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Bilateral Upper Extremity Exercise (BUEE) to Improve Motor Function in Ischemic Stroke Patients: A Case Study

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Abstract

Stroke remains one of the leading causes of mortality and disability worldwide, with hemiparesis being a common complication that significantly impairs upper extremity function. BUEE is an evidence-based nursing intervention aimed at stimulating neuroplasticity and enhancing motor recovery through the simultaneous movement of both arms. The purpose of this case study was to describe and analyze the implementation of BUEE as an evidence-based nursing intervention to improve upper extremity motor function in ischemic stroke patients with hemiparesis. This study also aimed to evaluate changes in muscle strength, movement coordination, and *Fugl-Meyer Assessment for Upper Extremity* (FMA-UE) scores following the implementation of BUEE in two patients with different hemiparetic sides. In addition, this case study sought to demonstrate that BUEE can be effectively applied in patients with either right- or left-sided hemiparesis, thereby supporting neuroplasticity, enhancing motor recovery, and improving patients' independence in performing activities of daily living.This case study aimed to describe the application of BUEE in two ischemic stroke patients with hemiparesis who were hospitalized in a stroke ward in Jakarta. The intervention was conducted twice daily for three consecutive days. Each 15-minute session consisted of bilateral movements of the shoulders, elbows, wrists, and fingers, performed actively or with assistance FMA-UE was used to evaluate motor function assesses active or assisted bilateral movements of the shoulders, elbows, wrists, and fingers before and after the intervention. Both patients demonstrated marked improvement in upper extremity motor performance. Mrs. S's FMA-UE score increased from 34 to 46 (from moderate to mild impairment), while Mrs. H's score improved from 43 to 57 (maintaining mild impairment with functional gains). Enhancements were also observed in muscle strength, coordination, and hemodynamic stability. Both patients tolerated the exercises well without any adverse effects. The results indicate that BUEE is an effective, safe, and economical intervention to improve upper extremity motor function and promote neuroplasticity in ischemic stroke patients with hemiparesis. This intervention can be integrated into routine hospital rehabilitation programs. Nurses are encouraged to apply BUEE as a non-pharmacological strategy to enhance motor recovery, prevent immobilization-related complications, and improve patient independence.

Keywords: Bilateral Upper Extremity Exercise, Hemiparesis, Ischemic Stroke, Motor Recovery, Nursing Intervention.

INTRODUCTION

Stroke is a syndrome characterized by an acute, clinically defined focal neurological deficit resulting from vascular injury to the central nervous system, either due to infarction or hemorrhage. Globally, stroke is the second leading cause of death and the third leading cause of disability, particularly in middle- to high-income countries (WHO, 2020). In 2021, stroke accounted for 1 in 6 cardiovascular-related deaths. Epidemiologically, one stroke occurs every 40 seconds, and one stroke-related death occurs every 3 minutes and 14 seconds. Approximately one-quarter of all cases (around 185,000) occur

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in individuals with a history of previous stroke. Ischemic stroke, which results from obstruction of blood flow to the brain, is the most prevalent type, representing approximately 87% of all cases. Data from the *Framingham Heart Study* indicate a decline in stroke incidence, although the study population was predominantly white (Lui et al., 2025).

Approximately 85% of all strokes are ischemic, typically caused by small-vessel arteriolosclerosis, cardioembolism, or large-artery atherothromboembolism (Murphy SJ & Werring Dj, 2020). In younger individuals, ischemic stroke may result from a wider range of etiologies, including extracranial arterial dissection, coagulation disorders, autoimmune diseases, migraine with aura, and the use of oral contraceptives or certain addictive substances. These factors demonstrate that stroke mechanisms in younger populations tend to be more complex and heterogeneous than in older adults (Murphy SJ & Werring Dj, 2020). Approximately 80% of stroke survivors experience sensorimotor deficits in the upper extremities during the (sub)acute phase, with optimal functional recovery occurring in only a small proportion within six months after onset. In roughly 18% of cases, upper extremity involvement is severe, directly limiting daily activities and contributing to long-term reductions in quality of life, a condition commonly referred to as hemiparesis (Dembele et al., 2024).

Hemiparesis is defined as motor weakness affecting one side of the body contralateral to the site of the brain lesion, ranging from mild weakness to complete paralysis of the affected extremities. Etymologically, the term hemiparesis derives from the Greek words hemi (half or one side) and paresis (weakness). This condition generally results from damage to the corticospinal tract or the motor cortex, which is responsible for voluntary movement (Nur et al., 2025). Stroke patients with hemiparesis who do not receive adequate therapeutic interventions are at risk of developing serious complications, including impaired neurological function, limited mobility, difficulty performing daily activities, and potential permanent disability (Nur et al., 2025). Approximately 70–80% of stroke patients experience hemiparesis, often leading to immobilization. The resulting muscle weakness can significantly affect functional independence, limiting the ability to perform essential activities such as working, walking, speaking, eating, and bathing. If hemiparesis is not promptly and properly managed, it can lead to permanent disability. Furthermore, prolonged immobilization increases the risk of complications such as pneumonia, pressure ulcers, contractures, deep vein thrombosis, muscle atrophy, and urinary or bowel incontinence (Maljuliani et al., 2023). One evidence-based intervention recommended for such patients is BUEE, which has been proven effective in improving upper extremity motor function in stroke patients with hemiparesis through the simultaneous activation of both arms, thereby supporting more optimal motor recovery.

BUEE intervention is a therapeutic exercise method involving the simultaneous use of both arms to improve motor function in the affected limb. The exercises may be performed with or without external support and consist of repetitive bilateral movements in symmetrical or alternating patterns. BUEE also includes bimanual exercises, requiring both arms to perform different but coordinated movements, thus promoting better motor integration (Dembele et al., 2024). Bilateral movements further contribute to improved postural control and optimal function of proximal muscles responsible for arm stability. In addition, proprioceptive feedback from the unaffected side stimulates the hemiplegic side, while repetitive training increases the secretion of *Brain-Derived Neurotrophic Factor* (BDNF), which plays a crucial role in neuroplasticity. Studies have demonstrated that patients undergoing BUEE experience significant improvements in FMA-UE, *Upper Extremity Function Test* (UEFT), *Modified Barthel Index* (MBI), and Brunnstrom scores between the fourth and eighth week of therapy, confirming that BUEE is more effective than unilateral exercises in accelerating motor recovery and enhancing independence in daily activities (Li et al., 2022).

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The main advantage of BUEE lies in its working principle, which involves the simultaneous movement of both sides of the body, stimulating activation of both cerebral hemispheres through the corpus callosum. This bilateral activation helps reduce interhemispheric inhibition and reactivates motor areas on the affected side of the brain, thereby promoting neuroplasticity and cortical reorganization key mechanisms in post-stroke motor recovery. Additionally, bilateral exercises trigger trunk muscle contractions that enhance proximal upper limb control and postural stability. Through consistent and repetitive movements, patients receive sensory feedback from the unaffected side, which strengthens neural connectivity and accelerates neuromuscular adaptation on the impaired side (Li et al., 2022). Numerous studies have confirmed that BUEE effectively improves muscle strength, coordination, and functional abilities in stroke patients with hemiparesis. Given the increasing prevalence of stroke and the limited implementation of evidence-based rehabilitation interventions in healthcare facilities, this study highlights the importance of analyzing the application of BUEE therapy to enhance motor skills, accelerate recovery, and improve the overall quality of life of ischemic stroke patients.

Despite the growing number of studies demonstrating the effectiveness of BUEE in improving motor recovery after stroke, most previous studies have primarily focused on long-term rehabilitation outcomes using experimental or randomized controlled trial designs. Limited studies have specifically explored the implementation of BUEE as a nurse-led intervention in daily clinical nursing practice, particularly in acute or subacute ischemic stroke patients with different hemiparetic sides. In addition, previous research has generally emphasized statistical outcomes without providing comprehensive descriptions of the nursing care process, patient responses, exercise tolerance, and practical challenges encountered during intervention implementation. Furthermore, evidence regarding the short-term effects of BUEE during early rehabilitation phases in hospital settings remains limited. Therefore, this case study aimed to address these gaps by describing the application of BUEE as an evidence-based nursing intervention in two ischemic stroke patients with different locations of hemiparesis, while also evaluating changes in upper extremity motor function, muscle strength, and patient rehabilitation responses during the early recovery phase.

METHODS

Design of Research

The method used is a case study with a nursing care approach that aims to comprehensively describe the application of BUEE interventions to improve upper motor skills in ischemic stroke patients with hemiparesis.

Settings and Samples

This study was conducted over six days in one of the stroke wards at Jakarta Hospital. The sample was determined using a purposive sampling technique, where subjects were selected based on inclusion criteria established by the researchers. The inclusion criteria were subacute stroke patients in the rehabilitation phase with arm hemiparesis, patients with stable sitting ability (with or without assistance), patients with good consciousness and the ability to follow instructions. Although the exact muscle strength figures were not recorded in the journal, it can be concluded that the muscle strength of the hemiparetic arm of the included patients was in the mild-moderate category (around 2–3/5, not 0/5 or total plegia).

The researchers first collected data through interviews, direct observation, documentation studies, and a physical examination focusing on upper extremity motor function using the FMA-UE instrument. The sample consisted of two patients who met the inclusion criteria. Measurement tools were used to assist the researchers in collecting information and recording findings. These tools include a medical-surgical nursing assessment form, a focused neurological status assessment form such as

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cranial nerves, the *National Institute of Health Stroke Scale* (NIHSS), a dysphagia screener, and the FMA-UE form to measure upper motor skills assessed active or assisted bilateral movements of the shoulders, elbows, wrists, and fingers before and after the intervention.

Bilateral Upper Extremity Exercise (BUEE)

The intervention implemented in this study was BUEE, which involves simultaneous movements of the hemiparetic and non-hemiparetic arms. This exercise aims to improve muscle strength, coordination, postural control, and upper extremity motor recovery in stroke patients with hemiparesis. Before the intervention, the patient was positioned sitting upright or in a semi-sitting position with arm support on a flat table. The nurse explained the procedure, monitored vital signs, and ensured the patient was stable prior to the exercise.

The exercise program consisted of bilateral shoulder flexion–extension, abduction–adduction, shoulder rotation, elbow flexion–extension, wrist flexion–extension, and finger opening–closing movements. Each movement was repeated eight times for approximately 10–15 minutes per session and performed twice daily. Patients unable to perform active movements received passive or active-assisted support from the nurse, with exercises gradually progressed to fully active movements according to patient tolerance. During the intervention, the nurse monitored pain, fatigue, and changes in vital signs, while evaluations before and after the intervention were conducted using the FMA-UE. Through the implementation of BUEE, improvements in motor function, neuroplasticity, and functional independence were expected.

Data Collection

BUEE is a non-pharmacological therapeutic intervention designed to improve upper extremity motor function in ischemic stroke patients with hemiparesis. This method involves the simultaneous use of both arms—the affected and unaffected sides—with the goal of stimulating bilateral activation of the cerebral hemispheres and enhancing movement coordination (Li et al., 2022).

Before administering the exercise, nurses should conduct a preparatory phase, which includes practicing the procedure with colleagues prior to patient interaction and performing a comprehensive assessment of the patient's condition. This assessment involves evaluating upper extremity muscle strength, the patient's ability to maintain a sitting position, level of consciousness (*Glasgow Coma Scale* ≥ 14), and stability of vital signs, particularly blood pressure and pulse rate (Kumar et al., 2022). Patients eligible to participate in the exercise are generally in the acute to rehabilitation phase, with upper extremity muscle strength ranging from 2 to 3 out of 5, allowing them to perform active exercises with assistance (Kim et al., 2022).

In addition to the physical assessment, nurses should also educate the patient and family about the benefits of BUEE. This education aims to ensure that the patient understands the objectives of the exercise namely, to increase muscle strength, improve bilateral coordination, and promote independence in daily activities such as eating, dressing, and reaching for objects. Family involvement is encouraged to support and assist during the exercises, helping to achieve optimal outcomes (Meng et al., 2023).

An initial motor function assessment is then conducted using the FMA-UE to establish the patient's baseline motor abilities before beginning the exercise program (Zheng et al., 2020). The equipment required for BUEE is relatively simple. The nurse prepares a chair with a backrest or positions the patient in a semi-sitting posture on the bed, provides a flat table for arm support, and uses lightweight sandbags to stabilize the wrists. The patient is positioned upright with both hands placed on the table. The unaffected arm is used to assist movements of the affected side. Before beginning the session,

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the nurse ensures that the patient's vital signs are stable and that there is no pain in the shoulder or elbow joints (Patil et al., 2020).

BUEE intervention was implemented in two ischemic stroke patients with hemiparesis who were hospitalized in a stroke ward at a hospital in Jakarta. Before the intervention, the researcher conducted an initial assessment including the patient's level of consciousness, sitting ability, vital signs, muscle strength, and motor function using the FMA-UE as the pre-test score. The intervention was carried out for three consecutive days, twice daily, resulting in a total of six exercise sessions. Each session lasted approximately 15 minutes and was performed in a sitting position on the bed. The exercises consisted of simultaneous bilateral movements, including shoulder flexion-extension, shoulder abduction-adduction, shoulder internal-external rotation, elbow flexion-extension, wrist flexion-extension, and finger opening-closing movements. During the initial stage, patients were assisted with passive-active assisted movements on the hemiparetic side, which were gradually progressed to active movements according to the patient's tolerance. Throughout the exercise sessions, nurses monitored the patients' vital signs, fatigue, and pain levels. After the intervention, motor function was re-evaluated using the FMA-UE as a post-test to assess changes in upper extremity motor function.

BUEE intervention was selected because it is an evidence-based nursing therapy that has been proven effective in improving upper extremity motor function in stroke patients with hemiparesis. BUEE works through simultaneous bilateral movements that stimulate activation of both cerebral hemispheres, thereby enhancing neuroplasticity and movement coordination. In addition, this intervention is relatively simple, safe, does not require special equipment, and can be independently implemented by nurses in the ward setting. The selection of this intervention was also supported by previous studies demonstrating improvements in FMA-UE scores, muscle strength, coordination, and activities of daily living following bilateral exercise training in stroke patients (Li et al., 2022).

The inclusion of two patients with different sides of weakness was intended to demonstrate that the BUEE intervention can be applied to patients with both right-sided and left-sided hemiparesis. The difference in the side of weakness aimed to determine whether bilateral exercises could still improve motor function regardless of the location of hemiparesis. The evaluation results showed that both patients experienced improvements in FMA-UE scores and muscle strength after the intervention, indicating that BUEE can be applied to various upper extremity weakness conditions caused by ischemic stroke (Kim et al., 2022).

During the exercise, the nurse continuously monitors the patient's condition for signs of fatigue, shoulder pain, or changes in vital signs such as elevated blood pressure. If any of these symptoms are observed, the exercise should be stopped immediately, and the patient should be given a rest period (Kumar et al., 2022). Active supervision by the nurse is essential to ensure that the exercise is performed safely and effectively, considering that stroke patients generally have physical limitations and are at risk of complications due to circulatory disorders. At the beginning of each session, the nurse demonstrates each movement while providing slow and clear verbal instructions to help the patient follow along. Verbal encouragement, such as praise and motivational cues, is given to enhance the patient's engagement and confidence. After each session, the nurse documents the patient's responses and evaluates the outcomes to monitor progress in motor skill improvement (Zheng et al., 2020).

Trustworthiness

Information from various sources was gathered to produce research results. This was accomplished through direct patient interviews, observational findings, physical examinations, collaborative

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support examinations reviewed through patient medical records, and discussions with clinical supervisors and academic advisors. This was done to ensure that patients provided consistent information and that researchers obtained reliable results.

Informed Consent

The implementation of BUEE requires obtaining informed consent from the patient and their family, as well as formal approval from the head of the stroke unit. This step ensures that all parties clearly understand the goals, procedures, and potential outcomes of the intervention, while maintaining ethical standards and adhering to institutional policies. Securing consent from both the patient's support system and the unit leadership promote transparency, shared decision-making, and respect for patient autonomy within the clinical setting.

The BUEE program consists of a 15-minute session conducted once daily, with each movement performed 8–12 times in 2–3 sets, depending on the patient's ability. The patient is guided to perform bilateral movements simultaneously in a specific sequence, including shoulder flexion–extension, shoulder abduction–adduction, shoulder internal–external rotation, elbow flexion–extension, wrist dorsiflexion–flexion, and finger movements such as opening and closing the fingers. If the patient is unable to move actively, the nurse assists with passive or active-assisted exercises, which are gradually progressed to full active range of motion as the patient's condition improves. During each session, the nurse closely monitors for signs of fatigue, pain, or changes in vital signs, and provides rest periods as needed to ensure safety and comfort.

Case Description

Mrs.S is a 59-year-old woman, married, she was admitted to the Emergency Department of General Hospital with complaints of sudden body weakness and slurred speech that had occurred for two days. The patient had been bed-ridden for one month after falling in the bathroom. Her medical history revealed hypertension and type 2 diabetes mellitus for more than five years, but she had been non-compliant with her prescribed Amlodipine and Metformin. On assessment, her *Glasgow Coma Scale* (GCS) was E4 M6 V5 (compos mentis) with right-sided weakness, muscle strength 2-2-2-2 | 4-4-4-4, and a FMA-UE score of 34, indicating severe motor impairment. Vital signs were BP 145/87 mmHg, MAP 106 mmHg, HR 69 bpm, RR 12 bpm, SpO_2 100%, and *Random Blood Glucose* (RDG) 300 mg/dL, showing hyperglycemia. Non-Contrast CT Brain revealed bilateral basal ganglia infarction involving the left internal capsule and left corona radiata, with an NIHSS score of 10, indicating moderate stroke severity. Neurological examination showed deficits in cranial nerves VII, X, XI, and XII, decreased physiological reflexes on the right side (hyporeflexia), and numbness on the right side of the body. Her family history indicated that her mother had hypertension and type 2 diabetes mellitus. Mrs. S was socially active, frequently attending community religious gatherings, and had strong family support. However, she often ignored her medication because she felt well. During hospitalization, she experienced difficulty swallowing and episodes of choking, requiring *Nasogastric Tube* (NGT) insertion and a soft diet. Laboratory results showed an HbA1C of 5.5%, indicating poor glucose control.

Mrs.H is a 71-year-old woman diagnosed with ischemic stroke and anemia. She has a five-year history of hypertension and regularly takes Candesartan 16 mg once daily. On admission, she complained of headache, fatigue, and weakness on the left side of her body. Cranial nerve examination revealed impairment of cranial nerve VII (Facial)—asymmetrical facial expression, uneven smile, and incomplete elevation of the left eyebrow—and cranial nerve XI (Accessory), evidenced by weakness of the left shoulder. Muscle strength was 5-5-5-5 | 3-3-3-3 in the upper and lower limbs on the left side, with an NIHSS score of 4, consistent with mild stroke. Non-Contrast CT Brain showed cerebral atrophy accompanied by hypodense lesions in the right basal ganglia and periventricular regions, while hematological tests revealed Hemoglobin 8.1 g/dL, Hematocrit 27.3%, and Erythrocyte 3.31×10^6/µL,

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for which the patient received two units of *Packed Red Cells* (PRC) transfusion. Vital signs were Blood Pressure 166/86 mmHg, Mean Arterial Presssure 112 mmHg, Heart Rate 88 bpm, Resiration Rate 24 bpm, SpO_2 98%. Neurological reflexes showed negative Babinski and Chaddock bilaterally, but decreased sensory perception on the left side. Her FMA-UE score was 41, indicating mild motor dysfunction, better than that of Mrs. S. Laboratory findings confirmed anemia and ineffective peripheral perfusion (capillary refill time > 3 seconds, pale skin, and poor turgor).

RESULTS

In this study, the description of the results and also the discussion focused on the nursing care that was given to ischemic stroke patients with hemiparesis.

Nursing Assesment

Table 1. General Assessment and Neurological Status

Assessment Component	Mrs. S	Mrs. H
Age	59 years	71 years
Gender	Female	Female
Medical Diagnosis	Ischemic stroke, Type 2 Diabetes Mellitus, Hypertension	Ischemic stroke, Hypertension, Anemia
Risk Factors	Hypertension, Type II Diabetes Mellitus	Hypertension (does not take medication regularly)
Glasgow Coma Scale (GCS)	Conscious and alert (GCS E4V5M6, compos mentis)	Conscious and alert (GCS E4V5M6, compos mentis)
Vital Signs	Blood pressure 145/87 mmHg, MAP 106 mmHg, pulse 69 bpm, respiration rate 12 times/min, oxygen saturation 100% (room air), temperature 36.5°C	Blood pressure 166/86 mmHg, MAP 112 mmHg, pulse 88 bpm, respiration rate 24 times/min, oxygen saturation 98% (room air), temperature 36.6°C
Main Complaint	Weakness on the right side of the body and slurred speech	Dizziness and weakness on the left side of the body
Neurological Examination	Deficits in cranial nerves VII (Facial), X (Vagus), XI (Accessory), and XII (Hypoglossal); hyporeflexia on the right side; negative Babinski and Chaddock reflexes; decreased sensation on the right side	Deficits in cranial nerves VII (Facial) and XI (Accessory); mild dysphagia but able to swallow with a spoon; negative Babinski and Chaddock reflexes; decreased sensation on the left side
Random Blood Glucose (RBG)	300 mg/dL	Not Provided
Motor Weakness	Right Extremities	Left Extremities
Muscle Strength	2-2-2-2 I 4-4-4-4 in right upper extremities	5-5-5-5 I 3-3-3-3 in the left upper extremity
National Institutes of Health Stroke Scale (NIHSS)	10 – Moderate stroke	4 – Mild stroke

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Cognitive Function	Responds appropriately to verbal commands; no signs of aphasia or confusion	Fully oriented to person, place, and time; intact communication ability
Additional Findings	Hyperglycemia (random blood glucose 300 mg/dL); history of poor adherence to diabetes medication	Anemia (Hb 8.1 g/dL, Hct 27.3%); received two units of packed red cells (PRC) transfusion
CT Brain (Non-Contrast)	Infarction in bilateral basal ganglia, left internal capsule, left corona radiata	Cerebral atrophy accompanied by hypodense lesions in the right basal ganglia and periventricular regions
Summary Interpretation	Exhibits more complex neurological deficits involving multiple cranial nerves, significant motor and sensory impairments, and metabolic comorbidities (Diabetes Mellitus and Hypertension)	Demonstrates mild neurological deficits with limited cranial nerve involvement, stable hemodynamics, but complicated by anemia

Table 2. Results of the initial FMA-UE Assessment Mrs S

Evaluation Criteria	Day 1		Day 2		Day 3	
	Pre	Post	Pre	Post	Pre	Post
Upper Extremities (0-36)	13	13	14	14	15	18
Wrist (0-10)	6	6	6	8	9	10
Hand (0-14)	10	11	11	12	13	13
Coordination and Speed (0-6)	4	4	4	5	5	5
Total	33	**34**	36	**39**	42	**46**

Table 3. Results of the initial FMA-UE Assessment Mrs H

Evaluation Criteria	Day 1		Day 2		Day 3	
	Pre	Post	Pre	Post	Pre	Post
Upper Extremities (0-36)	20	21	23	25	28	30
Wrist (0-10)	7	7	8	8	10	10
Hand (0-14)	10	11	12	12	12	12
Coordination and Speed (0-6)	4	4	5	5	5	5
Total	41	**43**	48	**50**	55	**57**

Based on the results of the assessment (Table 1-3) that has been done on both patients, Mrs. S and Mrs. H, both were diagnosed with ischemic stroke. Mrs. S is 59 years old and Mrs. H is 71 years old; both are female. On vital sign examination, Mrs. S showed Blood Pressure (145/87mmHg), MAP (106mmHg), HR (69 bpm), RR (12 bpm), SpO2 (100%), T (36.5°C), and *Random Blood Glucose* (RBG) = 300 mg/dL. Meanwhile, Mrs. H, Blood Pressure (166/86mmHg), MAP (112mmHg), HR (88x/minute),

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RR (24x/minute), SpO2 (98% room air), T (36.6°C). Physical examination of Mrs. S showed weakness of the right side of the extremities, decreased muscle strength (2/5 in the right upper and lower extremities) and Mrs. H in the left extremities with muscle strength (5/3), facial asymmetry, positive pathological reflexes, and impaired coordination and balance. The patient appeared to have difficulty performing independent activities such as eating, changing positions, and walking. In supporting examinations, the results of Non-Contrast CT Brain of Mrs. S showed an impression of infarction in the bilateral basal ganglia, left internal capsule, left corona radiata and in Mrs. H the results of Non-Contrast CT Brain showed an impression of cerebral atrophy accompanied by hypodense lesions in the right basal ganglia and periventricular regions. Laboratory examinations supported the presence of risk factors for hypertension who did not regularly take medication, with increased blood sugar levels in Mrs. S. Based on these results, both were categorized as having ischemic stroke with the main risk factor being hypertension, and additionally type II diabetes mellitus in Mrs.S.

Nursing Diagnosis and Intervention

Based on the data obtained from the assessment conducted on Mrs. S and Mrs. H, the nursing diagnoses according to the Standar Diagnosis Keperawatan Indonesia (SDKI) for Mrs. S were the risk of ineffective cerebral perfusion (D.0017), unstable blood glucose levels (D.0027), and impaired physical mobility (D.0054). Meanwhile, for Mrs. H, the nursing problems that emerged were the risk of ineffective cerebral perfusion (D.0017), ineffective peripheral perfusion (D.0009), and impaired physical mobility (D.0054).

The nurse developed a nursing intervention plan to improve the patient's upper extremity motor function based on assessment data and a nursing diagnosis of impaired physical mobility related to hemiparesis. The primary intervention implemented *was* BUEE, which aims to stimulate neuroplasticity and improve muscle strength, coordination, and functional movement of the affected arm. Based on hospital rehabilitation protocols, post-stroke patients with hemiparesis typically receive conventional physical therapy focusing on passive range of motion and strengthening exercises for the affected limb.

Initial observations indicated that the patient tended to rely heavily on the unaffected arm during daily activities and exhibited limited awareness and use of the hemiparetic side. Therefore, the nurse implemented BUEE as an additional intervention to encourage symmetrical and simultaneous movement of both arms. The exercises were performed in a seated position, with vital signs monitored before and after each session to ensure the patient's safety and physiological stability. Each session lasted approximately 15 minutes and was conducted twice daily for three consecutive days (six sessions total).

The exercise program consisted of a series of bilateral movements, including shoulder flexion-extension, shoulder abduction-adduction, internal-external rotation, elbow flexion-extension, wrist flexion-extension, and finger opening-closing. During the initial sessions, the nurse assisted the patient in performing passive-to-active movements on the hemiparetic side, which then gradually progressed to full active movements as the patient's motor control improved. Throughout the intervention, the nurse provided verbal encouragement and ongoing feedback to increase motivation and participation.

Before and after each exercise session, the nurse measured the patient's upper extremity motor function using the FMA-UE as a pre- and post-assessment to monitor progress. The intervention was well tolerated, and the patient demonstrated gradual improvements in muscle strength, coordination, and range of motion. The nurse continuously monitored for signs of fatigue or discomfort, ensured adequate rest periods, and documented all progress to guide further rehabilitation planning.

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Nursing Implementation

On the first and second days, an initial approach was carried out to establish a trusting relationship and enhance the patient's motivation to participate in the exercise program. The nurse provided education regarding the purpose and benefits of BUEE in improving upper extremity motor recovery. Before beginning the exercises, the nurse assessed the patient's vital signs to ensure stability and conducted a pre-test using the FMA-UE to determine baseline motor function. During the first two days, the patient performed passive-to-active assisted movements, including shoulder flexion–extension, shoulder abduction–adduction, and elbow flexion–extension, for approximately 15 minutes per session, twice daily (a total of four sessions). Throughout the exercises, the nurse provided assistance to the hemiparetic side, monitored for fatigue or pain, and offered verbal encouragement to maintain active participation.

On the third day, after the patient showed improved cooperation and motor control, the exercises were progressed to active-assisted and then fully active movements. The training included shoulder internal–external rotation, wrist flexion–extension, and finger opening–closing, performed twice daily (two sessions total). After each session, a post-test FMA-UE was administered to evaluate changes in upper extremity motor function. The results were compared with the pre-test scores to determine improvements in muscle strength, coordination, and range of motion.

Overall, the three-day BUEE program (six training sessions) resulted in an increase in FMA-UE scores, indicating improvement in the patient's upper extremity motor performance. The nurse consistently provided emotional support, monitored vital signs, and evaluated exercise outcomes as a basis for planning further interventions within the rehabilitation program for stroke patients with hemiparesis.

Nursing Evaluation

Table 4. Evaluation *of* Upper Extremity Muscle Strength in Mrs. S

Evaluation Aspect Mrs. S	Day 1	Day 2	Day 3
Blood Pressure	145/87 mmHg	140/79 mmHg	136/80 mmHg
Mean Artery Pressure (MAP)	106 mmHg	99 mmHg	96 mmHg
Muscle strength of right **upper** extremity	2-2-2-2	2-2-3-3	2-2-3-3
Muscle strength of right **lower** extremity	2-2-2-2	2-2-3-3	2-2-3-3
Muscle strength of left **upper** extremity	4-4-4-4	4-4-4-4	4-4-5-5
Muscle strength of left **lower** extremity	4-4-4-4	4-4-4-4	4-4-5-5

Based on the evaluation results of Mrs. S over three consecutive days, the patient demonstrated progressive improvement in several clinical parameters following the BUEE program. Her blood pressure decreased from 145/87 mmHg on Day 1 to 136/80 mmHg on Day 3, accompanied by a reduction in mean arterial pressure (MAP) from 106 mmHg to 96 mmHg, indicating better cardiovascular regulation. Muscle strength in the right upper and lower extremities increased from Day 1 to Day 2 and then stabilized on Day 3, while muscle strength in the left upper and lower extremities showed additional improvement on Day 3, reflecting enhanced functional performance on the affected side.

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Table 5. Evaluation *of* Upper Extremity Muscle Strength in Mrs. H

Evaluation Aspect Ny. H	Day 1	Day 2	Day 3
Blood Pressure	166/86 mmHg	132/78 mmHg	128/80 mmHg
Mean Artery Pressure (MAP)	112 mmHg	96 mmHg	96 mmHg
Muscle strength of right **upper** extremity	5-5-5-5	5-5-5-5	5-5-5-5
Muscle strength of right **lower** extremity	5-5-5-5	5-5-5-5	5-5-5-5
Muscle strength of left **upper** extremity	3-3-3-3	3-3-3-4	3-3-4-4
Muscle strength of left **lower** extremity	3-3-3-3	3-3-4-4	3-3-4-4

Based on the evaluation results of Mrs. H over three consecutive days, the patient demonstrated progressive improvement in cardiovascular parameters and motor function following the implementation of the BUEE program. Her blood pressure decreased from 166/86 mmHg on Day 1 to 128/80 mmHg on Day 3, accompanied by a reduction in mean arterial pressure (MAP) from 112 mmHg to 96 mmHg, indicating enhanced cardiovascular regulation. Muscle strength in the right upper and lower extremities remained stable across all three days, while muscle strength in the left upper and lower extremities showed gradual improvement from Day 1 to Day 3, reflecting increased functional capacity on the affected side.

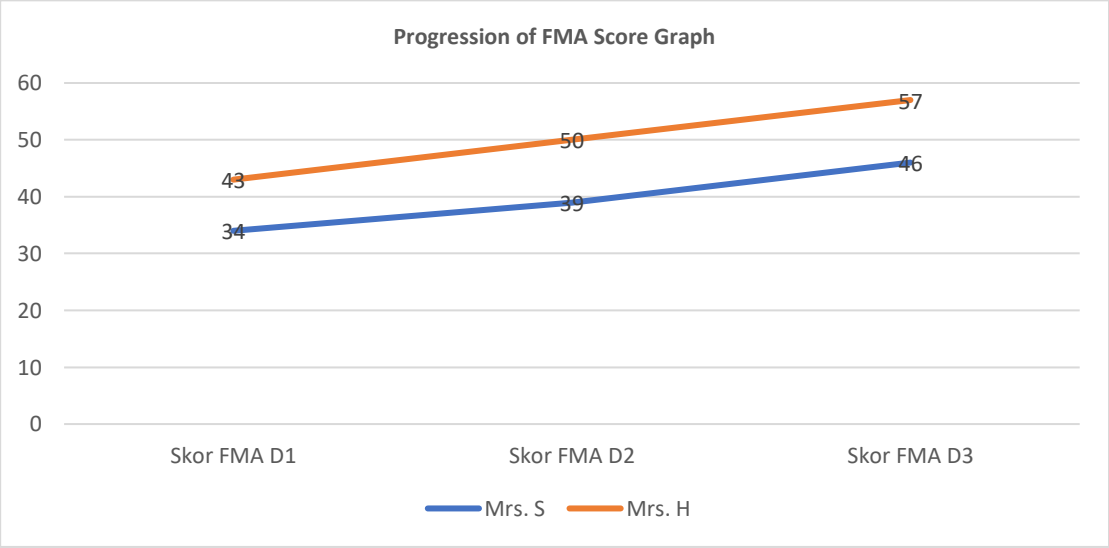


Figure 1. Evaluation Graph of FMA Scores in Mrs. S and Mrs. H Over Three Days

The FMA score progression graph illustrates a steady improvement in motor function for both Mrs. S and Mrs. H throughout the three-day evaluation period. Mrs. S's FMA score increased from 34 on Day 1 to 39 on Day 2 and reached 46 on Day 3, indicating gradual enhancement of motor performance following the BUEE intervention. Similarly, Mrs. H demonstrated continuous improvement, with scores increasing from 43 on Day 1 to 50 on Day 2 and further to 57 on Day 3, showing a more pronounced upward trend compared to Mrs. S. The consistent increases observed in both patients suggest that the BUEE program contributed positively to motor recovery, with Mrs. H exhibiting a greater rate of functional improvement over the intervention period.

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DISCUSSION

The discussion of this case study highlights that the implementation of BUEE produced positive improvements in both ischemic stroke patients with different locations of hemiparesis. The inclusion of two patients with different sides of weakness, namely right-sided hemiparesis in Mrs. S and left-sided hemiparesis in Mrs. H, was intended to demonstrate that BUEE can be effectively applied regardless of the location of motor weakness. This finding suggests that the effectiveness of bilateral training is not determined by whether the affected side is dextra or sinistra, but rather by the patient's motor response, neuroplasticity process, and participation during rehabilitation. Both patients showed improvements in muscle strength and FMA-UE scores after the intervention, indicating that BUEE can support motor recovery in various hemiparetic conditions following ischemic stroke (Meng et al., 2023).

The inclusion of two patients with different sides of weakness aimed to demonstrate that the BUEE intervention can be applied to both right-sided and left-sided hemiparesis. This difference was important to show that the effectiveness of bilateral exercises is not influenced by the location of weakness, but rather by the patient's motor response and neuroplasticity process. Both patients showed improvements in motor function after the intervention, indicating that BUEE can be implemented in various hemiparetic conditions following ischemic stroke.

The FMA-UE assessment evaluates four main subcomponents, including motor function, coordination/speed, sensation, and joint range of motion/pain. At baseline, Mrs. S demonstrated more severe impairment compared to Mrs. H, particularly in active movement and coordination of the affected upper extremity. Mrs. S had greater limitations in performing voluntary movements and required more assistance during the initial sessions, while Mrs. H was still able to perform several movements with active-assisted support. After the intervention, both patients experienced improvements in motor control, muscle strength, and movement coordination. However, Mrs. H showed more noticeable functional changes, especially in shoulder, elbow, and wrist movements, indicating greater recovery from her initial severe condition.

The improvement in FMA-UE score was greater in Mrs. H because her baseline motor impairment was more severe, providing a wider opportunity for functional improvement after intervention. Figure 1 shows that Mrs. H's FMA-UE score increased more sharply compared to Mrs. S throughout the three-day intervention period. This improvement may be related to the higher neuroplastic response that commonly occurs in patients with lower initial motor performance. In addition, Mrs. H demonstrated good participation, consistent exercise tolerance, and strong family support during the intervention process, which contributed to better recovery outcomes despite her more severe initial condition (Arya et al., 2021).

Based on the improvement observed in both cases, BUEE is recommended as a nurse-led evidence-based intervention for stroke patients with hemiparesis, particularly to improve upper extremity motor function during the rehabilitation phase. This intervention can be integrated into routine nursing rehabilitation programs because it is simple, safe, cost-effective, and does not require special equipment. The main factors that accelerated improvement in this case study were early and consistent exercise implementation, repetitive bilateral movements, active nurse supervision, patient cooperation, stable hemodynamic condition, and family support throughout the intervention process (Li et al., 2022).

Figure 1 clearly shows differences in the progression of FMA-UE scores between the two patients throughout the intervention period. Mrs. S's score increased from 34 on Day 1 to 39 on Day 2 and 46

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on Day 3, while Mrs. H's score increased more markedly from 43 on Day 1 to 50 on Day 2 and 57 on Day 3. The greater increase in Mrs. H's score may be explained by her more severe initial motor impairment, which provided a wider opportunity for functional improvement after repetitive bilateral training. Patients with lower baseline motor performance often demonstrate more visible improvement because the intervention stimulates neuroplastic adaptation more intensively during the early rehabilitation phase. In addition, Mrs. H showed good cooperation, consistent exercise tolerance, and strong family support throughout the intervention process, all of which contributed to faster recovery despite her initially more severe condition (Kumar et al., 2022).

These findings are consistent with previous studies demonstrating the benefits of bilateral upper extremity training, (Li et al., 2022) reported a statistically significant increase in FMA-UE scores after eight weeks of bilateral training, from 31.5 ± 6.2 to 45.8 ± 7.1 ($p < 0.05$). Another study conductedh (Patil et al., 2020) also observed significant improvements in motor recovery ($p < 0.05$) and reduced spasticity ($p = 0.02$) after six weeks of bilateral training. Moreover, a meta-analysis by (Dembele et al., 2024) confirmed a moderate pooled effect size (SMD = 0.48; 95% CI = 0.31–0.66; $p < 0.001$) with low heterogeneity ($I^2 = 24\%$), reinforcing the consistency of these outcomes.

Several factors influenced the different outcomes observed between Mrs. S and Mrs. H. The first factor was the severity of hemiparesis: Mrs. H had better residual motor function, which enabled faster progression toward full active movement. In contrast, Mrs. S's greater muscle weakness required a longer time to perform independent movements. The second factor was age and degenerative changes. Although Mrs. H was older, she had no history of falls or prolonged bed rest. Conversely, Mrs. S's history of a one-year bed rest contributed to reduced muscle elasticity and slower neuroplastic adaptation. The third factor was family support and motivation. Mrs. H received consistent assistance and encouragement from her family, while Mrs. S often exercised alone, affecting her consistency and progress.

From a nursing perspective, BUEE provides several advantages. This intervention can be independently implemented by nurses, requires no complex equipment, and is cost-effective. It enhances patient motivation, accelerates bilateral coordination, and prevents immobilization-related complications such as contractures and muscle atrophy (Meng et al., 2023). However, the intervention also requires dedicated implementation time, close supervision, and patient tolerance management, particularly during early sessions (Kim et al., 2022).

The implementation of BUEE has been shown to significantly enhance motor recovery in ischemic stroke patients with hemiparesis by stimulating neuroplasticity through symmetrical and repetitive movements of both arms. This case study demonstrates that the integration of BUEE into nursing care effectively improves muscle strength, coordination, and functional independence, as evidenced by increased FMA-UE scores in both patients. The intervention's success aligns with findings from a quasi-experimental study on self-efficacy–based programs, which reported that improving patients' confidence and motivation to perform activities of daily living (ADL) led to better functional outcomes and independence in stroke rehabilitation. Both approaches emphasize the importance of structured, nurse-led, and patient-centered interventions that not only restore physical function but also empower stroke survivors to actively engage in their recovery process (Pompey et al., 2025).

Overall, BUEE is an effective and safe intervention for ischemic stroke patients with hemiparesis. These exercises can be integrated into routine hospital rehabilitation programs or continued as home-based training. Nurses are encouraged to perform regular evaluations using the FMA-UE every two weeks to monitor motor skill progression and adjust exercise intensity as needed. With consistent implementation over eight weeks, BUEE has been shown to significantly improve upper extremity

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motor function, enhance neuroplasticity, and accelerate patients' independence in performing daily activities (Li et al., 2022).

Nursing Implications

The findings of this case study demonstrate that Bilateral Upper Extremity Exercise (BUEE) can be effectively implemented by nurses to improve upper extremity motor recovery in ischemic stroke patients with hemiparesis, even within a short intervention period of three consecutive days. Both patients showed measurable improvements in FMA-UE scores, muscle strength, coordination, and hemodynamic stability following six sessions of BUEE. Mrs. S's FMA-UE score increased from 34 to 46, while Mrs. H's score improved from 43 to 57, indicating that repetitive bilateral movement exercises may accelerate early motor recovery during the rehabilitation phase.

These findings imply that BUEE can be integrated into routine nursing rehabilitation care as a simple, safe, and cost-effective non-pharmacological intervention that does not require specialized equipment. Nurses can independently administer and monitor the exercises while simultaneously evaluating patient tolerance, muscle strength progression, and functional improvement using standardized tools such as the FMA-UE. The study also highlights the importance of consistent nurse supervision, verbal encouragement, and family involvement, as patients with stronger motivation and family support demonstrated faster rehabilitation progress.

In addition, the improvement in motor function observed in both patients suggests that early nurse-led rehabilitation interventions may help prevent complications associated with immobilization, including muscle atrophy, joint stiffness, and decreased functional independence. Therefore, nurses have an important role not only in providing direct rehabilitation interventions but also in educating patients and families regarding the continuation of bilateral exercises at home after discharge to support long-term recovery and independence in activities of daily living.

Overall, the implementation of BUEE has a positive impact on improving the quality of nursing care. It not only accelerates the rehabilitation process and promotes patient independence but also reinforces the professional role of nurses as practitioners who integrate scientific knowledge, clinical expertise, and a humanistic approach to support the holistic recovery of stroke patients.

CONCLUSION

In conclusion, this case study demonstrated that the implementation of BUEE as an evidence-based nursing intervention was effective in improving upper extremity motor function in ischemic stroke patients with hemiparesis. The intervention successfully increased muscle strength, movement coordination, and FMA-UE scores in both patients with different hemiparetic sides, indicating that BUEE can be applied effectively in patients with either right- or left-sided weakness. The findings also showed that repetitive bilateral exercises, combined with active nurse supervision, patient participation, and family support, contributed positively to neuroplasticity and early motor recovery during the rehabilitation phase. Therefore, this study supports the integration of BUEE into routine nursing rehabilitation programs as a safe, simple, and cost-effective intervention to enhance functional recovery and patient independence following ischemic stroke.

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