: n =8	(TOT) with Bobath program. **Duration:** Group A received 30 minutes / day TOT and 30 minutes / day Bobath therapy, for three days / week for about five weeks.	(TOT) only. **Duration:** Group B received one hour / day TOT therapy, three days /week for about five weeks.	**Functional recovery of upper limb:** FMA- UE **Arm motor function:** WMFT **Daily living Activities:** BI **Grip Strength Test:** PCE-FM1000force tester (force gauge load cell)	No significant differences were found between groups in FMA-UE, WMFT, BI, or grip strength.

Shahid et al., 2024[18] **Pakistan** **9/10**	**Exp**: 16 to 45 years **Con**: 16 to 45 years **Exp**: n = 30 **Con**: n =30	Task-oriented approach **Duration:** two sessions / week for about 24 weeks, for 30 to 45 minutes.	Bobath approach **Duration:** two sessions / week for about 24 weeks, for 30 to 45 minutes.	**Daily living Activities:** BI **Sensory-motor function:** MAS **Quality of life:** specific QoL scale	Both treatments improved young patients with stroke, but TOT was more effective compared to Bobath for ADL, motor function, and QoL.
Danial Baig et al., 2024 [32] **Pakistan** **6/10**	**Exp**: 50 to 70 years **Con**: 50 to 70 years **Exp**: n = 13 **Con**: n = 13	(CIMT) **Duration:** four sessions /week for about eight-week.	Bobath approach. **Duration:** four sessions /week for about eight-week.	**motor function - Upper limb:** FMA-UE CAHAI	Constraint Induced Movement Therapy (CIMT) led to better outcomes than the Bobath method, especially for overall arm function and the coordinated use of the wrist and hand.

BBS: Berg Balance Scale, **BI:** Barthel index, **CAHAI :** Chedoke Arm and Hand Inventory, **DNS:** Dynamic Neuro Muscular Stabilization ,**FAC:** Functional ambulation category, **FGS:** fast gait speed test, **FIM:** Functional Independent Measure, **FIM-M:** Functional Independence Measurement motor subscale, **FRT:** functional reach test, **GAS:** Goal Attainment Scale, **IEB:** instrumental evaluation of balance, **JTHFT:** Jebsen Taylor Hand Function Test ,**LOC:** gait analysis with locometre, **MAS-T:** Motor Assessment scale trunk subscale, **MCA:** Middle Cerebral artery, **MRS:** Modified Rankin Scale, **MRP:** Motor relearning program ,**MST:** Modified Schober's test, **3MWT:** 3min walking time test, **10 MWT**:10-Meter Walk Test, **NDT:**Neurodevelopmental treatment,**NHP:** Nottingham Health Profile, **PASS:** Postural assessment scale, **PreFULT:** Pre-Functional Upper Limb Test, **SS-QOL:** Stroke specific Quality of life, **STREAM:** Stroke Rehabilitation Assessment of Movement, **TIS:** Trunk Impairment scale, **TOT:** Task oriented training **TUG:** Timed up-and-go, **UL:** Upper limb, **WMFT:** Wolf Motor Function Test.

Table 2. Details of the risk of bias assessment

Study ID	Random allocation	Allocation concealment	Similar baseline data between groups	Blinding of subjects	Blinding of therapists	Blinding of assessors	Key outcomes obtained from more than 85% of the subjects	Intention to treat analysis	Between-group statistical comparison	Point measures and/or measures of variability	Total score
Fil Balkan et al., 2024[27]	1	1	1	0	1	1	1	0	1	1	8
Younas et al.,2024 [16]	1	1	1	0	0	1	1	0	0	1	6
Olczak et al.,2023[31]	1	0	1	1	1	0	1	0	1	1	7
Sütçü et al., 2023[14]	1	0	1	0	0	1	1	0	1	1	6
Brock et al., 2022[30]	1	1	1	0	0	1	1	1	1	1	8
Simi Hazarika et al., 2022[22]	1	0	0	0	0	0	1	0	1	1	4
Kuciel et al., 2021 [21]	1	1	0	1	0	1	1	0	1	1	7
Chitkara et al., 2021[33]	1	0	0	0	0	0	1	0	1	1	4
Khallaf ,2020[13]	1	1	1	1	0	1	1	0	1	1	8
Yoon et al.,2020[34]	1	0	1	0	0	0	1	0	1	1	5
Chen et al., 2019[37]	1	1	1	0	0	0	1	0	1	1	6
Mainka et al., 2018[26]	1	1	1	0	1	1	1	0	1	1	8

Candan & livanelioglu, 2017 [24]	**1**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**1**	**1**	**6**
Mikolajewska, 2017[40]	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**5**
Şimşek & Çekok, 2016 [38]	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**7**
Kilinç et al., 2016[29]	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**7**
Krukowska et al., 2016 [20]	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**5**
Ezema et al., 2018[19]	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**4**
Annethattil et al., 2017[36]	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**4**
Abrar et al., 2022[35]	**1**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**1**	**1**	**6**
Taha et al., 2018[15]	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**5**
Pratama, 2017[23]	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**5**
Rehman et al., 2015[25]	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**3**
Firoozeh et al., 2019 [17]	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**8**
Shahid et al., 2024[18]	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**9**
Danial Baig et al., 2024[32]	**1**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**1**	**1**	**6**

Statistical Analysis

Meta-analysis was applied for about 15 studies.

Statistical analysis for Trunk control:

Eight studies compared trunk control among the Bobath intervention group and the control group **(forest plot 1**). These studies showed considerable heterogeneity (n = 8 studies, n = 236 participants; P < 0.00001, I² = 82%), indicating that the true effect may vary depending on the population and context. A statistically insignificant change was found by the analysis. (P = 0.11, P > 0.05) in trunk control among Bobath group and control group (SMD = -1.30, 95% CI [-2.91, 0.30]). Findings suggest that additional research is required to draw definitive conclusions. Some studies show a slight favor toward Bobath [14] while others favor control interventions [33], This inconsistency contributes to the overall heterogeneity. However, Further research may be necessary to reach definitive conclusions. **(fig.2)**

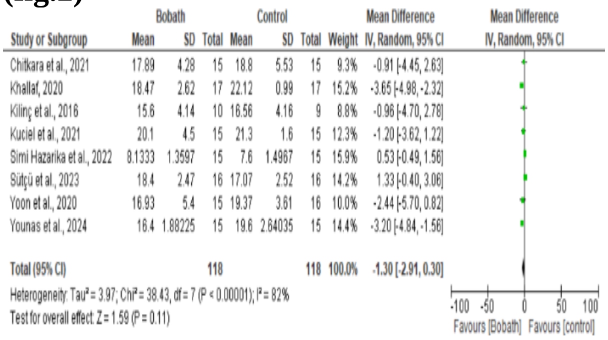

Figure (2). Forest plot of comparison: 1 Bobath concept on trunk control, outcome: 1.1 trunk impairment scale (TIS).

Statistical analysis for Balance:

Six studies assessed balance among study group (Bobath group) and control group **(Forest plot 2)**. There was heterogeneity among the six studies, (n= 6 studies, n= 190 participants, (P = 0002); I² = 79%). Results indicated that the difference is statistically significant (P <0.00001; P<0.05) in Balance (SMD= -4.81, 95% CI, [-6.38, -3.24]) among Bobath group and control group **(fig. 3)**.

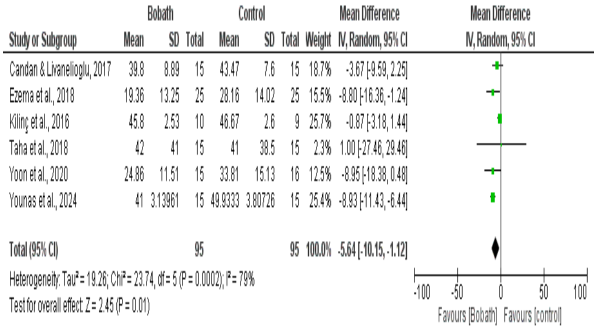

Figure (3). Forest plot of comparison: 2 Bobath concept on Balance, outcome: 2.1 Berg Balance Scale (BBS).

Statistical analysis for gait speed:

Four studies assessed gait speed among study group (Bobath group) and control group (Forest plot 3). There was heterogeneity among the four studies, (n= 4 studies, n= 109 participants, (P =0.0002); I² = 79%). Results indicated that the difference is statistically significant (P <0.00001; P<0.05) in speed parameter in gait (SMD= 0.15, 95% CI, [0.11, 0.19]) among Bobath group and control group. [N.B. The **Mikolajewska** study heavily influenced the overall result due to its large weight [28] **(fig. 4)**.

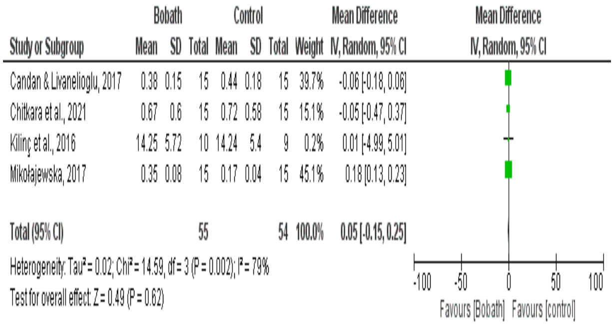

Figure (4). Forest plot of comparison: 3 Bobath concept on gait speed, outcome: 3.1 10-meter walk test (10MWT).

Statistical analysis for activities of daily living:

Four studies examined daily living activities among the study group (Bobath group) and the control group (Forest plot 4). There was heterogeneity among the four studies, (n= 4 studies, n= 612 participants, (P <0.0001); I² = 87%). That considerable variation among the included studies indicated that the true effect may differ based on the specific population and context. Results showed that there wasn't a statistically significant difference (P =0.12; P>0.05) in daily living activities (SMD= -3.07, 95% CI, [-6.98,0.84]) among group of Bobath and control group **(fig. 5)**.

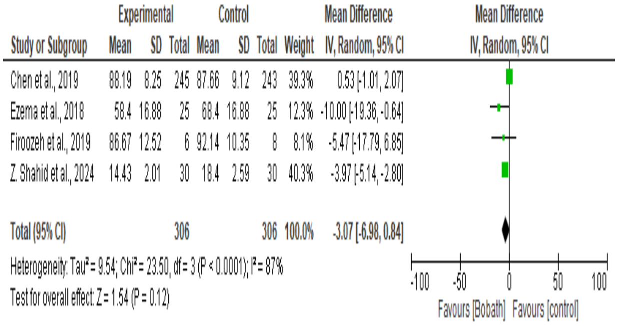

Figure (5). Forest plot of comparison: 4 Bobath concept on activities of daily living, outcome: 4.1 Barthel index (BI).

DISCUSSION:

This systematic review evaluated the impact of Bobath Concept compared to other stroke rehabilitation techniques. The analysis included 26 randomized controlled trials (RCTs) involving 1,513 patients clinically diagnosed with stroke, published before July 2024.

Current research findings suggest that the Bobath Concept may not consistently outperform other modern neurorehabilitation techniques. [5,41-43].

A 2023 systematic review comparing Bobath concept with training by task-specific exercises and robotics for recovery of upper limb found that task-specific exercises and robotic interventions yielded medium to large effect sizes (0.55–1.59), indicating greater improvements in UL function than Bobath therapy [5].

Another study reported that task-oriented exercises was more successful than Bobath concept in enhancing walking abilities and LL function after stroke. Notably, Bobath therapy only showed superiority over PNF in a single trial [41]. A 2021 review further reinforced that Bobath Concept may be less successful than alternative therapies for recovery of motor [42].

Additionally, a review examining UL rehabilitation in acute stroke found that while Bobath therapy had some benefits compared to no intervention, it was inferior to other therapies in enhancing motor function, arm-hand kinematics, and daily living activities (ADLs). This may be attributed to Bobath's focus on movement normalization rather than functional task performance [43].

Unlike earlier reviews, this study incorporates 24 more randomized controlled trials, providing a broader and more recent examination of the Bobath concept. Additionally, it addresses a key gap in the literature by evaluating outcomes across multiple body regions, rather than focusing solely on lower limb recovery or gait improvement. Out of the 26 RCTs analyzed, meta-analysis was performed on 15 studies and 10 were excluded, due to heterogeneity in assessment tools, measurement approaches, and study design variations, which prevented direct comparisons. This updated synthesis reinforces the conclusion that while the Bobath concept remains a widely used approach, alternative rehabilitation strategies may offer greater functional benefits for stroke recovery. additional high-quality research is required to refine clinical recommendations.

The Bobath concept has demonstrated efficacy in improving motor function across multiple domains of stroke rehabilitation, as evidenced by various clinical studies. Comparative studies proved the superiority of the Bobath therapy over the Feldenkrais method in balance improvement, attributed to its systematic problem-solving approach that integrates sensory stimulation, postural control activation, and task-specific movement training [23]. Bobath-based trunk training proved more effective than conventional therapy for enhancing sitting ability and control of trunk among acute patients, regardless of severity, due to its focus on sensorimotor integration rather than isolated strength training [27]. The Bobath concept was also has greater impact than PNF in balance and independence of function, likely due to its emphasis on early intervention promoting neuroplasticity [19].

Research by **Olczak and Dornowski** demonstrated that Bobath-based interventions yielded significant functional improvements in stroke-affected non-dominant UL[31]. The study emphasized that Bobath exercises specifically enhance grasping ability and overall functional capacity, recommending their systematic incorporation into stroke rehabilitation protocols. These benefits likely stem from the concept's focus on bilateral integration and task-oriented training approaches. **Brock** investigated Bobath therapy's efficacy for patients with persistent UL deficits (4-16 weeks post-stroke)[30]. Their findings revealed superior outcomes compared to conventional rehabilitation, particularly in directional control during functional tasks (e.g., tabletop reaching), motor control restoration and overall UL functional recovery[30]. **Danial Baig** examined interventions such as Constraint Induced Movement Therapy (CIMT) and Bobath approach have beneficial effect on recovery of motor function. However (CIMT) is more beneficial for upper limb recovery especially for overall arm function and hand-wrist coordination[32].

Mikołajewska's comparative study revealed that younger stroke survivors undergoing Bobath therapy demonstrated superior gait improvements compared to traditional rehabilitation methods[28]. The intervention group showed statistically significant enhancements in key gait parameters. findings suggest Bobath concept may be particularly beneficial for optimizing gait mechanics in younger stroke populations, potentially due to greater neuroplasticity and responsiveness to sensorimotor training approaches[28]. **Kilinç** conducted a 12-week longitudinal study comparing Bobath therapy with conventional approaches[29]. While initial assessments showed comparable baseline function between groups, the Bobath group demonstrated significant intra-group improvements in control of trunk and parameters of gait, markedly better performance on the 10MW test post-intervention and progressive functional gains throughout the training period. These results indicate that while both approaches may achieve similar initial outcomes, Bobath therapy appears to facilitate more substantial and sustained improvements in walking ability over extended rehabilitation periods[29].

The Bobath concept effectively reduced the support area and path length of the center of pressure (COP). The analysis showed that the Bobath concept had more impact on reducing the COP path length in post-stroke patients. In contrast, patients who received PNF-based therapy exhibited significantly worse results. Both treatment groups demonstrated a similar trend in reducing the support surface area. However, the most reduction was observed in the Group, which received Bobath therapy. [20]

The Bobath concept has been shown in numerous trials to have results that are equivalent to those of other well-known rehabilitation techniques for stroke recovery. Research shows equivalent effectiveness between Bobath and task-oriented exercises for improving control of trunk, motor abilities, and balance [14,15], with potential synergistic benefits when combined. For UE rehabilitation, Bobath therapy produces similar results compared to constraint-induced movement therapy [17,25], while matching PNF efficacy for postural control[21]. Additionally, Bobath yields comparable outcomes to technology-assisted interventions like Nintendo Wii therapy for ADL, self-care, locomotion, and quality of life measures [38].

These findings collectively suggest that while the Bobath concept remains an effective neurorehabilitation approach, its results are generally on par with other evidence-based interventions across various functional domains of stroke recovery.

On the other hand, current evidence demonstrates that multiple rehabilitation approaches achieve comparable or superior outcomes to the Bobath concept in stroke recovery. Sixteen studies suggested that Task-Oriented Training, PNF, DNS, mCIMT, Robotic-Assisted Gait Training (RAS-TT), and the motor relearning program (MRP) are at least as effective as, and in some cases more effective than, the Bobath concept. **Younas, Shahid and Khallaf** reported greater improvements in balance, motor abilities, and quality of satisfaction of life through principles of task specificity and motor learning[13,16,18].

Proprioceptive neuromuscular facilitation (PNF) and DNS show enhanced trunk stability and postural control through reflex-mediated strategies[22,33,34].

Modified constraint-induced movement therapy (mCIMT) demonstrated superior efficacy for balance and gait symmetry[24]and upper limb motor function[32], while robotic-assisted gait training yielded better improvements in gait parameters [26]. MRP proved more effective for spasticity reduction, though combining MRP with Bobath may optimize UL rehabilitation [35-37]. These findings collectively suggest that while the Bobath concept remains clinically relevant, alternative evidence-based approaches frequently achieve superior functional outcomes across specific rehabilitation domains.

Study Strengths

This systematic review offers several methodological strengths, including the comprehensive analysis of 26 randomized controlled trials involving 1,513 stroke patients, providing a robust evidence base for comparing the Bobath Concept with alternative rehabilitation approaches. By incorporating 24 additional studies beyond prior reviews, this work delivers an updated and more extensive evaluation of motor recovery across multiple functional domains, including UL function, gait, balance, and control of trunk in patients clinically diagnosed with stroke. Additionally, the application of meta-analysis to 15 studies enhances the reliability of the findings, while the exclusion of 10 studies due to methodological heterogeneity ensures greater consistency in comparative assessments. The review also addresses a gap in previous literature by examining whole-body recovery rather than focusing narrowly on specific impairments.

Study Limitations

This review has a few limitations despite its strengths. The exclusion of 10 studies due to heterogeneity in outcome measures and intervention protocols may have introduced selection bias, potentially overlooking valuable data on certain rehabilitation approaches. Direct comparisons and the generalizability of results are made more difficult by variations in study designs, patient demographics (such as variations in the severity and chronicity of strokes), and intervention durations among the included trials. Furthermore, the capacity to evaluate long-term treatment effects is limited by the prevalence of small-scale RCTs and the absence of follow-up on long-term in a lot of studies. While the review highlights comparative efficacy of various approaches, the absence of standardized protocols for Bobath and alternative therapies makes it challenging to definitively conclude superiority in specific clinical contexts.

CONCLUSION

According to the current findings, Bobath Concept continues to serve as a useful option in stroke rehabilitation, especially for enhancing balance, trunk stability, and upper limb function. However, it does not consistently outperform other evidence-based interventions across all domains. However, emerging evidence suggests that alternative interventions—including task-specific training, DNS, CIMT, robotic gait training, and MRP—often yield equal or greater functional improvements, particularly for gait symmetry, spasticity reduction, and task performance. These findings underscore the need for individualized rehabilitation plans tailored to patient-specific goals and impairments. To improve stroke recovery techniques and further refine clinical recommendations, future research should give priority to large-scale, RCTs with high-quality with standardized protocols and measurements of long-term outcome.

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