The Effects of Bobath Therapy on Balance, Gait, and Physical Function in Stroke Patients: A Systematic Review and Meta-Analysis

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Purpose This study aimed to quantitatively evaluate the effects of Bobath therapy on balance, gait, and physical function in stroke patients through a systematic review and meta-analysis. By synthesizing evidence, this study sought to address inconsistencies in the literature and provide a clearer understanding of the clinical efficacy of Bobath therapy. ***Methods*** A systematic search was conducted in CENTRAL, CINAHL, Embase, MEDLINE, and Web of Science in November 2024. Randomized controlled trials (RCTs) evaluating Bobath therapy in stroke patients were included. Data synthesis and meta-analysis were performed using RevMan 5.4, with the effect sizes calculated as standardized mean differences (SMDs) under a random-effects model. Heterogeneity was assessed using the I^2 statistic and Cochrane's Chi-squared test. ***Results*** Six RCTs with a total of 246 stroke patients were included. Bobath therapy demonstrated a moderate positive effect on balance (SMD 0.59, 95% confidence interval [CI]: 0.04–1.15, $p = 0.04$, $I^2 = 69\%$) and gait performance (SMD 0.56, 95% CI: 0.02–1.11, $p = 0.04$, $I^2 = 52\%$). For physical function, a small-to-moderate effect was observed (SMD 0.52, 95% CI: 0.00–1.04, $p = 0.05$, $I^2 = 36\%$). Measures such as center of pressure (COP) and modified rankin scale (MRS) were adjusted for directionality to ensure consistency. However, the limited number of studies prevented a robust assessment of publication bias. ***Conclusion*** This meta-analysis highlights Bobath therapy's moderate effectiveness in improving balance, gait, and physical function in stroke patients but emphasizes the need for more rigorous RCTs to validate findings and evaluate long-term outcomes.

Key words Balance, Bobath therapy, Gait performance, Meta-analysis, Physical function, Stroke rehabilitation, Systematic review

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I. Introduction

Stroke is one of the leading causes of death and disability worldwide, resulting in significant physical and functional limitations for survivors.[1)] In particular, impairments in balance, gait, and physical function greatly impact the ability of stroke patients to perform daily activities and maintain their quality of life, posing substantial challenges to independent living.[2,3)] To address these issues, various rehabilitation approaches have been developed and implemented.[4)] The Bobath Concept, a prominent neurodevelopmental treatment (NDT) approach, focuses on normalizing abnormal postural and movement patterns to facilitate functional recovery in patients.[5)] This therapeutic method aims to improve balance, gait, and overall physical independence and is widely utilized in rehabilitation practices globally.[6)] Previous studies have suggested that Bobath therapy may have a positive impact on improving balance and physical function in stroke patients. However, a lack of consensus among the findings has been identified as a significant limitation.[7,8)] Notably, the majority of studies have compared Bobath therapy with conventional therapy or with other rehabilitation approaches such as constraint-induced movement therapy (CIMT), motor relearning program (MRP), task-oriented training, and dynamic neuromuscular stabilization (DNS).[9-13)] Additionally, numerous studies have investigated Bobath therapy in combination with other intervention techniques.[14-16)] This variability has

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led to differences in the interpretation of study results, contributing to issues of heterogeneity regarding the effects of Bobath therapy.[8,17] Consequently, it has been challenging to comprehensively evaluate the overall effectiveness of Bobath therapy. To date, while a few systematic reviews have been conducted on Bobath therapy, studies quantitatively evaluating its effects through meta-analysis are scarce.[8,18] Therefore, this study aims to comprehensively analyze the effects of Bobath therapy on balance, gait, and physical function in stroke patients and to quantitatively assess its efficacy through meta-analysis. By addressing the limitations of previous research, this study seeks to clarify the clinical effectiveness of Bobath therapy and contribute to the development of effective rehabilitation strategies for stroke patients.

II. Materials and Methods

1. Study design

This study is a systematic review and meta-analysis that synthesizes Bobath-based therapy for stroke patients through both qualitative and quantitative analyses. The review was conducted in accordance with the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and was pre-registered in the International Prospective Register of Systematic Reviews (PROSPERO) (No. CRD42024620356).

2. Eligibility criteria

The eligibility criteria were established based on the PICOSD framework: Participants [P], Intervention [I], Comparison [C], Outcomes [O], and Study Design [SD].

3. Inclusion Criteria

1) Participants

The participants included patients diagnosed with stroke.

2) Intervention

The intervention included Bobath therapy or Bobath-based therapy, encompassing subcategories aligned with the Bobath Concept.

3) Comparison

The comparators included interventions such as task practice, Dynamic Neuromuscular Stabilization (DNS), traditional exercise, Proprioceptive Neuromuscular Facilitation (PNF), conventional therapy, or body-weight supported treadmill training (BWSTT).

4) Outcomes

The outcomes measured included scales representing physical function, balance and gait.

5) Study Design

The studies included were randomized controlled trials (RCTs) retrieved from databases and published in peer-reviewed journals.

4. Exclusion criteria

Studies were excluded if they did not include subcategories related to the Bobath Concept in RCTs, were not conducted on human participants, were not published in English, were reported only in conference proceedings, or were published before 2011.

5. Lierature-Search strategy

The studies included in this review were independently searched by two researchers with meta-analysis experience in November 2024. The search strategy was constructed by combining terms representing P (Participants), I (Intervention), and SD (Study Design) and was based on Medical Subject Headings (MeSH). Predefined keywords such as (randomized controlled trial) AND (stroke patients) AND (bobath therapy OR bobath-based OR bobath concept OR neurodevelopment therapy) were used, along with index terms. The search was conducted in international electronic databases, including the Cochrane Central Register of Controlled Trials (CENTRAL), Cumulative Index of Nursing and Allied Health Literature (CINAHL), Excerpta Medica Database (Embase), Medical Literature Analysis and Retrieval System Online (MEDLINE), and Web of Science.

6. Study selection and data extraction

Studies retrieved from the previously mentioned electronic databases were imported into Microsoft Excel

(Microsoft, Redmond, Washington, USA) to remove duplicate records. Following the PRISMA guidelines, the titles and abstracts of the studies were screened, and full-text reviews were conducted for further assessment. In cases where discrepancies occurred, the full texts were reviewed collaboratively to reach a consensus on final inclusion.

7. Risk of bias assessment

The risk of bias (RoB) in the included RCTs was assessed using a standardized tool developed by the Cochrane Bias Methods Group, which evaluates seven domains of bias. Two researchers independently assessed the risk of bias as low (+), high (-), or unclear (?), and any discrepancies were resolved through joint review of the original studies to reach consensus.[19)]

8. Strategy for Data Synthesis

Data synthesis was conducted using RevMan 5.4 (The Cochrane Collaboration, England), a software designed for systematic reviews. Meta-analysis was performed when at least three studies provided comparable variables or quantitative data measured before and after the intervention. Effect sizes were calculated as standardized mean differences (SMD), and a random-effects model was used to account for variability between studies.[20)] Heterogeneity was assessed using the I^2 statistic and Cochrane's Chi-squared test, with I^2 values above 75% indicating high heterogeneity and values below 40% indicating low heterogeneity[21)]. Publication bias was evaluated using funnel plots generated by RevMan 5.4[22)].

III. Results

1. Literature search and characteristics of the included studies

A total of 63 studies were identified through international electronic databases. After removing 11 duplicate studies using Excel, the titles and abstracts of the remaining studies were screened and 10 studies were excluded. Full-text reviews excluded 36 studies based on the following reasons. Nine studies did not provide data, six involved different interventions, 18 had inappropriate study designs, two had unsuitable comparisons, and one did not meet participant criteria. After these exclusions, a total of six RCTs were included for qualitative and quantitative synthesis(Figure 1).[9, 23-27)]

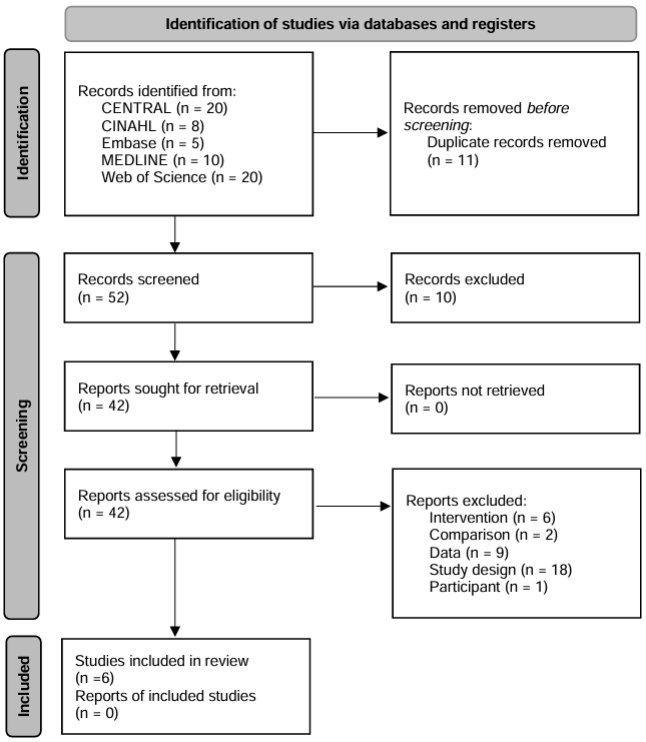

Figure 1. PRISMA diagram.

1) Methodological Quality Assessment

The methodological quality assessment of the six included RCTs showed 100% agreement between researchers. The results of the RoB assessment for the seven domains are as follows. Random sequence generation (+: 6), allocation concealment (+: 3, ?: 3), blinding of participants and personnel (-: 6), blinding of outcome assessment (+: 4, ?: 2), incomplete outcome data (+: 6), selective reporting (+: 6), and other bias (-: 2, ?: 4) (Figure 2).

2) Bobath Therapy for Stroke Rehabilitation

The six RCTs included in this systematic review involved a total of 246 stroke patients. The interventions included Bobath therapy and Bobath-based therapy,

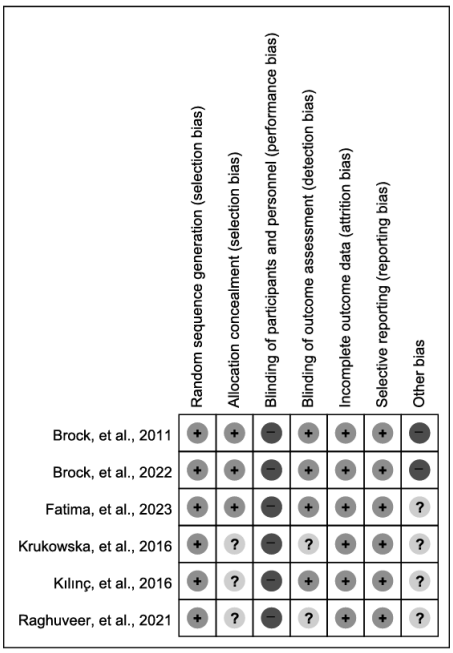

Figure 2. Risk of bias summary.

which are subcategories of the Bobath concept. The treatment duration ranged from 2 to 12 weeks. The outcome measures included evaluation tools representing balance, gait, and physical function (Table 1).

3) Effects of body awareness therapy on balance

The meta-analysis of six studies assessing the effects of Bobath therapy on balance included a total of 193 participants (96 in the experimental group and 97 in the control group) (Figure 3). The pooled SMD was 0.59 (95% CI: 0.04 to 1.15), indicating a moderate positive effect of Bobath therapy on balance compared to control interventions. The I^2 statistic was 69%, suggesting moderate-to-high variability among the included

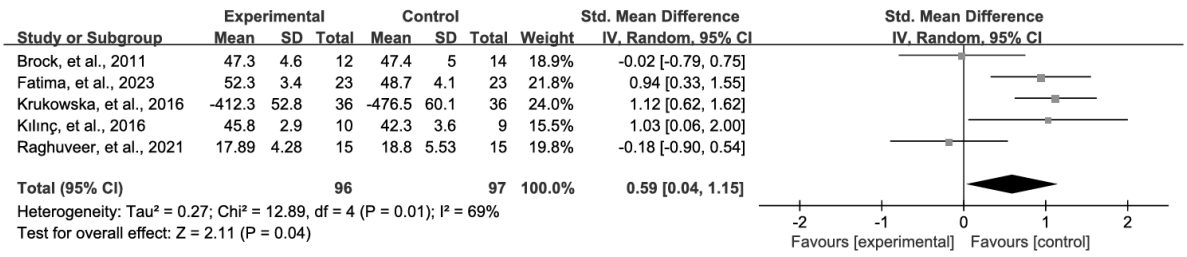

Figure 3. Forest plot on balance.

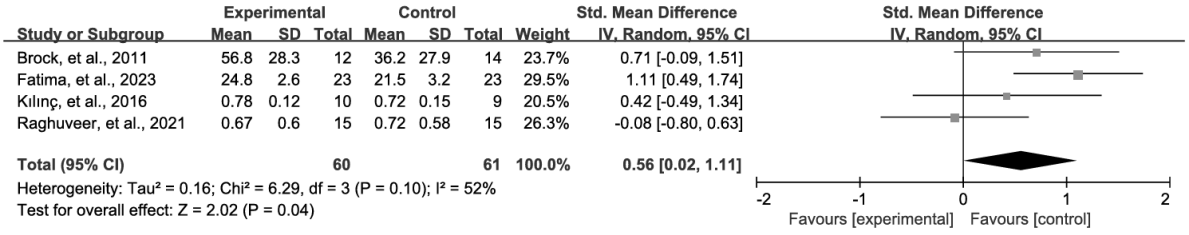

Figure 4. Forest plot on gait performance.

studies. The overall effect was statistically significant (p = 0.04). Among the included balance measures, COP was adjusted by multiplying by -1 to align the directionality with other outcome measures, ensuring consistency in the analysis. These results suggest that Bobath therapy moderately improves balance in stroke patients, although the observed heterogeneity highlights variability in study designs and intervention protocols.

4) Effects of body awareness therapy on gait performance

The meta-analysis of four studies assessing the effects of Bobath therapy on gait performance included a total of 121 participants (60 in the experimental group and 61 in the control group) (Figure 4). SMD was 0.56 (95% CI: 0.02 to 1.11), indicating a moderate positive effect of Bobath therapy on gait performance compared to control interventions. The I^2 statistic was 52%, suggesting moderate variability among the included studies. The overall effect was statistically significant (p = 0.04). These results suggest that Bobath therapy has a moderate beneficial effect on gait performance in stroke patients, although the observed heterogeneity reflects some differences in study designs and intervention protocols.

5) Effects of body awareness therapy on physical function

The meta-analysis of three studies assessing the effects of Bobath therapy on physical function included a total of 102 participants (54 in the experimental group and 48 in the control group)(Figure 5). The pooled SMD was 0.52 (95% CI: 0.00 to 1.04), indicating a small-to-moderate positive effect of Bobath therapy on

Table 1. Characteristics of included studies

Study	Sample size	Therapeutic intensity	Outcome
Brock, et al., 2011[23]	EG = 12 CG = 14	A total of 2 weeks of therapy was administered, with the EG receiving 1 hour sessions of Bobath-based therapy and task practice three times per week, while the CG received 1 hour sessions of task practice only.	Balance = BBS Gait = gait velocity
Brock, et al., 2022[9]	EG = 29 CG = 24	A total of 2 weeks of therapy was administered, with the EG receiving 1 hour sessions of Bobath-based therapy three times per week, while the CG received 1 hour sessions of conventional therapy.	Physical function = STREAM
Fatima, et al., 2023[24]	EG = 23 CG = 23	A total of 12 weeks of therapy was administered, with the EG receiving 45 minute sessions of NDT three times per week, while the CG received 45 minute sessions of BWSTT three times per week.	Balance = BBS Gait = FGA
Kılınç, et al., 2016[25]	EG = 10 CG = 9	A total of 12 weeks of therapy was administered, with the EG receiving 1 hour sessions of Bobath-based trunk exercises three times per week, while the CG received 1 hour sessions of conventional exercises focused on stretching, strengthening, mat activities, and range of motion.	Balance = BBS Gait = 10MWT Physical function = STREAM
Krukowska, et al., 2016[26]	EG = 36 CG = 36	A total of 6 weeks of therapy was administered, with the EG receiving daily 1 hour sessions of NDT-Bobath therapy for 35 sessions, while the CG received daily 1 hour sessions of PNF therapy for the same duration.	Balance = COP
Raghuveer, et al., 2021[27]	EG = 15 CG = 15	A total of 6 weeks of therapy was administered, with the EG receiving daily 1 hour sessions of NDT, while the CG received daily 1 hour sessions of DNS.	Balance = TIS Gait = 10MWT Physical function = MRS

Note. EG: experimental group, CG: control group, BBS: Berg balance scale, STREAM: stroke rehabilitation assessment of movement, NDT: neurodevelopmental training, BWSTT: body weight supported treadmill training, FGA: functional gait assessment, 10MWT: 10 meter walk test, PNF: proprioceptive neuromuscular facilitation, COP: center of pressure, DNS: dynamic neuromuscular stabilization, TIS: trunk impairment scale, MRS: modified rankin scale.

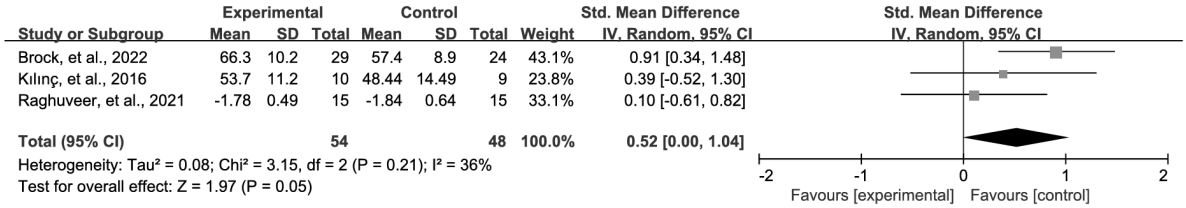

Figure 5. Forest plot on physical function.

physical function compared to control interventions. The I^2 statistic was 36%, suggesting low-to-moderate variability among the included studies. The overall effect was borderline statistically significant ($p = 0.05$). Among the physical function measures, MRS was adjusted by multiplying by -1 to align the directionality with other measures, such as STREAM, where higher values indicate better outcomes. These results suggest that Bobath therapy has a small-to-moderate positive impact on physical function in stroke patients, with low-to-moderate heterogeneity indicating relatively consistent findings across studies.

6) Publication Bias

In this review, six studies were synthesized for the systematic review and meta-analysis based on the eligibility criteria. According to Cochrane Reviews, assessment of publication bias is not recommended when fewer than 10 studies are included in the analysis[28]. Therefore, publication bias was not evaluated in this study.

Ⅳ. Discussion

The results synthesized in this review indicate that Bobath therapy demonstrated moderate positive effects on balance and gait performance, and small-to-moderate effects on physical function. Specifically, the pooled results showed an SMD of 0.59 (95% CI: 0.04–1.15) for balance, 0.56 (95% CI: 0.02–1.11) for gait performance, and 0.52 (95% CI: 0.00–1.04) for physical function. These findings suggest that Bobath therapy provides significant improvements compared to conventional therapy and other rehabilitation approaches. However, the observed heterogeneity (I^2) was moderate-to-high, with 69% for balance and 52% for gait performance, indicating that differences in study design and intervention protocols may have influenced the interpretation of results. The findings of this study align with the mechanistic evidence reported in previous literature on Bobath therapy.[29-31] Bobath therapy, as a neurodevelopmental approach, focuses on normalizing abnormal postures and movement patterns while enhancing balance control and movement efficiency.[5] The use of evaluation tools such as STREAM and MRS in this study reflects these underlying mechanisms. While STREAM provides a comprehensive assessment of overall movement and functional independence, MRS focuses on more specific domains of physical function.[32,33] The differences between these tools further highlight the complexity of interpreting results related to physical function. This study represents the first meta-analysis to quantitatively evaluate the effects of Bobath therapy, making a significant contribution to the literature. Unlike previous systematic reviews that primarily relied on qualitative assessments, this study provides quantitative effect sizes, offering a clearer understanding of the clinical efficacy of Bobath therapy. However, several limitations should be noted. First, the small number of included studies (fewer than 10, as per Cochrane guidelines) precluded an assessment of publication bias. Second, the variability in study designs and comparator interventions contributed to the observed heterogeneity, which poses a challenge for generalizing the findings. To address these limitations, future research should include subgroup analyses or meta-regression to explore the sources of heterogeneity and provide deeper insights into the effectiveness of

Bobath therapy. Clinically, this study suggests that Bobath therapy can be an effective approach for improving balance, gait, and physical function in stroke patients. However, future research should focus on high quality randomized controlled trials using standardized assessment tools and consistent protocols. Additionally, further studies are needed to evaluate the long-term effects of Bobath therapy and its applicability across diverse patient populations. In conclusion, the findings of this meta-analysis provide evidence supporting the moderate effectiveness of Bobath therapy in enhancing balance, gait, and physical function in stroke patients. By addressing existing gaps in the literature, this study highlights the clinical relevance of Bobath therapy as a rehabilitation strategy. Nevertheless, the observed heterogeneity and methodological variability among the included studies underscore the need for further research to establish stronger evidence and refine its implementation in clinical practice.

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