POST STROKE FATIGUE AND ITS ASSOCIATED FACTORS AMONG STROKE SURVIVORS IN THE SECOND AFFILIATED HOSPITAL OF GUIZHOU UNIVERSITY OF TRADITIONAL CHINESE MEDICINE, CHINA

DONG YUAN

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by

DONG YUAN

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LIST OF ABBREVIATIONS

ADLs	Activities of Daily Living
AUC	Area Under the Curve
BI	Barthel Index Scale
CDC	Centers for Disease Control and Prevention
CNSSS	China National Stroke Screening Survey
CRP	C-reactive protein
EC+PST	Energy Conservation plus Problem Solving Therapy
FIM	Functional Independence Measure
FSS	Fatigue Severity Scale
GBD	Global Burden of Disease
HADS	Anxiety and Depression Scale
HbA1c	Glycated Hemoglobin
HRQOL	Health-related Quality of Life
KMO	Kaiser-Meyer-Olkin
NIHSS	National Institutes of Health Stroke Scale
NPSF	Non-post stroke Fatigue
PHQ-9	Patient Health Questionnaire-9
PSD	Post stroke Depression
PSF	Post stroke Fatigue
QoL	Quality of Life
RAM	Roy Adaptation Model
ROC	Receiver Operating Characteristic
SPSS	Statistical Package for Social Science
SS-QoL	Stroke-specific Quality of Life

SV-SS-QoL	Short Version of the Stroke Specific Quality of Life Scale
USM	Universiti Sains Malaysia
WSO	World Stroke Organization

LIST OF APPENDICES

KELETIHAN PASCA STROK DAN FAKTOR PERKAITANNYA DALAM KALANGAN PEMANDIRI STROK DI HOSPITAL GABUNGAN KEDUA UNIVERSITI PERUBATAN TRADISIONAL CINA GUIZHOU, CHINA

ABSTRAK

Keletihan selepas strok (PSF) adalah keadaan biasa yang melemahkan dalam kalangan pesakit strok, yang memberi kesan ketara kepada kualiti hidup (QoL), aktiviti kehidupan harian (ADL), dan hasil pemulihan. Walaupun penting dari sudut klinikal, perkadaran dan faktor berkaitan PSF masih kurang diterokai, terutamanya dalam kalangan pesakit strok muda dan pertengahan umur. Kajian keratan rentas ini bertujuan untuk menilai perkadaran PSF dan faktor-faktor berkaitannya dalam kalangan 271 pesakit strok di Hospital Kedua Universiti Perubatan Tradisional Cina Guizhou, yang dijalankan dari September 2023 hingga Januari 2024 menggunakan kaedah persampelan mudah. Peserta dimasukkan jika mereka berumur 18 hingga kurang daripada 60 tahun, tidak terlantar, dan mengalami strok dalam tempoh 3 bulan, manakala mereka yang mengalami disfungsi kognitif teruk atau komorbiditi yang mengancam nyawa dikecualikan. Data dikumpulkan menggunakan instrumen yang disahkan, termasuk soal selidik ciri sosiobudaya, Skala Keletihan (FSS), Versi Ringkas Skala Kualiti Hidup Khusus Strok (SV-SS-QoL), Soal Selidik Kesihatan Pesakit-9 (PHQ-9), dan Indeks Barthel (BI), dan dianalisis menggunakan SPSS versi 29.0. Perkadaran PSF dalam kalangan pesakit strok adalah 45.8%. Analisis univariat mengenal pasti faktor signifikan yang berkaitan dengan PSF, termasuk umur, jantina, pendapatan, tahap pendidikan, status pekerjaan, situasi tempat tinggal, kemurungan, QoL, dan ADL. Analisis regresi logistik multivariat mengesahkan bahawa umur,

jantina, pendapatan, status pekerjaan, kemurungan, QoL, dan ADL adalah faktor utama. Pesakit pertengahan umur (36–59 tahun) adalah 12.94 kali lebih berkemungkinan mengalami keletihan berbanding pesakit muda (18–35 tahun) (OR 12.94, 95% CI: 1.91–87.83), dan pesakit perempuan menghadapi risiko PSF 3.54 kali lebih tinggi berbanding pesakit lelaki (OR 3.54, 95% CI: 1.45–8.64). Kemurungan secara signifikan meningkatkan kemungkinan keletihan sebanyak 23% bagi setiap peningkatan unit skor kemurungan (OR 1.23, 95% CI: 1.13–1.34), manakala faktor perlindungan termasuk pendapatan yang lebih tinggi (OR 0.14, 95% CI: 0.04–0.53), status pekerjaan yang stabil (OR 0.09, 95% CI: 0.02–0.44), QoL yang lebih baik (OR 0.81, 95% CI: 0.75–0.86), dan ADL yang lebih baik (OR 0.97, 95% CI: 0.95–0.98). Model ini menunjukkan kalibrasi yang baik (ujian Hosmer-Lemeshow, $\chi^2 = 3.85$, $P = 0.87$) dan ketepatan sebanyak 85.2%. Kajian ini menonjolkan perkadaran PSF yang tinggi dan hubungannya yang pelbagai dalam kalangan pesakit strok muda dan pertengahan umur. Pengenalpastian awal kumpulan berisiko tinggi, seperti individu pertengahan umur, wanita, dan mereka yang mengalami kemurungan, adalah penting. Jururawat boleh menangani PSF dengan menyediakan sokongan psikologi, meningkatkan QoL dan ADL, serta mempromosikan kestabilan pendapatan dan pekerjaan. Penemuan ini menawarkan pandangan yang berguna untuk membangunkan program pemulihan peribadi untuk mengurangkan beban PSF dan meningkatkan hasil pemulihan.

POST STROKE FATIGUE AND ITS ASSOCIATED FACTORS AMONG STROKE SURVIVORS IN THE SECOND AFFILIATED HOSPITAL OF GUIZHOU UNIVERSITY OF TRADITIONAL CHINESE MEDICINE, CHINA

ABSTRACT

Post stroke fatigue (PSF) is a common and debilitating condition among stroke survivors, significantly affecting their quality of life (QoL), activities of daily living (ADLs), and recovery outcomes. Despite its clinical importance, the proportion and associated factors of PSF remain underexplored, particularly in young and middle-aged stroke survivors. This cross-sectional study aimed to assess the proportion of PSF and its associated factors among 271 stroke survivors at the Second Affiliated Hospital of Guizhou University of Traditional Chinese Medicine, conducted from September 2023 to January 2024, using a convenient sampling method. Participants were included if they were aged 18 to less than 60 years, not bedridden, and had experienced a stroke within 3 months, while those with severe cognitive dysfunction or life-threatening comorbidities were excluded. Data were collected using validated instruments, including a sociodemographic characteristics questionnaire, the Fatigue Severity Scale (FSS), Short Version of the Stroke-Specific Quality of Life Scale (SV-SS-QoL), Patient Health Questionnaire-9 (PHQ-9), and Barthel Index (BI), and analyzed using SPSS version 29.0. The proportion of PSF among stroke survivors was 45.8%. Univariate analysis identified significant factors associated with PSF, including age, gender, income, education level, occupational status, living situation, depression, QoL, and ADLs. Multivariate logistic regression confirmed that age, gender, income, occupational status, depression, QoL, and ADLs were key factors. Middle-aged

survivors (36–59 years) were 12.94 times more likely to experience fatigue compared to younger survivors (18–35 years) (OR 12.94, 95% CI: 1.91–87.83), and female survivors faced a 3.54 times higher risk of PSF compared to males (OR 3.54, 95% CI: 1.45–8.64). Depression significantly increased the likelihood of fatigue by 23% per unit increase in the depression score (OR 1.23, 95% CI: 1.13–1.34), while protective factors included higher income (OR 0.14, 95% CI: 0.04–0.53), stable occupational status (OR 0.09, 95% CI: 0.02–0.44), better QoL (OR 0.81, 95% CI: 0.75–0.86), and improved ADLs (OR 0.97, 95% CI: 0.95–0.98). The model demonstrated good calibration (Hosmer-Lemeshow test, $\chi^2 = 3.85$, $P = 0.87$) and an accuracy of 85.2%. This study highlights the high proportion of PSF and its multifactorial associations in young and middle-aged stroke survivors. Identifying high-risk groups, such as middle-aged individuals, females, and those with depression, is essential. Nurses can address PSF by providing psychological support, enhancing QoL and ADLs, and promoting income and occupational stability. These findings offer insights for developing personalized rehabilitation programs to alleviate PSF and improve recovery outcomes.

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Stroke is a leading cause of death and disability worldwide, characterized by acute or permanent brain dysfunction resulting from disrupted cerebral blood circulation (Cipolla et al., 2018; Kuriakose & Xiao, 2020). According to the 2019 Global Burden of Disease Report, stroke remains the second leading cause of death and the third leading cause of disability globally (GBD, 2019; Feigin et al., 2021). It disproportionately affects low- and middle-income countries, where healthcare resources are often insufficient to address long-term complications (Wu et al., 2019). The Centers for Disease Control and Prevention highlights that one in six cardiovascular deaths is attributed to stroke, with over half of stroke survivors experiencing significant mobility issues and long-term disability (CDC, 2023).

In China, the incidence and burden of stroke are particularly pronounced, with rates continuing to rise despite advancements in prevention and treatment. The lifetime risk of stroke among Chinese residents is the highest globally, at 39.9%, underscoring the immense healthcare challenges posed by this condition (Masaebi et al., 2021). Between 2002 and 2013, the first-episode incidence of stroke among individuals aged 40 to 74 in China more than doubled, with an annual growth rate of 8.3% (Sun et al., 2018). This trend is contrary to the declining rates observed in developed countries such as the United States and Japan (Virani et al., 2020; Takashima et al., 2017). For young and middle-aged populations, stroke poses unique challenges as they face dual pressures of workforce participation and family responsibilities, leading to profound economic and social impacts (Ma et al., 2024).

Among the many complications following a stroke, Post Stroke Fatigue (PSF)

is particularly debilitating. PSF is defined as persistent mental and physical exhaustion that is not alleviated by rest, significantly impairing recovery and reducing quality of life (Paciaroni & Acciarresi, 2019). Globally, PSF affects up to half of stroke survivors, with prevalence rates in Asia ranging from 23% to 63% (Alghamdi et al., 2021; Hinkle et al., 2017). Even six years post stroke, fatigue persists in approximately 37% of survivors, emphasizing its chronic nature (Cumming et al., 2018). PSF is frequently overlooked by healthcare providers due to its subtle and subjective symptoms, resulting in delayed or inadequate interventions. This oversight further exacerbates functional decline, psychological distress, and dependence on others for daily activities (Kjeverud et al., 2020; Lanctôt et al., 2020).

For young and middle-aged stroke survivors, PSF presents additional challenges. The interplay between physical fatigue, psychological stress, and socio-economic factors such as work-related demands and caregiving responsibilities intensifies the burden of recovery (Edwards et al., 2018; Rocha & Arcinas, 2020). Moreover, PSF often coexists with post stroke depression (PSD), which affects approximately 30% to 50% of stroke survivors (Zhang et al., 2019; He et al., 2019). This overlap further complicates management, as both conditions significantly hinder rehabilitation and long-term recovery. Despite its prevalence and impact, PSF remains under-researched in China, particularly among younger stroke survivors (Huang et al., 2024; Maaijwee et al., 2015; Zhu et al., 2024).

The Second Affiliated Hospital of Guizhou University of Traditional Chinese Medicine is a key regional center for stroke rehabilitation in Guizhou Province, uniquely integrating traditional Chinese and modern medical practices. Treating a large number of stroke survivors annually, the hospital provides an ideal environment for studying PSF, particularly given the region's socio-economic challenges, such as

limited healthcare resources and unequal access to rehabilitation services. Addressing PSF in this context is crucial for improving stroke care outcomes (Li et al., 2020; Xue et al., 2024; Yang et al., 2023).

This study aims to investigate the prevalence and associated factors of PSF among young and middle-aged stroke survivors hospitalized within three months of stroke onset. By identifying high-risk patients and the contributing factors, this research seeks to provide evidence-based insights to improve nursing practices. The findings will support the development of tailored interventions, including standardized assessments, psychological support, and lifestyle modifications, to enhance recovery and quality of life.

1.2 Problem Statement

Stroke is one of the leading causes of death and disability worldwide, with China being one of the most heavily burdened countries. The overall prevalence of stroke in China is approximately 3.1%, with around 2.5 million new cases reported annually (Yi et al., 2020; Zhang et al., 2024). In 2020, the incidence and mortality rates of stroke in mainland China were 505.2 per 100,000 and 343.4 per 100,000, respectively, highlighting the significant public health threat posed by this condition (Tu et al., 2023). Furthermore, stroke is the primary cause of long-term disability in China, with over 80% of survivors experiencing persistent functional impairments, including motor dysfunction, cognitive decline, and speech difficulties. These impairments significantly affect patients' daily lives and their ability to reintegrate into society (Björck et al., 2024; Zhang et al., 2021). Additionally, 30–50% of stroke survivors are unable to return to work within a year, further exacerbating the economic burden on families and society. The dual challenge of high mortality and disability

rates makes stroke one of the most pressing public health issues in China (Pearce et al., 2023).

Among stroke survivors, PSF is one of the most prevalent and debilitating complications, with a global prevalence ranging from 20% to 62%, and up to 40% in specific Chinese populations (Shawky et al., 2022; Xue et al., 2024; Yang et al., 2021). Studies have shown that PSF symptoms often peak during the early post stroke period, particularly within the first three months, with 42.3% of patients reporting significant fatigue during this time (Eriksson et al., 2023; Rutkowski et al., 2021). This early-phase PSF not only delays recovery but is also closely associated with long-term outcomes. Research indicates that the severity of PSF within the first three months is a strong predictor of functional limitations and social reintegration difficulties one year post stroke. Early identification and intervention during this critical period are therefore essential for mitigating PSF's long-term impact and improving patients' recovery outcomes (Cichon, Wlodarczyk, et al., 2021; Ho et al., 2024; Li et al., 2024).

Despite the well-recognized impact of PSF, most existing studies have focused on elderly stroke survivors, while limited attention has been given to younger and middle-aged survivors (Huang et al., 2024). This demographic faces unique challenges, including the dual pressures of returning to work and fulfilling family responsibilities, which impose substantial physical and psychological burdens that hinder rehabilitation (Wang & Feng, 2022; Wenzel et al., 2021). Societal expectations for rapid productivity recovery further exacerbate these challenges, making PSF an urgent public health and socio-economic concern.

Furthermore, current research on the factors associated with PSF in younger and middle-aged survivors remains insufficient. While some studies have identified potential associations between PSF and various physiological, psychological, and

social factors, these studies are often limited in scope and fail to explore the complex interactions among these factors. Additionally, there is a lack of comprehensive analyses of the specific manifestations and impacts of PSF within this demographic (Wu et al., 2022; Zhang et al., 2021). These gaps hinder a holistic understanding of PSF and impede the development of targeted interventions tailored to the unique needs of younger and middle-aged survivors.

To address these gaps, this study focuses on the first three months post stroke, aiming to evaluate the prevalence of PSF and identify its associated factors among younger and middle-aged stroke survivors. By addressing this critical period, the study seeks to provide scientific evidence for the design of precise rehabilitation strategies to improve recovery outcomes, enhance the quality of life, and reduce the socio-economic burden on this specific population.

1.3 Research Questions

i. What is the prevalence of post stroke fatigue among stroke survivors at the Second Affiliated Hospital of Guizhou University of Traditional Chinese Medicine?

ii. What are the associated factors for post stroke fatigue at the Second Affiliated Hospital of Guizhou University of Traditional Chinese Medicine?

1.4 Research Objectives

The research objectives are divided into two categories: general and specific objectives.

1.4.1 General Objective

To assess the prevalence of post stroke fatigue and identify its associated factors among stroke survivors hospitalized within three months of stroke onset at the Second Affiliated Hospital of Guizhou University of Traditional Chinese Medicine during the study period from September 2023 to January 2024.

1.4.2 Specific Objectives

(a) To measure the prevalence of PSF among stroke survivors using the Fatigue Severity Scale (FSS).

(b) To assess the level of depression among stroke survivors using the Patient Health Questionnaire-9 (PHQ-9).

(c) To evaluate the quality of life (QoL) of stroke survivors using the Short Version of the Stroke-Specific Quality of Life Scale (SV-SS-QoL).

(d) To determine the activities of daily living (ADLs) of stroke survivors using the Barthel Index (BI).

(e) To analyze the associations between sociodemographic factors (e.g., age, gender, income, education level, marital status, occupational status, and living situations), depression, quality of life, and activities of daily living with PSF.

1.5 Research Hypothesis

（a） Ho1: PSF is prevalent among stroke survivors within three months of stroke onset, as measured by the FSS.

（b） Ho2: Depression is significantly prevalent among stroke survivors within three months of stroke onset, as measured by the PHQ-9.

（c） Ho3: The QoL of stroke survivors within three months of stroke onset varies significantly, as evaluated by the SV-SS-QoL.

（d） Ho4: The ADLs among stroke survivors within three months of stroke onset exhibit significant variation, as measured by the BI.

（e） Ho5: Sociodemographic factors (e.g., age, gender, income, education level, marital status, occupational status, and living situations), depression, QoL, and ADLs are significantly associated with PSF.

1.6 Significance of the Study

This study holds both theoretical and practical significance in advancing the understanding and management of post stroke fatigue, particularly among younger and middle-aged stroke survivors, a demographic facing unique physical, psychological, and social challenges.

From a theoretical perspective, the research contributes to refining the framework for understanding PSF by examining its associated factors, such as sociodemographic characteristics, depression, activities of daily living, and quality of life. This framework provides a foundation for future scholars to conduct more comprehensive and multidimensional studies, addressing existing gaps in the literature and enhancing empirical research on PSF.

Practically, the study offers valuable evidence for developing targeted intervention strategies and improving clinical management of PSF. It highlights the importance of enhancing diagnosis and treatment while supporting personalized interventions and tailored nursing plans that address the specific needs of PSF patients. These findings provide healthcare professionals with insights into managing PSF symptoms more effectively, facilitating patients' reintegration into work and family life, and ultimately improving their quality of life. By addressing both individual and systemic challenges, this study contributes to advancing clinical care and supporting

better outcomes for stroke survivors, especially those within younger and middle-aged demographics.

1.7 Conceptual and Operational Definitions

Table 1.1 Conceptual and operational definitions

Terms	Theoretical Definition	Operational Definition
Post stroke fatigue（PSF）	Is described as early exhaustion accompanied by weariness, lack of energy, and aversion to effort, typically not alleviated by rest. This condition is particularly prevalent among stroke survivors, often hindering their physical and mental recovery processes (Paciaroni & Acciarresi, 2019).	In this study, post stroke fatigue is defined as persistent tiredness not alleviated by rest, experienced by stroke survivors within the first three months after stroke onset, with a specific focus on young and middle-aged individuals**.** It is measured using the Fatigue Severity Scale (FSS), a validated tool specifically developed for assessing fatigue in clinical populations. The FSS includes nine items rated on a 7-point Likert scale, with total scores ranging from 9 to 63. A score of 36 or higher indicates the presence of PSF, with higher scores reflecting greater fatigue severity. This tool was selected due to its widespread use and reliability in measuring fatigue among stroke survivors (Wu & Wang, 2007).
Depression	Is characterized by persistent low mood and loss of interest or pleasure in most activities, accompanied by symptoms such as sleep disturbances, fatigue, appetite changes, and difficulty concentrating. Among stroke survivors, depression is a common consequence, significantly impacting their recovery outcomes and quality of life (Ferro et al., 2016).	In this study, depression is defined as persistent low mood and associated symptoms, including fatigue, changes in appetite, and poor concentration, experienced by stroke survivors. Depression is measured using the Patient Health Questionnaire-9 (PHQ-9), a widely used and validated screening tool. The PHQ-9 includes nine items rated on a 4-point Likert scale, with total scores ranging from 0 to 27. Depression severity is categorized as follows: 0–4 (no depression), 5–9 (mild depression), 10–14 (moderate depression), 15–19 (moderately severe depression), and ≥20 (severe depression). This tool was chosen for its simplicity, clinical applicability, and ability to categorize depression levels in a stroke population (Wang et al., 2014).

Table 1.1 Continued

Terms	Theoretical Definition	Operational Definition
Quality of Life (QoL)	Refers to the perception of one's position in life within the context of cultural and value systems, as well as personal goals, expectations, and concerns. For stroke survivors, quality of life is a crucial indicator of their ability to adapt to physical, emotional, and social challenges(Moura et al., 2022).	In this study, QoL refers to stroke survivors' perception of their position in life within cultural and personal contexts. It is measured using the Short Version of the Stroke Specific Quality of Life Scale (SV-SS-QoL), a validated tool designed for stroke populations. The SV-SS-QoL includes 12 items rated on a 5-point Likert scale, with total scores ranging from 12 to 60. Scores are categorized as low (12–27.99), medium (28.00–43.99), and high (44.00–60.00). These categories provide insight into the overall trends of QoL in stroke survivors and their correlation with other study variables (Tang et al., 2021).
Activities of Daily Living (ADLs)	Refer to essential abilities for independent self-care, including eating, bathing, and mobility. In the context of stroke survivors, ADLs are critical indicators of functional recovery and self-sufficiency (Mlinac & Feng, 2016).	In this study, ADLs are defined as the ability to perform essential self-care tasks, such as eating and bathing. These are measured using the Barthel Index (BI), a widely recognized tool for assessing functional independence. The BI consists of 10 items scored from 0 to 15, with total scores ranging from 0 to 100. Higher scores indicate better self-care ability, categorized as follows: 100 (intact), 61–99 (mild impairment), 41–60 (moderate impairment), 21–40 (severe impairment), and ≤20 (extreme impairment). The BI was chosen for its reliability in measuring ADL levels and its utility in categorizing the degree of functional impairment among stroke survivors (Wu et al., 2012).

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter employs a narrative review to systematically analyze the prevalence and associated factors of PSF. It begins with an overview of the characteristics of stroke and the definition of PSF, establishing the research context. Subsequently, it delves into the prevalence of PSF and its associated factors, focusing on sociodemographic characteristics, psychological factors, and disease-related physiological factors, while also addressing the limitations of existing studies. Finally, the Roy Adaptation Model (RAM) is introduced as the theoretical framework, providing a scientific foundation and clear direction for the research design.

2.2 Overview of Stroke

Stroke, or cerebrovascular accident, refers to acute neurological dysfunction caused by localized cerebral circulatory disorders. It is one of the most significant diseases threatening human health (Li et al., 2022; Murphy & Werring, 2020). Based on pathological mechanisms, stroke is classified into ischemic stroke, caused by insufficient blood supply to brain tissue due to vascular obstruction, and hemorrhagic stroke, which results from ruptured cerebral blood vessels leading to intracerebral or subarachnoid hemorrhage. Both types of stroke can result in severe neurological impairments, significantly affecting patients' health and quality of life (Hong et al., 2021; Hu & Liu, 2021; Maida et al., 2024).

According to the World Stroke Organization (WSO), stroke is the leading cause of disability and the second leading cause of death globally, with approximately 16.9 million people affected annually and an incidence rate of 258 cases per 100,000

population (Feigin et al., 2022; Topçuoğlu, 2022). The incidence is significantly higher in men than in women, particularly in the 55–60 age group (Li et al., 2022). Stroke severely impacts patients' physical functioning and mental health, manifesting in motor disabilities, speech difficulties, and emotional challenges such as anxiety and depression. These complications not only reduce patients' quality of life but also hinder rehabilitation, increasing the burden on individuals, families, and society. As such, stroke represents an urgent global public health concern requiring immediate attention (Freytes et al., 2021; Owolabi et al., 2021; Jambi et al., 2024).

2.2.1 Definition of Post Stroke Fatigue

Post stroke fatigue (PSF) refers to a subjective sense of weakness or fatigue experienced by stroke survivors, characterized by excessive exhaustion after minimal physical or mental activity that cannot be effectively alleviated by rest (Chen et al., 2023). Ingles et al. (1999) first introduced the concept of PSF, highlighting its multidimensional nature, including physical, cognitive, and social aspects. Building on this foundation, Groot et al. (2003) conducted a comprehensive literature review and further refined the understanding of PSF by describing it in terms of vitality, attention, sleep quality, emotional affect, and duration. They proposed the first diagnostic criteria, defining PSF as significant fatigue and mental exhaustion persisting for at least two consecutive weeks post stroke, with fatigue disproportionate to daily activity levels. These criteria outline six key features, at least one of which must be present: increased fatigue after activity lasting for several hours, fatigue not effectively relieved by sleep or rest, preserved motivation but reduced efficiency, a negative impact on daily life or work, significant distress or worry about the fatigue, and lack of confidence in overcoming energy depletion. More recently, Thomas et al. (2019) and Lanctôt et al. (2020) characterized PSF as a "distinctive fatigue," marked by excessive tiredness, lack

of energy, and an increased need for rest, even though rest may not effectively alleviate the symptoms. Despite these efforts, no unified consensus on the definition of PSF has been reached, reflecting the complexity and multidimensionality of this condition. This underscores the need for further research to refine its definition, standardize diagnostic criteria, and develop effective interventions to improve clinical outcomes.

2.2.2 Prevalence of Post Stroke Fatigue

Post stroke fatigue is a common and debilitating condition among stroke survivors, with its prevalence varying widely across studies. These variations are attributed to differences in the definition of PSF, assessment tools, evaluation timelines, and regional population characteristics. Early studies, such as the one conducted by Ingles et al. (1999) on 181 stroke patients, reported a PSF prevalence of 68%, with 40% of patients identifying fatigue as their most severe symptom or one of the most severe symptoms. A meta-analysis further demonstrated that the choice of assessment tool significantly influences reported prevalence rates, with studies using the Fatigue Severity Scale (FSS) reporting rates between 42% and 53%, while those using the Multidimensional Fatigue Inventory (MFI) reported rates ranging from 43% to 62% (Alghamdi et al., 2021).

The prevalence of PSF varies across different stages of stroke recovery. In the acute phase, studies have reported substantial heterogeneity, with Su et al. (2021) observing fatigue symptoms in 29.8% of 60 patients, Ma et al. (2024) reporting a prevalence of 49.26%, and Zeng et al. (2024) finding a prevalence of 61.87%. During the remission phase, the prevalence of PSF has been reported to range from 36% to 50% at three months post stroke (Delva et al., 2015; Paudel et al., 2023). By six months, most studies indicate prevalence rates between 32% and 56% (Liu et al., 2020; Ouyang et al., 2024; Paudel et al., 2023; Rutkowski et al., 2021). For stroke survivors with a disease

course exceeding six months, PSF prevalence has been documented to range from 22% to 75% (Huang et al., 2024; Kjeverud et al., 2020). Notably, follow-up studies have indicated that nearly 52% of stroke survivors still report fatigue five years post stroke, underscoring the chronic nature of PSF (Cumming et al., 2016; Schnitzer et al., 2023). While some researchers suggest that PSF prevalence may increase over time due to cumulative physical and psychological burdens, others propose that fatigue symptoms gradually diminish as patients recover and adapt to post stroke life (Ho et al., 2021a; Lerdal et al., 2009; McDonald & Mead, 2023).

Geographical differences have also been identified as a significant factor influencing PSF prevalence. A systematic review revealed that the average prevalence of PSF in Asia was 35%, which was lower than the rates reported in Europe (55%) and the United States (52%)(Cumming et al., 2016). Additional studies highlighted considerable variability within regions, with prevalence rates reported at 40% in China, 53.52% in the Netherlands, 58.9% in Ghana, and as high as 70% in Jordan (Sarfo et al., 2019; Zhan et al., 2023). These disparities may be attributed to differences in healthcare systems, cultural attitudes towards fatigue, diagnostic practices, and regional variations in stroke management and rehabilitation.

The significant variability in PSF prevalence can be attributed to differences in definitions, assessment tools, recovery stages, and regional populations. These inconsistencies highlight the need for standardized assessment protocols and longitudinal studies to better understand the temporal and geographical factors influencing PSF. Additionally, targeted interventions should address both the acute and chronic impacts of PSF to improve the quality of life for stroke survivors worldwide.

2.2.3 Associated Factors of Post Stroke Fatigue

The associated factors of PSF can be summarized based on relevant literature

and the RAM theoretical framework (Jolly et al., 2023; Roy, 2011; Zhang et al., 2021). These associated factors are primarily concentrated in three areas: sociodemographic characteristics, psychological factors, and disease-related or physiological factors. Sociodemographic characteristics include age, gender, income, education level, marital status, occupational status, and living situations. Psychological factors mainly involve depression and quality of life. Disease-related and physiological factors encompass activities of daily living, sleep disorders, biochemical markers, and stroke lesion location. This classification highlights the multidimensional nature of PSF and its influencing factors.

2.2.3(a) Age

The relationship between PSF and age has been widely studied, but findings remain inconsistent, reflecting the complexity of this association. Some studies suggest that fatigue severity increases with age, making advanced age a significant predictor of PSF, particularly among older women (García et al., 2025; Hashmi et al., 2024; Vu et al., 2024). Others report a U-shaped relationship where younger and older patients experience higher fatigue levels than middle-aged individuals (Kjeverud,2024). Additionally, Ozyemisci et al. (2019) and subsequent studies highlight the higher prevalence of PSF among younger stroke survivors, whereas other research finds no significant association between age and PSF (Aarnes et al., 2020; Marker et al., 2018).

Given these inconsistent findings, this study adopts an age classification of 18-35 years (young adulthood) and 36-59 years (middle adulthood), focusing specifically on the young and middle-aged stroke survivors (18-59 years). This classification is supported by prior research categorizations and aligns with evidence suggesting that younger stroke survivors experience higher PSF prevalence (CPC Central Committee and State Council, 2017). Young adulthood is often characterized by peak physical and

mental capacities, while middle adulthood involves increased health risks and dual responsibilities from work and family (Alebeek et al., 2018; Wister et al., 2022). These distinctions address critical gaps in the literature and allow for systematic examination of PSF patterns within this demographic.

By emphasizing the young and middle-aged population, this study aims to provide a clearer understanding of PSF's relationship with age, bridging gaps in the literature and offering insights that could inform tailored interventions and support strategies for stroke survivors.

2.2.3(b) Gender

Gender has been identified as a potential factor influencing PSF risk, but research findings remain inconclusive. Ibrahim et al. (2024) found that young female stroke patients exhibited a significantly higher PSF prevalence than males, whereas Zhu et al. (2024) noted more pronounced daytime hypersomnia symptoms related to fatigue among male first-time stroke patients. Chen et al. (2023) concluded in a review that gender's influence on fatigue levels varies, with no consistent patterns observed across studies. These discrepancies call for further exploration into the role of gender in PSF.

2.2.3(c) Income

The association between income levels and PSF has been widely examined, with many studies highlighting the protective role of higher income against fatigue. For instance, (Sibbritt et al., 2022) found that patients with fewer financial difficulties experienced significantly lower fatigue scores[1]. Consistent with these findings, (Engberg et al., 2017; Hong et al., 2021) and Hong et al. (2021) also reported that higher income levels were associated with reduced fatigue severity. Conversely, Harris et al. (2021) found no statistically significant link between income levels and PSF. These mixed results point to the complexity of the income-PSF relationship and the need for

further research to better understand the underlying mechanisms.

2.2.3(d) Education Level

The role of education in PSF has also been widely studied, producing mixed results. While some studies found no significant association (Elizabeth Tremayne et al., 2021; Labrague & Ballad, 2021; Sokal et al., 2021), others revealed that lower education levels increase fatigue risk. For instance, Ruiz et al. (2021)found that patients with lower educational attainment were significantly more likely to experience fatigue, and Miller et al. (2022) reported that higher literacy levels consistently correlated with a reduced risk of PSF. These contrasting findings underscore the need for further research to clarify education's influence on PSF.

2.2.3(e) Marital Status

Studies on the relationship between marital status and PSF have produced mixed findings. While some research found no significant association (Chen & Marsh, 2018; Delva et al., 2018), others identified abnormal marital status, such as being divorced or separated, as a predictor of PSF (López et al., 2018; Broek et al., 2024). Teng et al. (2023) observed that single individuals exhibited higher fatigue levels compared to those who were married or cohabiting. However, other studies suggested that individuals with a spouse reported greater fatigue than those who were single, widowed, or divorced (Cho et al., 2022; Shrout et al., 2021). These conflicting results may reflect differences in social support, caregiving responsibilities, or emotional stress across marital groups, highlighting the need for further investigation into the underlying mechanisms of this complex relationship.

2.2.3(f) Occupational Status

The relationship between occupational status and PSF has been extensively

studied, with mixed findings. Drummond et al. (2017) reported that actively employed individuals experienced higher fatigue levels compared to those who were retired or unemployed. In contrast, Figueredo et al. (2020), Porro et al. (2019), and La et al. (2022) linked returning to work (RTW) to improved recovery outcomes and survival rates. However, Juniartha et al. (2020) found no significant association between occupational status and fatigue, while Coevorden et al. (2022) observed higher fatigue levels among unemployed individuals. These inconsistent findings underscore the need for further investigation into the influence of occupational status on PSF.

2.2.3(g) Living Situations

The relationship between living situations and PSF has been explored in multiple studies, yielding inconsistent findings. Riazuelo (2021)observed that individuals living with loved ones reported higher levels of fatigue compared to those living alone. In contrast, other studies found no significant association between living alone and fatigue (Braamse et al., 2020; A. Drummond et al., 2017), although some suggested a potential trend toward increased fatigue risk among individuals who live alone (Dahlberg et al., 2022; Gao et al., 2021). These mixed results highlight the need for further research to clarify the role of living arrangements in PSF.

2.2.3(h) Depression

The relationship between depression and PSF is complex and has been widely studied, with findings showing a strong association between the two conditions. Higher levels of fatigue are consistently linked to an increased likelihood of depression (Medeiros et al., 2020; Veal et al., 2023), as systematic reviews indicate that 29%-34% of PSF patients exhibit depressive symptoms, while 10% of individuals with depression report no fatigue, suggesting that the two conditions can coexist or exist independently (Aarnes et al., 2020; Ponchel et al., 2015). Correlational studies further reveal a

moderate positive relationship between PSF and depression, with correlation coefficients ranging from 0.4 to 0.6 (Meng et al., 2020). Mechanistically, depression may intensify fatigue by increasing psychological stress, reducing resilience, and lowering energy levels, while PSF may exacerbate depressive symptoms by impairing quality of life, reducing social support, and weakening coping abilities (Davies et al., 2021.; Ghosh et al., 2024). Despite these findings, the exact biological mechanisms underlying this bidirectional relationship remain unclear, particularly in terms of neuroinflammation, neurotransmitter imbalances, and endocrine dysfunction, highlighting the need for further investigation (Chaves-Filho et al., 2019).

2.2.3(i) Quality of Life (QoL)

PSF is strongly linked to QoL and is widely recognized as a major barrier to stroke recovery (Alahmari et al., 2024; Hu et al., 2024; Lee & Kim, 2024). The presence of PSF significantly reduces patients' ability to perform daily activities, leading to a marked decline in QoL (Ogwumike et al., 2022). Research consistently shows a negative correlation between PSF and health-related QoL (HRQoL), with this relationship being particularly evident when measured using tools such as the Stroke-Specific Quality of Life (SS-QoL) and SF-36 scales (Akter, 2015; Alotaibi et al., 2021). Additionally, observational studies indicate that PSF negatively impacts both short-term QoL and long-term health and psychological outcomes (Lillicrap et al., 2016). This close association underscores the critical importance of addressing PSF to enhance QoL and overall recovery in stroke survivors (Ramírez et al., 2019).

2.2.3(j) Activities of Daily Living (ADLs)

PSF has a significant negative impact on activities of daily living (ADLs). Studies using tools such as the Functional Independence Measure (FIM), Fatigue Severity Scale (FSS), and Barthel Index consistently report a negative correlation

between fatigue severity and ADLs performance (Blomgren et al., 2019; Usman et al., 2024). Patients with early fatigue symptoms face greater challenges in regaining ADLs independence, with higher fatigue levels observed among those scoring below 33 on the Barthel Index (Oyake et al., 2021; Skogestad et al., 2021; Zhu et al., 2024). However, some studies have reported no significant association between PSF and ADL, suggesting variability due to differences in study design, timing of assessments, and individual patient characteristics (Elf et al., 2016; Meng & Liu, 2022). Interventions such as Energy Conservation plus Problem Solving Therapy (EC+PST) have shown promise in improving ADLs capacity and reducing fatigue scores (Kim et al., 2019). Further research is needed to explore the mechanisms underlying these relationships and to validate effective intervention strategies.

2.2.3(k) Sleep Disorders

Sleep disorders are a common complication among stroke patients, with up to 50% reporting such issues (Cai et al., 2021; Fulk et al., 2020). These disturbances often result in fatigue, negatively impacting physical recovery and energy replenishment. Some studies suggest that sleep disorders may serve as an independent risk factor for PSF. For instance, Ho et al. (2021b) reported that sleep disorders significantly increased the risk of PSF, with sleep quality explaining 5.9% of the variance in fatigue scores. Similarly, Zhang et al. (2021) found that individuals with sleep disorders were 2.01 times more likely to experience fatigue than those without. However, Becker et al. (2024) reported no significant long-term association between sleep disorders and PSF, possibly due to differences in study design or patient characteristics. This inconsistency underscores the need for further research to clarify the underlying mechanisms and to provide a stronger evidence base for targeted interventions.

2.2.3(l) Biochemical Markers

Biochemical markers have been associated with PSF. Liu et al. (2020) and Chen et al. (2024) found that elevated C-reactive protein (CRP) levels predicted PSF within six months of stroke, while (Wu et al., 2015) noted this association diminished after six months. In contrast, Klinedinst et al. (2019) observed a negative correlation between fatigue and CRP in chronic stroke patients, with no links to other inflammatory markers. Other studies reported significant associations between PSF and markers such as homocysteine and homocysteine and glycated hemoglobin (HbA1c) (Cichon et al., 2021; Ouyang et al., 2024; Wu et al., 2015). These findings suggest a potential role of biochemical markers in PSF, but further research is needed to clarify their mechanisms and clinical applications.

2.2.3(m) Stroke Lesion Location

Recent studies have explored the relationship between stroke lesion location and PSF using various approaches. Some studies categorized lesion location based on hemispheric lateralization. For example, Mutai et al. (2017) found that infarctions in the right hemisphere were associated with a higher incidence of PSF. Others classified lesions by anatomical regions, with Cotter et al. (2021) reporting that damage to the prefrontal cortex significantly increased the risk of PSF, while Kuppuswamy et al. (2015) found that reduced cortical excitability was linked to a greater likelihood of PSF. However, some studies reported no significant association between lesion location and PSF (Aarnes et al., 2020; Ulrichsen et al., 2020). Overall, the relationship between stroke lesion location and PSF remains inconclusive, necessitating further research for validation.

2.3 Summary

In summary, PSF arises from a broad range of factors, including sociodemographic, psychological, and disease-related physiological aspects, highlighting its complexity. Despite progress in understanding these associations, significant gaps and inconsistencies persist. Therefore, this study aims to clarify the prevalence of PSF and its relationships with associated factors, providing guidance for interventions that enhance stroke survivors' quality of life and rehabilitation outcomes.

In this study, the selection of variables is grounded in both prior research and the logical framework of the study objectives. These variables include age, gender, income level, education level, marital status, occupational status, living situation, depression levels, quality of life, and activities of daily living. These variables were included in the model because they have been frequently associated with PSF in previous studies. For instance, age was categorized into 18-35 years and 36-59 years to reflect developmental and health-related differences, focusing specifically on the young and middle-aged population. Gender was analyzed with males as the reference group, and baseline levels for income and education were chosen to represent higher-risk groups. Marital status was categorized to examine how being unmarried, married, or widowed may influence PSF, as previous studies have suggested that social support plays a critical role in recovery. Occupational status was included to evaluate the impact of unemployment, employment, and retirement on fatigue levels, given the varying physical and psychological demands associated with these statuses. Living situation was considered to assess the influence of living alone, with a partner, or in other arrangements on the experience of PSF. Depression levels, QoL, and ADLs were included as psychological and functional variables that have consistently been linked to PSF severity and recovery outcomes.

Through this systematic and scientifically informed approach to variable selection and categorization, this study seeks to further explore the multifactorial nature of PSF, providing robust evidence to support targeted interventions and filling critical gaps in current research.

2.4 Theoretical and Conceptual Framework

2.4.1 The Roy Adaptation Model as the Theoretical Framework

The Roy Adaptation Model (RAM), developed by nursing theorist Callista Roy in the late 1960s, provides a comprehensive framework for understanding how individuals maintain health and functionality through adaptation to internal and external stimuli (Phillips & Harris, 2014). The model is grounded in four fundamental concepts: person, health, environment, and nursing. It views the person as a holistic, dynamic system that integrates biological, psychological, and social dimensions. Health is conceptualized as a dynamic process in which individuals achieve wholeness and harmony through successful adaptation. The environment encompasses both internal stimuli, such as psychological states and physiological functions, and external stimuli, including social and cultural factors. Nursing, as defined by RAM, aims to regulate stimuli, enhance adaptive responses, and support individuals in achieving optimal health outcomes (Roy, 2011).

The model further delineates four adaptive modes to analyze individual responses: the physiological-physical mode, self-concept mode, role function mode, and interdependence mode. The physiological-physical mode focuses on basic needs, such as oxygenation, nutrition, and physical activity. The self-concept mode examines psychological factors and self-perception. The role function mode emphasizes the fulfillment of social and occupational roles, while the interdependence mode highlights

the importance of social support and interpersonal relationships. Additionally, RAM identifies two adaptive systems—regulator and cognator subsystems—that enable individuals to respond to stimuli. The regulator subsystem involves physiological mechanisms, whereas the cognator subsystem encompasses psychological and cognitive processes, such as perception, judgment, and emotion. Together, these elements form a structured and dynamic model for understanding and guiding adaptive processes in health and nursing contexts (Alkrisat & Dee, 2014; Naga & Al-Atiyyat, 2014). The theoretical framework is illustrated in Figure 2.1.

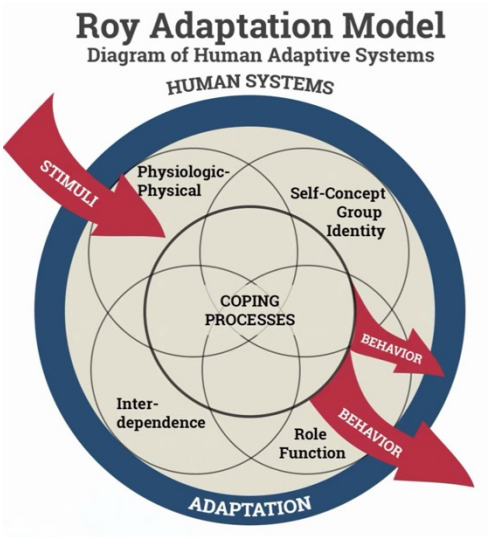

Figure 2.1 Roy Adaptation Model

2.4.2 Development of the Conceptual Framework

The conceptual framework of this study is based on the RAM, as illustrated in Figure 2.2, which hypothesizes that sociodemographic, psychological, and physiological factors collectively influence the degree of PSF. Sociodemographic factors (e.g., age, gender, income, education level, marital status, occupational status, and living situations) form the foundation of external and internal stimuli in the adaptation process. Psychological factors (e.g., depression and QoL) reflect the individual's self-concept adjustment ability, while physiological factors (e.g., ADLs) serve as key indicators of functional recovery. Under the RAM framework, health is