CHAPTER I
INTRODUCTION

A. Background

Non-Communicable Diseases (NCDs) are diseases that are not transmitted between people, such as heart disease, stroke, cancer, diabetes, and COPD. NCDs develop slowly and are influenced by lifestyle habits. NCDs currently tend to be increasing. The relationship is strong because NCD risk factors such as high blood pressure, uncontrolled diabetes, high cholesterol, obesity, smoking, and lack of physical activity are also major triggers of stroke. Stroke itself is one of the most dangerous types of NCD because it can cause long-term disability. Therefore, stroke has become a major focus in global efforts to prevent and manage NCDs (WHO 2022).

Stroke is a brain disorder that occurs when the blood supply to a particular area of the brain is interrupted, causing brain tissue damage and death due to a lack of nutrient supply (Majumder, 2024). A decrease in blood flow to the brain can be caused by narrowing or blockage of blood vessels, or bleeding arising from the rupture of blood vessels in the brain. This condition can also be triggered by the formation of blood clots that travel from other parts of the body due to a particular disease or brain injury, which then blocks the cerebral arteries. As a result, brain function stops and the brain's functional ability declines (Idsam et al., 2022).

According to the American Heart Association, stroke is a condition of sudden brain dysfunction with rapid development, affecting either a specific area (focal) or the entire brain, caused by the cessation of blood flow to the brain due to a blockage or bleeding (Tsao et al., 2023). Stroke is one of the major global health concerns because of its extensive impact on morbidity and mortality. According to a World Health Organization (WHO) report, stroke accounts for approximately 11% of all global deaths and is the leading cause of long-term disability in adults. The high incidence of stroke results

not only in the loss of physical ability but also in the loss of independence in performing daily activities (WHO, 2025).

According to World Stroke Organization (WSO) data, stroke still ranks second as the leading cause of death and disability worldwide when viewed in terms of disability-adjusted life years lost. WSO reports that there are 101 million stroke sufferers worldwide, with approximately 12.2 million new cases occurring each year and more than 160 million disability-adjusted cases globally, a figure that reflects the magnitude of the public health problem caused by stroke.

According to the Indonesian Health Survey (2023), stroke is one of the leading causes of mortality and disability in Indonesia, contributing 11.2% of all disability cases and 18.5% of all deaths, equivalent to more than 1.7 million stroke cases nationally. The prevalence of stroke was recorded at 8.3 per 1,000 population, indicating a still-high disease burden. This figure has changed compared to the previous survey, where the 2018 Basic Health Research (Riskesdas) reported a stroke prevalence of 10.9 per 1,000 population, reflecting the dynamics of stroke trends in Indonesia along with changes in risk factors and population characteristics. A worrying finding is that most patients experience impaired upper extremity motor function, which significantly affects their independence in performing daily activities.

According to data from the Bengkulu City Health Office for 2024 and 2025, 364 people had stroke. The community health center (Puskesmas) with the highest number of stroke cases was Puskesmas Sawah Lebar, Bengkulu City, with 75 cases, followed by Puskesmas Lingkar Timur in second place with 59 cases, while Puskesmas Muara Bangkahulu ranked third with 50 stroke cases (Bengkulu City Health Office, 2024).

Stroke causes several impairments, such as muscle weakness or even paralysis on one side of the body (hemiparesis or hemiplegia). Weakness of the upper extremity muscles is often marked by a decreased ability to grip, lift, or move the arm and hand optimally, which results in impaired ability to perform daily activities. Other symptoms are usually accompanied by signs

such as difficulty speaking (dysarthria), tingling, numbness, decreased coordination, and decreased reflexes on the affected side of the body. This weakness is caused by damage to the motor pathways in the brain, particularly the corticospinal tract, which inhibits the transmission of nerve impulses to the upper extremity muscles. The severity of the weakness can vary depending on the location and extent of the affected brain area (Boentert, 2023).

Stroke is a neurological condition that affects survivors' daily lives in physical, psychological, and social aspects. Brain tissue damage due to impaired blood flow causes various neurological deficits, such as sensory, cognitive, speech, and motor function impairments (Fajria et al., 2024). One of the main manifestations that often appears is muscle weakness (paresis), which occurs due to disruption of the corticospinal motor pathway, thereby reducing the brain's ability to control muscle contractions. This muscle weakness plays a significant role in limiting functional activity and is a major cause of post-stroke disability, especially when it involves the upper extremities (Marliana et al., 2023).

Upper extremity muscle weakness due to stroke is a complex condition because, in addition to reducing strength, it also impairs coordination and fine motor skills. Marlina (2023) explains that recovery of hand and arm function is more difficult than that of the lower limbs, because of the complex anatomy of the hand and the extensive involvement of cortical areas in regulating precise movements (Marliana et al., 2023). The slow recovery process affects quality of life, as patients experience obstacles in basic activities such as eating, dressing, and writing. This also affects their confidence and motivation to continue therapy. Therefore, targeted, intensive, and continuous rehabilitation is needed so that upper extremity function can recover optimally (Marliana et al., 2023).

If stroke patients with upper extremity muscle weakness do not undergo exercise, the functional recovery process will be hindered because the muscles that should receive additional stimulation are used less and less

frequently, resulting in ongoing weakness and disuse atrophy. This condition is worsened by the emergence of persistent spasticity, tissue shortening, and the risk of contractures that limit joint movement. The absence of exercise and lack of structured sensorimotor input results in the neuroplasticity process not proceeding optimally, so that the brain loses the opportunity to form new neural pathways that support the recovery of strength, coordination, and range of motion. As a result, the patient's ability to perform activities of daily living (ADL) continues to decline. Therefore, the exercise needed by stroke patients can take the form of rehabilitation (Fajria et al., 2024).

Rehabilitation plays an important role in the recovery of post-stroke motor function through active exercise, passive exercise, and occupational therapy. Active exercise of the hand muscles can stimulate neuroplasticity, improve strength, coordination, and movement control, while also preventing stiffness and spasticity. With measured intensity, this exercise improves circulation and sensorimotor responses and forms new neural pathways, making patients more independent in daily activities. In addition, passive exercise of the hand muscles helps maintain range of motion, prevents stiffness and contractures, reduces spasticity through proprioceptive stimulation, and prepares the hand for subsequent active exercise, while occupational therapy for the hand muscles uses meaningful daily tasks (such as gripping, pinching, or buttoning clothes) to stimulate neuroplasticity, improve fine motor skills and coordination, and encourage independence in daily activities (Choirunnisya et al., 2023).

One active exercise method proven effective in increasing hand muscle strength in stroke patients is Proprioceptive Neuromuscular Facilitation (PNF). This exercise is an active exercise method that is effective in increasing upper extremity muscle strength in post-stroke patients because of its ability to facilitate the neuroplasticity process. This exercise uses diagonal and spiral movement patterns that resemble everyday functional activities, thereby providing meaningful and repeated sensorimotor stimulation to the central nervous system (Syokumawena et al., 2024). The

combination of contraction and relaxation with controlled resistance utilizes the principle of irradiation to activate weak muscles through facilitation of stronger muscles, while also improving the balance of agonist and antagonist muscle work. Repeated activation in this functional movement pattern plays a role in cortical reorganization and strengthening of the corticospinal pathway, thereby not only increasing muscle strength but also neuromuscular coordination, joint stability, and voluntary movement control in the upper extremities (Ni et al., 2024).

Research results prove that Proprioceptive Neuromuscular Facilitation (PNF) exercise given to 34 non-hemorrhagic post-stroke patients three times a week for three months was able to significantly increase upper extremity muscle strength. The paired t-test yielded a p-value of 0.001 (Syokumawena et al., 2024). Research results by Sethi & Yashendra (2024) show that administering Proprioceptive Neuromuscular Facilitation (PNF) therapy to chronic ischemic stroke patients was able to significantly improve arm motor function. Before the intervention, most patients experienced upper extremity weakness that caused their hand to be rarely used in daily activities. After 8 weeks of PNF exercise, there was a marked improvement in the ability to move, lift, and perform functional activities using the weak hand. These results indicate that PNF is an effective exercise method for re-stimulating nerve and muscle function, thereby helping stroke patients gradually recover arm motor ability. The paired t-test yielded a p-value of 0.05.

In addition to the PNF exercise method, there is another effective method for hand rehabilitation in stroke patients, namely Hand Ball Grasping. This exercise is performed by gripping soft balls of various sizes and textures to increase grip strength, fine motor function, and proprioception. Hand Ball Grasping has been shown to support upper extremity motor recovery, especially in strengthening grip ability, which plays an important role in daily activities. In addition, this exercise helps reduce spasticity through muscle tone modulation while providing sensory stimulation that enriches sensorimotor integration. Regular implementation of the exercise contributes

to improved bilateral hand coordination, which is needed for functional activities such as opening bottles, writing, and buttoning clothes (Yani & Anggraini, 2025).

The results of a study by Hensel et al. (2023) conducted in Deli Tua using the Hand Ball Grasping intervention showed an increase in muscle strength in stroke patients. Before the intervention was given, 90% of respondents experienced hand muscle weakness, while 10% experienced impaired coordination between the thumb and other fingers. After regular ball-grip therapy, there was a significant increase in respondents' hand muscle strength. This study proves that Hand Ball Grasping is an effective exercise method for increasing upper extremity muscle strength in patients.

Based on research conducted by Syokumawena et al. (2024) on post-stroke patients in the working area of Puskesmas Merdeka and 1 Ulu Palembang in South Sumatra, with a sample of 34 people. A Hand Dynamometer (CAMRY) was used to assess hand grip strength. Participants performed an initial warm-up exercise for 10-15 minutes, followed by PNF exercise consisting of three movements. Each movement lasted 30 seconds with a 10-second relaxation period between movements. The intervention dose was set at once a day, three times a week, for three months. The study results showed a significant increase in muscle strength after the PNF intervention, indicating that the change was statistically significant. This shows that PNF is an effective intervention for increasing muscle strength in post-stroke patients.

Based on a preliminary survey conducted in August in the working area of Puskesmas Sawah Lebar, there were 75 stroke patients. Through observation and interviews with 7 stroke patients, data on upper extremity muscle strength was obtained. From the examination results using the Manual Muscle Testing (MMT) scale, it was found that all 7 respondents experienced decreased upper extremity muscle strength. In detail, 2 people were in the muscle strength category of score 3 (movement can be performed against gravity without resistance), 3 people were in the score 2 category (movement

can only be performed when gravity is eliminated), and 2 people were in the score 1 category (there is muscle contraction but it does not produce movement). Based on the interview results, patients stated that Proprioceptive Neuromuscular Facilitation (PNF) and Hand Ball Grasping therapy to increase upper extremity muscle strength had never been administered to stroke patients in the working area of Puskesmas Sawah Lebar. Based on the description above, the researcher is interested in determining "the effect of the combination of Proprioceptive Neuromuscular Facilitation (PNF) and Hand Ball Grasping on increasing upper extremity muscle strength in post-stroke patients in the working area of Puskesmas Sawah Lebar, Bengkulu City, in 2026.

B. Problem Formulation

Upper extremity muscle weakness in stroke patients is a condition of decreased muscle contraction ability characterized by reduced strength, endurance, and coordination of arm and hand movement due to disruption of the central nervous system. This condition occurs because of brain tissue damage that inhibits motor nerve impulses to the upper extremity muscles. As a result, stroke patients experience difficulty performing functional movements such as gripping, lifting, or moving the arm normally, which ultimately leads to limitations in daily activities and decreased independence. Based on the background described above, the research problem can be formulated as follows: "Is there an effect of the combination of Proprioceptive Neuromuscular Facilitation (PNF) and Hand Ball Grasping on increasing upper extremity muscle strength in post-stroke patients in the working area of Puskesmas Sawah Lebar, Bengkulu City, in 2026?"

C. Research Objectives

1. General objective

   To determine the effect of the combination of Proprioceptive Neuromuscular Facilitation (PNF) and Hand Ball Grasping on increasing

upper extremity muscle strength in post-stroke patients in the working area of Puskesmas Sawah Lebar, Bengkulu City.

2. Specific objectives

   1) To determine the characteristics of post-stroke patients, including age, gender, education, and type of stroke, in the working area of Puskesmas Sawah Lebar, Bengkulu City.
   2) To determine the mean upper extremity muscle strength values of post-stroke patients before and after treatment in the intervention group and the control group in the working area of Puskesmas Sawah Lebar, Bengkulu City.
   3) To determine the difference in mean upper extremity muscle strength values of post-stroke patients before and after treatment in the intervention group and the control group in the working area of Puskesmas Sawah Lebar, Bengkulu City.
   4) To determine the effect of Proprioceptive Neuromuscular Facilitation (PNF) and Hand Ball Grasping exercises on increasing upper extremity muscle strength in post-stroke patients in the working area of Puskesmas Sawah Lebar, Bengkulu City.

D. Research Benefits

1. Theoretical Benefits

   This research is expected to contribute to the development of science, particularly in the fields of nursing and neurological rehabilitation. In addition, it can serve as a scientific reference and conceptual basis for further research related to active exercise-based rehabilitation interventions in post-stroke patients.

2. Practical Benefits

   a. For Patients and Families

      The results of this study can provide information and understanding to post-stroke patients and their families regarding the benefits of combined PNF and Hand Ball Grasping exercises in increasing upper extremity muscle strength, and it is hoped that families will be

able to support patients in performing simple exercises independently at home as part of the ongoing rehabilitation process.

b. For Health Services (Community Health Centers)

This research can serve as a basis for implementing evidence-based, simple, and easily applicable post-stroke rehabilitation interventions for health workers, particularly at health service facilities, in order to improve the quality of services for post-stroke patients.

c. For Educational Institutions

This research can add useful scientific references as teaching material, learning resources, and case studies in the field of nursing, particularly neurological and rehabilitation nursing.

d. For Future Researchers

The results of this study can serve as a reference for future researchers to examine the effect of the combined PNF and Hand Ball Grasping exercises on other aspects, such as movement coordination, independence in daily activities, and quality of life of stroke patients.