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Predictors and short-term outcomes of post-stroke fatigue in initial phase of transition from hospital to home: A prospective observational study

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Abstract

Aim: To analyse the interactions of associated factors with post stroke fatigue (PSF) after discharge home and determine the predictors of PSF and their impact on stroke survivors.

Design: A prospective observational study.

Methods: A total of 94 patients with acute stroke were recruited between May 2019 -July 2020. The main outcomes were fatigue, depression, insomnia, sarcopenia, and health-related quality of life (HRQOL) and were assessed at admission and 1 month after discharge. Fatigue was measured using the Fatigue Assessment Scale. Depression and Insomnia were assessed using the Hospital Anxiety and Depression Scale-Depression and Insomnia Severity Index, respectively. Sarcopenia was measured using the SARC-F questionnaire, and HRQOL was assessed using the Short Form-8.

Results: Acute phase PSF was an independent predictor of PSF after discharge home. Moreover the path analysis revealed that this effect is mediated through both the direct effect of acute-phase PSF on PSF after discharge home and through the indirect effect of interaction with pre-stroke SARC-F, acute phase depression, and acute phase insomnia, which remains a separate predictor of acute-phase PSF. In total, 17% of the survivors had persistent PSF. Persistent PSF was significantly associated with depression, insomnia, sarcopenia, and a lower quality of life scores.

Conclusions: Post-stroke fatigue may occur in the acute phase and persists after discharge, it will not only affect later depression, insomnia, and quality of life, but also sarcopenia.

Impact: Acute phase PSF was found to be an independent predictor of PSF after discharge home. In addition, the interaction with pre-stroke SARC-F, acute phase depression and insomnia had an indirect connection with PSF after discharge home, which remains a separate predictor of acute-phase PSF. Thus, early assessment and management of mental status, sleep problems, and sarcopenia during hospitalization might be an important step in post-stroke rehabilitation and home transition.

KEYWORDS
depression, fatigue, insomnia, nursing, quality of life, sarcopenia, stroke

1 | INTRODUCTION

Fatigue occurring as a consequence of stroke is a common complaint (van der Werf et al., 2001), identified as early as 1999 by Ingles et al. (1999) in a study of 181 patients with acute stroke. The Ingles study found that 40% of stroke survivors considered fatigue as one of their most serious sequelae. In recent years, 25–85% of patients reported experiencing post-stroke fatigue (PSF) (Cumming et al., 2016), even those with good neurological recovery (Marsh et al., 2018; Staub & Bogousslavsky, 2001). These rates exceed fatigue levels in the general population that range only from 10–23% (Lamers et al., 2013; Lerdal et al., 2005; Loge & Kaasa, 1998). Unlike normal fatigue resulting from overexertion, PSF is not relieved with normal rest and has been documented to persist chronically in some stroke survivors (Barbour & Mead, 2012; Chaudhuri & Behan, 2004; Duncan et al., 2012; Wu, Kutlubaev et al., 2015; Wu, Mead et al., 2015).

In community patients, PSF is defined as at least a 2-week period over the past month when the patient has experienced fatigue, lack of energy, or an increased need to rest every or nearly every day, leading to difficulty in taking part in everyday activities. In hospital patients, PSF is defined when the patient has experienced fatigue, a lack of energy, or an increased need to rest every day or nearly every day since their stroke. Fatigue leads to difficulty in taking part in everyday activities and therapies, or the need to terminate an activity early due to fatigue. (Lynch et al., 2007). PSF not only interferes with social participation and daily activities, but also has a negative impact on their rehabilitation outcomes, including participation in rehabilitation therapy and return to work (Glader et al., 2002; van de Port et al., 2007; Andersen et al., 2012). Moreover PSF has been shown to be related to poor neurological recovery, functional limitations, decreased quality of life, and increased institutionalization and mortality (Choi-Kwon et al., 2005; Glader et al., 2002; Naess & Nyland, 2013). PSF is an often neglected but important stroke sequela with far reaching consequences (Lerdal et al., 2009). However, little is known about the underlying mechanism and management of PSF (Aarnes et al., 2020).

2 | BACKGROUND

Recently, an increasing number of physiotherapists, nurses, and researchers have paid increasing attention to PSF. In 2016, the top 10 published research priorities specific to stroke nursing identified managing fatigue as a top research priority (Rowat et al., 2016). Previous studies have shown that PSF is related to the stroke survivor's gender, age, pre-stroke fatigue, or whether stroke was recurrent or first-ever (Nadarajah & Goh, 2015; Ponchel et al., 2015). Many studies have demonstrated a strong relationship between PSF and psychological factors such as depression (Lerdal et al., 2011; van der Werf et al., 2001). However, the relationship between fatigue and depression remains controversial due to PSF can also occur in the absence of depression (Ponchel et al., 2015). In addition, sleep problems such as insomnia was listed as the contributors to fatigue (Leppävuori et al., 2002). A previous study showed that fatigue measured 1 year after stroke was associated with both sleep disturbance and physical disability (Appelros, 2006). Moreover poor functional ability related to higher levels of PSF, and functional status was reported to mediate the influence of PSF on HRQOL (Vincent-Onabajo & Adamu, 2014). Furthermore, poor functional capacity seems to be related to the increase of the risk of sarcopenia and reduced muscle strength can also leads to loss of functional capacity (Dhillon & Hasni, 2017; Oliveira et al., 2019). Despite some studies having shown a strong association between low skeletal muscle mass and fatigue in cancer patients (Bye et al., 2017; Wang et al., 2020), to our best knowledge, muscle loss or sarcopenia was not considered in previous studies on PSF. Muscle wasting is a common complication of stroke, with 42% of stroke survivors having sarcopenia (Su et al., 2020). The impact of muscle weakness after stroke on physical function reduction or disability (Bohannon, 2007) indicates that it may also contribute to a reduction in psychological function.

As stroke survivors try to manage and adapt to changes or functional limitations, the rhythm and routines of life after stroke will also change. At the initial phase of transition at discharge from hospital to home, the real consequences of the stroke on daily life become apparent (Beunder et al., 2015). Many stroke survivors reported that a salient feature of the transition phase is managing fatigue (Rittman et al., 2004). However, 43% of stroke survivors reported inadequate support to manage their fatigue problems (McKevitt et al., 2011). Thus, frustration is a common response to these changes 1 month after discharge (Rittman et al., 2004). Moreover, the continuity of care is even more difficult for stroke survivors with language, motor, or visual impairments that substantially hinder telephone contact to schedule and confirm appointments after discharge from the hospital (Broderick & Abir, 2015). To improve home transition for stroke patients, the outcomes of PSF should be determined after the patient returns home for a period. As such, it is important for healthcare professionals to identify risk factors during hospitalization and manage them in time. A recent study (Lerdal & Gay, 2013) reported that acute phase fatigue is a significant predictor of later physical health. Thus, the acute phase may represent a critical period for functional recovery. However, studies investigating PSF in the acute phase, such as the first or second week after stroke, are scarce (Chaudhuri & Behan, 2004; Schepers et al., 2006). Furthermore, most previous studies were focused on the impact of PSF on the long-term outcomes after stroke (Andersen et al., 2012; Christensen et al., 2008;

Elf et al., 2016; Glader et al., 2002), studies investigating PSF in the initial phase of transition from hospital to home are scarce.

3 | THE STUDY

3.1 | Aims

This study aimed to investigate the characteristics of PSF from the acute phase to the first month after discharge, analyse the possible predictors and interactions of associated factors towards the PSF after discharge home, and determine the impact of PSF on the short-term outcomes after stroke that included depression, insomnia, sarcopenia, and HRQOL.

3.2 | Design

This study was a part of the For S (Support System for Stroke Survivors) project. This project is prospective observational study that aims to improve home transition and long-term outcomes for stroke patients during the hospitalization period. This study was a single-centre, prospective observational study of data collected between May 2019–July 2020 at a neurosurgical hospital in Sapporo, Hokkaido, Japan.

3.3 | Participants

Participants who met the following criteria were included: (a) diagnosis of an acute stroke (the acute onset of focal neurological deficit as a result of underlying cerebrovascular disease, including both ischemic and haemorrhagic stroke); (b) age > 30 years; (c) willing to discharge from the hospital to home; and (d) willing to complete the study. The exclusion criteria were: (a) a Mini-Mental State Exam (MMSE) score of <24 or significant impairments in cognition; (b) severe paralysis, severe aphasia, or communication difficulties; (c) inability to speak Japanese; (d) medically unstable or has planned surgery; (e) had a past or present history of depression or started on antidepressant drug therapy within the past 3 months; (f) taking pharmacological treatments for fatigue; and (g) current participation in other research studies that might affect fatigue or add a significant burden to the participant.

The sample size was anticipated to be achievable in a limited time (18 months) available for recruitment in this study. Multiple linear regression (MLR) is a common statistical analysis in a multivariate model that examines how multiple independent variables are related to one dependent variable. At least one journal now requires a minimum $N = 5$ per group for statistical analyses. Some researchers have been advised to use $N = 10–20$ per predictor (Curtis et al., 2015). Path analysis is an extension of multiple regressions. It goes beyond regression in that it allows for the analysis of more complicated models (Streiner, 2005). Some researchers have been advised to use $N = 5$ or 20 per estimated parameter (Bentler & Chou, 1987; Wolf et al., 2013). Therefore, the sample size calculations based on 5 minimum numbers of cases per independent variable [Sample size, N = (number of predictors) × (5 – 20 cases per variable)]. There were five main outcomes variables were measured in this study that included fatigue, depression, insomnia, sarcopenia, and HRQOL. Thus, we pre-specified measured variables for PSF and found that they should be less than or equal 6 based on previous studies and the current study design. This study purposely selects the 15 cases for each variable, and the total of 90 respondents required in this study fulfils the suggested sample size of Multiple linear regression and path analysis. Considering a 10% dropout rate, the desired sample size to be collected was 99.

3.4 | Data collection

This study has three stages. The screening stage (screening stroke patients within 2 weeks of admission) involved a review of the electronic medical records along with the nurse manager to predetermine potentially eligible participants. Then, the nurse manager contacted their attending physician to assess whether they did not meet any exclusion criteria and obtain permission. The second stage involved along with the nurse manager going to the ward to provide a detailed verbal explanation of the study to the eligible participants and obtained informed consent from the patients or their relatives. Finally, the assessment stage was conducted at baseline (acute phase: within 2 weeks after admission) and follow-up (patients came to the hospital for follow-up at 1 month after discharge).

3.4.1 | Assessment of PSF and course of PSF

Considering a good feasibility, validity, and reliability in measuring fatigue in stroke patients (Mead et al., 2007). Fatigue was measured using the Fatigue Assessment Scale (FAS), which is a 10-item self-report scale on the different aspects of fatigue, with responses made on a 5-point Likert scale: 1 = never; 2 = sometimes; 3 = regularly; 4 = often; 5 = always (Cumming & Mead, 2017; Michielsen et al., 2003). The scale is scored from 10 to 50, with higher scores indicating greater fatigue. FAS is easy to complete and has been established to be a reliable and valid tool for identifying fatigue in various diseases and conditions (Michielsen et al., 2003). FAS has been used in 26 different diseases or conditions, including stroke, neurologic disorders, and sarcoidosis. In addition, FAS is the only fatigue measurement tool that has a cutoff value for stroke patients (Hendriks et al., 2018; Mead et al., 2007; Michielsen et al., 2004; Smith et al., 2008), a score of ≥24 indicating post-stroke fatigue (Cumming & Mead, 2017).

The course of PSF was classified as follows: no PSF, defined as no fatigue (FAS score < 24) at baseline and follow-up; persistent PSF, fatigue (FAS score ≥ 24) both at baseline and at follow-up; recovered from PSF, with fatigue at baseline but without fatigue at follow-up;

and incident PSF, without fatigue at baseline but with fatigue at follow-up.

3.4.2 | Demographic, clinical, and stroke characteristics

Demographic characteristics included age, sex, and family composition. Clinical characteristics included medical condition, smoking status, alcohol consumption, body mass index, MMSE score, and Functional Independence Measure score. Stroke characteristics included previous stroke, type of stroke, and length of hospital stay. All data were collected from the electronic medical records.

3.4.3 | Assessment of possible pre-stroke risk factors

Pre-stroke sarcopenia was assessed using the SARC-F questionnaire, which is a rapid questionnaire to screen for sarcopenia using self-reported information. The SARC-F is comprising 5 assessment items: strength, assistance walking, rising from a chair, climbing stairs, and falls. (Malmstrom & Morley, 2013). Patients answered based on their condition before the stroke. The total SARC-F score ranges from 0–10 points, a score of ≥4 were classified as having a risk of sarcopenia (Ida et al., 2019), with higher scores indicating higher risk of sarcopenia. Pre-stroke fatigue was assessed using a single-item self-report, and patients who reported fatigue lasting longer than 3 months before the stroke were defined as having pre-stroke fatigue. Data on pre-stroke sleep disorders were collected from electronic medical records.

3.4.4 | Assessment of possible post-stroke risk factors and outcomes

The SARC-F questionnaire was used to screen for sarcopenia at follow-up, and patients with a score of ≥4 were classified as having a risk of sarcopenia (Ida et al., 2019; Malmstrom & Morley, 2013). Depression was assessed at baseline and follow-up using the Hospital Anxiety and Depression Scale- Depression (HADS-D). The HADS-D is a Likert scale composed of seven items to which patients respond through a 4-point scale (from 0–3) referring to overt symptoms (Annunziata et al., 2011), with scores >7 set as a cutoff for classifying depression (Hatta & Higashi, 1998; Zigmond & Snaith, 1983; Zigmond et al., 1993). The HADS-D showed to be a valid instrument to measure the symptom severity of depression in both primary care patients and in the general population (Bjelland et al., 2002). Moreover the HADS-D as one of the most widely used screening tools for post-stroke depression has superior psychometric properties and clinical utility indices in stroke populations (Burton & Tyson, 2015). Insomnia was assessed at baseline and follow-up using the Insomnia Severity Index (ISI), which is a reliable and valid instrument to detect cases of insomnia in the population (Morin et al., 2011). The ISI is a 7-item scale used to assess sleep quality and insomnia severity over the previous 2 weeks rated on a 0–4 scale, and the total score ranges from 0–28. A higher score indicates more severe insomnia, with a score of >7 being the cut-off for classifying insomnia (Bastien et al., 2001; Munezawa et al., 2009). Health-related quality of life (HRQOL) was assessed using the Short Form-8 (SF-8) questionnaire at baseline and follow-up. SF-8 is an 8-item tool that is commonly used to assess HRQOL and has demonstrated acceptable validity and reliability in population studies. Moreover SF-8 takes less time to complete, appears to be less confusing, therefore, likely to be more acceptable to patients (Gulati et al., 2009). The eight questions are used to calculate two summary measure scores: physical component score (PCS) and mental component score (MCS), with higher scores indicating better health (Fukuhara & Suzukamo, 2004).

3.5 | Ethical considerations

This prospective observational study was approved by the Ethics Committee of the Faculty of Health Sciences, Hokkaido University (Reference No 18–82,19–80). All participating patients or their relatives provided informed consent.

3.6 | Data analysis

Statistical analyses included univariate, multivariate, and path analyses. Continuous variables were presented using means and standard deviations or median and range, whereas categorical variables were presented using frequencies and percentages. Normally distributed continuous variables were analysed using the Student's *t*-test and a one-way analysis of variance. Meanwhile, non-normally distributed variables were analysed using the non-parametric Mann–Whitney *U*-test and Kruskal–Wallis with Bonferroni multiple-comparison test. Categorical variables were evaluated using the chi-squared test. Significant variables in the univariate analysis (with p values < 0.05) were included in the baseline simple linear regression model. Considering that significant variables at baseline may also affect the results of follow-up, not only the significant variables in the univariate analysis but also the variables in the baseline linear regression were included in the follow-up simple linear regression model. Variables with p values < 0.05 in the simple linear regression model were entered into the MLR model to determine the relationships between these predictors and PSF. All statistical analyses were conducted using IBM SPSS Statistics Version 26.0 (IBM Corp., Armonk, NY, USA). p values <0.05 were considered significant.

Path analysis, a form of applied regression analysis, was conducted to evaluate hypothetical relationships between variables towards the explanation of PSF after discharge, using the IBM SPSS Amos 26.0 (IBM Corp.). The explanatory factors included in the

model were selected based on existing literature and our findings (variables with p values <0.05 in the MLR). The total PSF score at follow-up was entered into the model as the main dependent variable. We used path analysis to identify a model that will capture the interactions of fatigue, depression, and insomnia in the acute phase and pre-stroke SARC-F in stroke survivors and, in particular, will help explain how these factors lead to PSF after discharge. Several steps were taken to test the assumptions of the model. If the initial model does not fit the data, the model is modified and retested until an acceptable fit is achieved. The model fit was assessed using the following criteria: (a) chi-square (χ^2) goodness-of-fit statistic (good fit if $p > 0.05$); (b) chi-square degrees of freedom ratio (χ^2/df) (good fit if <3); (c) the goodness-of-fit index (GFI) (good fit if ≥0.9); (d) the Comparative Fit Index (CFI) (good fit if ≥0.9); Tucker–Lewis Index (TLI) (good fit if ≥0.9); normed Fix Index (NFI) (good fit if ≥0.9); and (e) the root mean square error of approximation (RMSEA) (acceptable if from 0.06 to 0.08) (Hooper et al., 2008; Hu & Bentler, 1999; Schreider et al., 2006). The significance of the direct, indirect, and total effects was evaluated with the bootstrap resampling method, with 2000 bootstrap samples and 95% confidence intervals around the standardized estimates. Effects with $p < 0.05$ were considered significant (Preacher & Hayes, 2008). R-square was used to evaluate the variance of each variable explained in the model.

3.7 | Validity, reliability, and rigour

We selected the assessment scales with good validity and reliability to ensure the high quality of this study, and this questionnaire was checked using a pre-test to establish whether questions are properly worded, clear enough to be easily understood by Japanese patients. Moreover to ensure that all investigators can understand the survey instruments thoroughly, and ask questions in a manner that will convey the same message to respondents, we provided with manuals, and all the investigators accepted the training before investigation. As part of the field quality control program, when the investigator was conducting the investigation, a supervisor was present to monitor progress in the investigation and take remedial action where necessary. Furthermore, recheck was conducted after data input to ensure the accuracy of data.

4 | RESULTS

4.1 | Patient characteristics

In total, 104 of the 171 stroke patients who were recruited consented to participate in the study (Figure S1). Of them, 94 patients had complete follow-up. The mean patient age was 68.5 (*SD* 10.0) years at baseline, 38% of the patients were women, and 30% were living alone. The median length of hospital stay was 16 days (range, 8–142 days), and the mean FAS scores at baseline and at follow-up were 19.4 (*SD* 6.7) and 18.8 (*SD* 7.2), respectively. The patient characteristics are presented in Table 1.

4.2 | Prevalence of PSF at baseline and follow-up

In total, 94 stroke survivors were followed up for 1 month after discharge. PSF was prevalent in 25.5% of the patients in the acute phase (baseline) and in 29.8% at 1 month after discharge (follow-up). In total, 61.7% of the stroke survivors did not have PSF at all, whereas 17.0% of the survivors had PSF at both time points. Overall, 8.5% of the survivors had fatigue at baseline but recovered at follow-up, while 12.8% of survivors had no PSF at baseline but had PSF at follow-up.

4.3 | Factors associated with fatigue at baseline and follow-up

Univariate analysis showed a higher proportion of acute phase PSF in women ($p = 0.019$). Previous stroke ($p = 0.029$) and haemorrhagic stroke ($p = 0.037$) were significantly associated with acute phase PSF. Pre-stroke fatigue ($p < 0.001$) and a higher pre-stroke SARC-F score ($p = 0.030$) were significantly associated with acute phase PSF. In addition, depression ($p = 0.008$) and insomnia ($p = 0.001$) were significantly associated with PSF in the acute phase. Meanwhile, female sex ($p = 0.047$), previous stroke ($p = 0.008$), depression ($p = 0.010$), and fatigue ($p < 0.001$) at the acute phase were significantly correlated to PSF after discharge home.

4.4 | Factors associated with FAS score at baseline and follow-up

Univariate regression showed that previous stroke ($\beta = 0.21$, $p < 0.001$), haemorrhagic stroke ($\beta = 0.32$, $p = 0.002$), pre-stroke fatigue ($\beta = 0.61$, $p = 0.041$), higher scores of pre-stroke SARC-*F* ($\beta = 0.32$, $p = 0.002$), depression ($\beta = 0.47$, $p < 0.001$), and insomnia ($\beta = 0.47$, $p < 0.001$) were significantly associated with higher acute phase FAS scores. Haemorrhagic stroke ($\beta = 0.21$, $p = 0.048$), pre-stroke fatigue ($\beta = 0.36$, $p < 0.001$), a higher pre-stroke SARC-F score ($\beta = 0.23$, $p = 0.027$), fatigue ($\beta = 0.66$, $p < 0.001$), depression ($\beta = 0.42$, $p < 0.001$), and insomnia ($\beta = 0.28$, $p = 0.007$) were significantly associated with higher FAS scores after discharge home. Multiple regression showed that pre-stroke fatigue ($\beta = 0.39$, $p < 0.001$), higher scores of pre-stroke SARC-*F* ($\beta = 0.16$, $p = 0.034$), depression ($\beta = 0.21$, $p < 0.010$), and insomnia ($\beta = 0.19$, $p < 0.023$) were significantly associated with higher acute phase FAS score. The R-square indicated that 50% of the variance in acute phase PSF can be explained by this model. Only the FAS score at the acute phase ($\beta = 0.64$, $p < 0.001$) was significantly associated with a higher FAS score after discharge home. The R-square indicated that 42% of the

TABLE 1 Patient characteristics at baseline and follow-up

Characteristics	Baseline				Follow-up		
	Total $N = 94$	PSF $N = 24$	No PSF $N = 70$	p-value	PSF $N = 28$	No PSF $N = 66$	p
Demographics							
Age, mean years (*SD*) [c]	68.5 (10.0)	70.0 (10.1)	68.0 (10.0)	0.412	70.6 (7.5)	67.6 (10.8)	0.193
Sex, Female *n* (%)[a]	36 (38)	14 (58)	22 (31)	0.019*	15 (54)	21 (32)	0.047*
Living alone, *n* (%)[a]	28 (30)	4 (17)	24 (34)	0.103	6 (21)	22 (33)	0.248
Clinical characteristics							
Hypertension, *n* (%)[a]	42 (45)	9 (38)	33 (47)	0.412	11 (39)	31 (47)	0.493
Diabetes, *n* (%)[a]	24 (26)	3 (13)	21 (30)	0.090	5 (18)	19 (29)	0.266
Cancer, *n* (%)[a]	9 (10)	2 (8)	7 (10)	0.811	3 (11)	6 (9)	0.807
Smoking, *n* (%)[a]				0.223			0.711
Current	28 (30)	9 (38)	19 (27)		10 (36)	18 (27)	
Former	19 (20)	2 (8)	17 (24)		5 (18)	14 (21)	
Alcohol drinking, *n* (%)[a]				0.251			0.071
Current	47 (50)	9 (38)	38 (54)		9 (32)	38 (58)	
Former	4 (4)	2 (8)	2 (3)		2 (7)	2 (3)	
MMSE†, median (range)[b]	28 (25–30)	28 (25–30)	28 (25–30)	0.299	27 (25–30)	28 (25–30)	0.077
BMI, mean (*SD*)[c]	24.7 (3.9)	24.7 (4.8)	24.7 (3.6)	0.972	24.1 (3.3)	25.0 (4.2)	0.323
FIM at admission							
Total, median (range)[b]	93 (41–126)	89 (41–126)	96 (43–126)	0.267	93 (41–126)	94 (43–126)	0.921
Motor, mean (*SD*)[c]	62.7 (18.3)	60.4 (19.1)	63.5 (18.0)	0.466	63.9 (19.2)	62.2 (18.0)	0.691
Cognitive, median (range)[b]	33 (16–35)	31 (16–35)	33 (24–35)	0.622	32 (16–35)	34 (22–35)	0.635
Stroke characteristics							
Previous stroke, *n* (%)[a]	13 (14)	7 (29)	6 (9)	0.029*	4 (14)	9 (14)	0.934
Type of stroke, *n* (%)[a]				0.037*			0.191
Ischemic	86 (91)	19 (79)	67 (96)		24 (86)	62 (94)	
Hemorrhagic	8 (9)	5 (21)	3 (4)		4 (14)	4 (6)	
Paralysis, *n* (%)[a]	38 (40)	11 (46)	27 (39)	0.532	12 (43)	26 (39)	0.754
Pre-stroke characteristics							
Pre-stroke fatigue, *n* (%)[a]	18 (19)	14 (58)	4 (6)	<0.001*	10 (36)	8 (12)	0.008*
Pre-stroke sleep disorder, *n* (%)[a]	36 (38)	10 (42)	26 (37)	0.694	12 (43)	24 (36)	0.554
Pre-stroke SARC-F, median (range)[b]	1 (0–7)	2 (0–7)	1 (0–5)	0.030*	2 (0–7)	1 (0–4)	0.137
Post-stroke characteristics							
Depression, *n* (%)[a]	21 (22)	10 (42)	11 (16)	0.008*	11 (39)	10 (15)	0.010*
Insomnia, *n* (%)[a]	50 (53)	20 (83)	30 (43)	0.001*	19 (68)	31 (47)	0.063
Fatigue, *n* (%)[a]	–	–	–	–	16 (57)	8 (12)	<0.001*

Note: Values are shown as means (*SD*), median (range), or proportions (%).

Abbreviations: BMI, body mass index; FIM, Functional Independence Measure; MMSE, Mini-Mental State Exam; PSF, poststroke fatigue; *SD*, standard deviation.

[a]Chi-square test.

[b]Mann–Whitney *U* test.

[c]*t*-test.

*Significant association ($p < 0.05$).

†Missing 29, $n = 65$.

variance in PSF after discharge home can be explained by this model (Table 2).

4.5 | Path analysis

We used path analysis to identify a model that will capture the interactions of pre-stroke sarcopenia, depression, insomnia, and fatigue in stroke survivors and, in particular, will help clarify how these factors lead to PSF after discharge home. Based on the existing literature and our findings (variables found to be significantly associated with FAS score in the multiple linear regression), a model was hypothesized (Figure S2). This initial model had a poor fit: $\chi^2/df = 5.643$, $p < 0.001$, GFI = 0.90, CFI = 0.818, TLI = 0.546, NFI = 0.798 and RMSEA = 0.219. The model was thus modified and retested until the final model (Figure 1) had an acceptable fit as follows: $\chi^2/df = 1.482$, $p = 0.205$, GFI = 0.976, CFI = 0.981, TLI = 0.953, NFI = 0.947, and RMSEA = 0.072. As shown in Figure 1, pre-stroke SARC-*F* ($\beta = 0.194$, $p = 0.030$), insomnia ($\beta = 0.355$, $p = 0.000$), and depression ($\beta = 0.353$, $p = 0.000$) had a significant direct effect on acute phase PSF. Acute phase PSF had a significant direct effect on PSF after discharge home ($\beta = 0.579$, $p = 0.001$). However, depression ($\beta = 0.204$, $p = 0.001$), insomnia ($\beta = 0.205$, $p = 0.001$), and pre-stroke SARC-*F* ($\beta = 0.112$, $p = 0.044$) only had an indirect association with PSF after discharge home through acute phase PSF, (Tables S1 and S2). The R-square indicated that 43% of the variance in PSF after discharge home can be explained by this model.

4.6 | Impact of post-stroke fatigue on short-term outcomes

The acute phase PSF was significantly associated with fatigue (67% versus 17%; $p < 0.01$), insomnia (71% versus 30%; $p < 0.01$), higher SARC-F scores (2 versus 1; $p = 0.026$), and lower QOL scores (PCS, 48 versus 51; $p = 0.029$; MCS, 46 versus 51; $p = 0.006$) at 1 month after discharge (Table S3). Stroke survivors with persistent PSF included a significantly higher proportion of individuals with depression (31% versus 5%; $p = 0.003$), insomnia (81% versus 24%; $p = 0.001$), and sarcopenia (SARC-F score ≥ 4; 44% versus 9%; $p < 0.001$]) compared with survivors who had no PSF. Moreover, those with PSF showed a significantly higher SARC-F score (3 versus 1; $p < 0.001$) and significantly lower HRQOL scores (PCS, 43 versus 51; $p = 0.046$; MCS, 45 versus 51; $p = 0.001$) compared with survivors who had no PSF (Figure 2). No significant differences were found among the other groups (Table 3).

5 | DISCUSSION

This study addressed some evidence gaps regarding the relationships between associated factors and PSF after discharge home. In our study, acute phase PSF was an independent predictor of PSF after discharge, with direct relationships. Acute phase depression, acute phase insomnia, and pre-stroke SARC-F had indirect correlations with PSF after discharge home. This correlation was mediated by acute phase PSF, which also remained a separate predictor of acute phase PSF. In this study, PSF was prevalent in 25.5% and 29.8% of the patients in the acute phase and at 1 month after discharge, respectively. Furthermore, 17.0% of the survivors had persistent PSF, and persistent PSF was significantly associated with depression, insomnia, sarcopenia, and a lower HRQOL score. These findings provide instrumental scientific data that can be used to develop strategies to manage PSF. Furthermore, to the best of our knowledge, this is the first study to report that persistent PSF not only affects depression, insomnia, and lower HRQOL scores, but is also related to sarcopenia.

Our findings in the univariate analyses are consistent with those of other studies (van de Port et al., 2007; Lerdal et al., 2011) that showed a higher proportion of PSF in women than in men. However, several other studies have also reported no sex differences in the incidence of PSF (Appelros, 2006; Naess et al., 2005). In the regression analysis, we found no significant difference in the sex distribution and FAS score between those with and without PSF. In the univariate and multivariate analyses, pre-stroke fatigue was correlated to post-stroke fatigue, consistent with previous findings (Lerdal et al., 2011). There might be numerous potential explanations for this finding, including pre-existing disease, poor health, lifestyle factors, vulnerability to stress, and mental health conditions (Kjeverud et al., 2020).

In line with the findings of previous studies (Acciarresi et al., 2014; Kjeverud et al., 2020), the bidirectional relationship between depression and insomnia played a prominent role in the occurrence of PSF. Although fatigue is a characteristic symptom of depression, PSF and post-stroke depression also share common risk factors, such as functional impairments (MacIntosh et al., 2017). PSF can also occur without depression (De Doncker et al., 2018; Ponchel et al., 2015). Van der Werf et al. (2001) found that only 38% of patients with severe fatigue were also depressed. The current study showed similar findings, with 41.7% and 32.1% of patients with fatigue being depressed in the acute phase and at 1 month after discharge, respectively. Moreover depression was prevalent in 22.3% of the participants in the acute phase and in 12.8% at 1 month after discharge. A previous study reported that insomnia occurs in 57% of patients in the early months after stroke (Leppävuori et al., 2002). The current study showed similar findings, with 53.2% and 40.4% of patients having insomnia in the acute phase and at 1 month after discharge, respectively.

However, while the prevalence of insomnia was significantly decreased at 1 month after discharge, the prevalence of PSF did not. PSF can occur without depression and/or insomnia. In this study, we found that acute phase PSF had no significant impact on depression after discharge. However, fatigue in the acute phase that continued to discharge was significantly associated with depression after discharge. Thus, early PSF management can not only prevent PSF, but also prevent depression after discharge. Acute phase depression and insomnia had direct associations with acute phase PSF. Additionally,

TABLE 2 Linear regression analyses of the associations between FAS scores at baseline and follow-up

	Baseline				Follow-up			
	Univariate analyses		Multivariate analyses†		Univariate analyses		Multivariate analyses‡	
Variables	β (95% CI)	*p*	β (95% CI)	*p*	β (95% CI)	*p*	β (95% CI)	*p*
Sex[a]	0.15 (−0.73–4.84)	0.150			0.17 (−0.57–5.44)	0.113		
Previous stroke[b]	0.21 (7.51–13.05)	<0.001*	0.11 (−0.67–5.05)	0.131	0.06 (−3.00–5.59)	0.551		
Type of stroke[c]	0.32 (2.87–12.21)	0.002*	0.09 (−1.68–5.77)	0.278	0.21 (0.06–10.47)	0.048*	0.06 (−2.90–6.15)	0.477
Pre-stroke characteristics								
Pre-stroke fatigue [d]	0.61 (0.16–7.95)	0.041*	0.39 (3.67–9.61)	<0.001*	0.36 (2.97–10.01)	<0.001*	−0.10 (−5.61–1.97)	0.341
Pre-stroke SARC-F scores	0.32 (0.55–2.29)	0.002*	0.16 (0.06–1.40)	0.034*	0.23 (0.131–2.06)	0.027*	0.01 (−0.78–0.83)	0.945
Post-stroke characteristics								
Depression scores	0.47 (0.52–1.19)	<0.001*	0.21 (0.10–0.69)	0.010*	0.42 (0.46–1.20)	<0.001*	0.16 (−0.03–0.67)	0.075
Insomnia scores	0.47 (0.34–0.76)	<0.001*	0.19 (0.03–0.41)	0.023*	0.28 (0.10–0.60)	0.007*	−0.04 (−0.28–0.18)	0.680
Fatigue scores	–	–	–	–	0.66 (0.54–0.88)	<0.000*	0.64 (0.45–0.94)	**<0.001***

Abbreviation: CI, confidence interval.

[a]Sex is coded as female, 1; male, 0.

[b]Previous stroke status is coded as previous stroke, 1; first-ever stroke, 0.

[c]Type of stroke is coded as hemorrhagic, 1; ischemic, 0.

[d]Pre-stroke fatigue status is coded as pre-stroke fatigue, 1; non-pre-stroke fatigue, 0.

*Significant association ($p < 0.05$).

†Adjusted R^2: 0.502.

‡Adjusted R^2: 0.419.

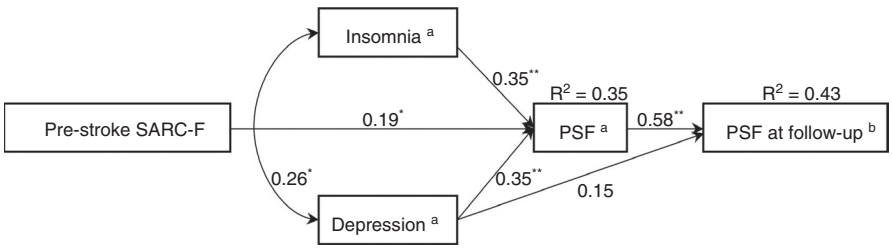

FIGURE 1 Final version of the path model analysis of PSF at 1 month after discharge. [a]measured at the acute phase; [b]measured at 1 month after discharge; *p<0.05; **p<0.01. Model fitness: χ^2/df=1.482; p=0.205; GFI=0.976; CFI=0.981; TLI=0.953; NFI=0.947; REMSEA=0.072. Indirect effect: PSF at follow-up<---Pre-stroke SARC-F (β=0.112*); PSF at follow-up <---Depression at baseline (β=0.204**); PSF at follow-up <---Insomnia at baseline (β=0.205**)

acute phase depression and insomnia also had indirect correlations with PSF after discharge home, with the correlation mediated by acute phase PSF. Collectively, these findings highlight the importance of management of mental and sleep problems during hospitalization in patients with PSF.

A novel finding in our study is that pre-stroke SARC-F score had direct correlations with acute phase PSF and indirect correlations with PSF after discharge home. Some studies have shown that low skeletal muscle mass is strongly associated with fatigue in cancer patients (Bye et al., 2017; Wang et al., 2020). Meanwhile, there have been no studies on stroke patients. Skeletal muscle mass has been reported to be a potential target for reducing fatigue (Al-Majid & Mccarthy, 2001; Morgado et al., 2016; Neefjes et al., 2017). A potential explanation for this finding is that reduced skeletal muscle mass might induce feelings of tiredness, general weakness, and lack of energy, which may in turn lead to fatigue (Neefjes et al., 2013;

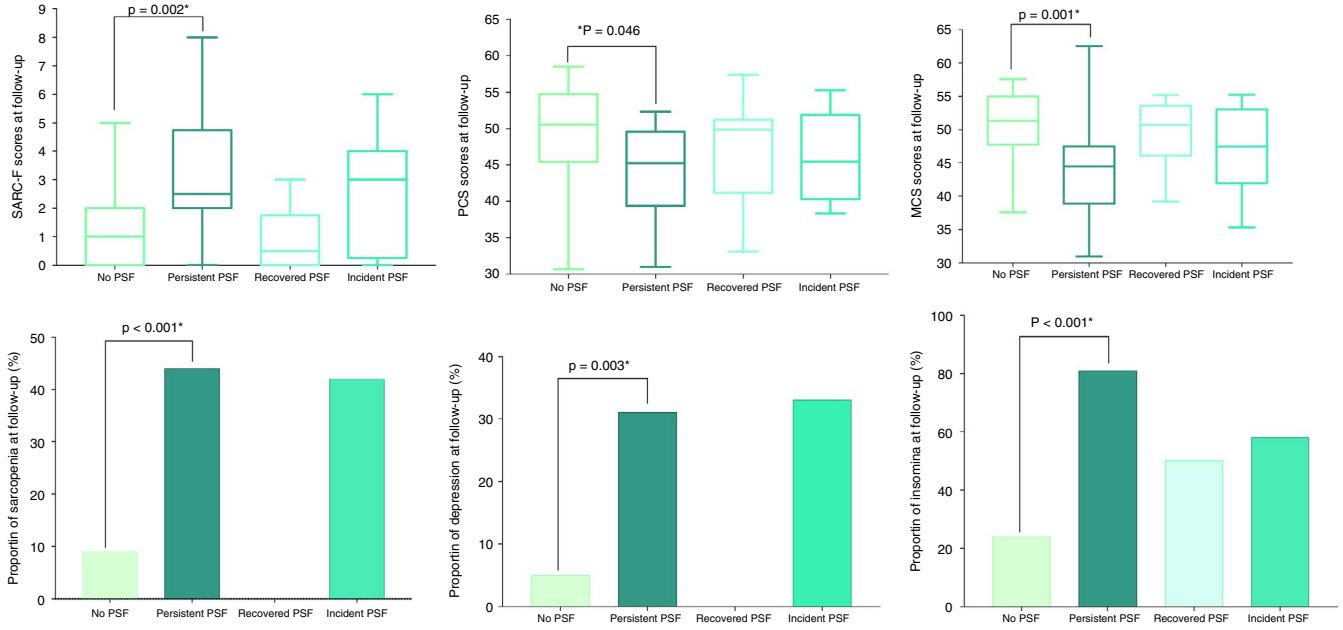

FIGURE 2 Follow-up outcomes of the patients with post-stroke fatigue. *Adjusted using Bonferroni correction for multiple tests [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 3 Follow-up outcomes of post-stroke fatigue patients

Variables	No PSF $N = 58$	Persistent PSF $N = 16$	Recovery PSF $N = 8$	Incident PSF $N = 12$	p
Age, mean years (*SD*)[b]	67.9 (10.6)	72.2 (7.7)	65.5 (13.2)	68.4 (7.0)	0.384
Sex, Female *n* (%)[a]	17 (29)	10 (63)	4 (50)	5 (42)	0.091
Length of hospital stay, median days (range)[c]	16 (8–142)	15 (9–63)	19 (9–64)	20 (10–78)	0.768
FIM at discharge, median (range)					
Total[c]	125 (103–126)	122 (113–126)	126 (124–126)	125.5 (103–126)	0.279
Motor[c]	90 (72–91)	88 (85–91)	91 (89–91)	91 (72–91)	0.120
Cognitive[c]	35 (26–35)	35 (28–35)	35 (35)	35 (31–35)	0.600
Post-stroke characteristics (follow-up)					
Depression, *n* (%)[a]	3 (5)	5 (31)[‡]	0	4 (33)[§]	0.003*
Insomnia, *n* (%)[a]	14 (24)	13 (81)[‡]	4 (50)	7 (58)	<0.001*
Sarcopenia (SARC-*F* ≥ 4), *n* (%)[a]	5 (9)	7 (44)[‡]	0	5 (42)	0.001*
SARC-F scores, median days (range)[c]	1 (0–5)	3 (0–8)[‡]	0.5 (0–3)	3 (0–6)	<0.001*
Quality of life, median days (range)[†]					
PCS[c]	51 (31–58)	43 (31–52)[‡]	50 (33–57)	46 (38–55)	0.038*
MCS[c]	51 (38–58)	45 (31–63)[‡]	50 (39–55)	46 (35–55)	0.003*

Note: Values are shown as means (*SD*), median (range), or proportions (%). Abbreviations: FIM, Functional Independence Measure; MCS, mental component score; PCS, physical component score; *SD*, standard deviation. Kruskal-Wallis with Bonferroni multiple-comparison test.

[a]Chi-square test.

[b]One-way ANOVA.

[c]Kruskal-Wallis.

*Significant association ($p < 0.05$).

[†]Missing 1, $n = 93$.

[‡]Significant differences between no fatigue versus persistent fatigue.

[§]Significant differences between no fatigue versus recovery from fatigue.

Wagner & Cella, 2004). It is also worth noting that we found that acute phase PSF was associated with a higher SARC-F score after discharge but not with sarcopenia after discharge. However, fatigue in the acute phase that continue to discharge has a significant impact on sarcopenia after discharge. This may be related to the pre-stroke SARCF score having direct associations with the acute phase PSF. Furthermore, fatigue and low physical function lasted until 1 month after discharge. This ultimately leads to a reduction in physical activity and a decline in the patient's mental and physical function, which may in turn cause muscle loss or sarcopenia. Sarcopenia may then worsen fatigue and lead to decreased activity and social interaction. Moreover the sequelae of sarcopenia may contribute to frailty, decreased capacity for independent living, and subsequent increase in health care costs (Marcell, 2003; Neefjes et al., 2013; Wagner & Cella, 2004). Further research is needed to better understand the mechanism underlying the association between PSF and sarcopenia.

A previous study with a mean follow-up of 1.5 years reported that 57% of the patients never had PSF, 26% had persistent PSF, 9% had recovered PSF, and 8% had incident PSF (Snaphaan et al., 2011). Similar findings were found in our study despite a shorter follow-up of only 1 month: 61.7% of the stroke survivors did not have PSF at all, 17.0% of the survivors had persistent PSF, 8.5% of the survivors had recovered PSF, and 12.8% of survivors had incident PSF. This may indicate that long-term PSF is likely to occur 1 month after discharge from the hospital and last for several years. Moreover fatigue within 2 weeks following stroke was the major risk factor of PSF after discharge. In addition, 17.0% of the stroke survivors had persistent PSF. This indicates that fatigue in the acute phase may last until discharge home, and PSF after discharge is likely to last for several years. PSF itself is not a severe event, but it is the poor outcomes caused by PSF that should be carefully managed. Our findings are similar to those of earlier studies showing that PSF has a significant impact on HRQOL in stroke patients (Chen et al., 2015; Lerdal & Gay, 2013; Naess et al., 2006; van de Port et al., 2007; Tang et al., 2010). PSF has a significant effect on depression, insomnia, and sarcopenia, and these factors may in turn influence the patient's HRQOL. Previous studies have shown that a markedly impaired QOL in patients with insomnia and sarcopenia (Ishak et al., 2012; Tsekoura et al., 2017). Post-stroke depression in the acute phase of stroke is an independent predictor of QOL in both the acute and chronic phases of stroke (Kim et al., 2018). This study showed that if PSF occurs in the acute phase and persists after discharge, it will affect later depression, insomnia, sarcopenia, and HRQOL. Thus, future research should focus on developing early interventions that improve fatigue before discharge rather than waiting for the fatigue to exert noticeable effects on physical and psychological health.

5.1 | Limitations

To the best of our knowledge, this is the first study to identify the predictors and short-term outcomes of PSF in the transition from hospital to home. However, this study also has some limitations. First, the results may be influenced by inclusion bias. We excluded patients with severe paralysis, severe aphasia, communication difficulties, or who were unable to respond to the questionnaire. Thus, most of the severe stroke patients in whom the prevalence of fatigue or sarcopenia is higher may have been lost. In addition, we do not have data on the direct measure of stroke severity, such as the National Institutes of Health Stroke Scale score. Moreover given that the symptoms of stroke include paralysis and imbalance, we were unable to measure the grip strength and gait speed in all patients. In addition, pre- and post-stroke sarcopenia were only measured using the self-report SARC-F questionnaire, which renders the measure vulnerable to recall bias. Furthermore, the sample size of this study, particularly that of the sarcopenia group, was relatively small. Although the sample size was calculated based on statistical methods, it may also make it difficult to determine if this outcome is a true finding. Thus, studies with larger sample sizes are needed to confirm our findings.

Despite these limitations, the present study has important implications for health professionals and future studies because of the high prevalence of PSF, its adverse effect in stroke survivors, and its importance for rehabilitation and outcomes. PSF is gaining increasing attention and is now evaluated in several guidelines for stroke practice (Eskes et al., 2015; Lanctôt et al., 2019; Winstein et al., 2017). However, research in this area remains scant, and thus, effective treatment modalities and/or management strategies for PSF are yet to be established (Ponchel et al., 2015; Wu, Kutlubaev et al., 2015; Wu, Mead et al., 2015). To the best of our knowledge, this is also the first study to analyse the interactions of pre-stroke sarcopenia, acute phase depression, acute phase insomnia, and acute phase fatigue with the occurrence of PSF after discharge home. Moreover PSF at the acute phase may last until discharge home, and PSF after discharge is likely to last for several years. Thus, health professionals need to pay attention to the subjective experience of PSF in clinical practice and provide timely assessment and interventions during hospitalization. Our data provide evidence that can be useful for achieving this goal and preventing later perceptible effects on physical and psychological health. In the field of research, this evidence could help clarify the mechanisms of PSF and develop new interventions for its management.

6 | CONCLUSIONS

In this study, 17.0% of stroke survivors had persistent PSF. Persistent PSF is not only associated with depression, insomnia, and lower HRQOL scores, but also with sarcopenia. Acute phase PSF was an independent predictor of PSF after discharge home. In addition, the interaction with acute phase depression, acute phase insomnia, and pre-stroke SARC-F had an indirect connection with post-stroke fatigue after discharge home, which remains a separate predictor of acute-phase post-stroke fatigue. These findings indicate that early assessment and management of mental status, sleep problems, and

sarcopenia during hospitalization might be an important step in post-stroke rehabilitation and home transition.

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CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

AUTHOR CONTRIBUTIONS

Design of the study, MY, MO, and YS. Data Collection, YS, MA, MS, NH, MY, KH, CI. Statistical Analysis or Interpretation of Data: YS and KH. First Draft Preparation, YS. Manuscript Revision, MY, KH, MO, and YS. Study Supervision: MY. All authors reviewed the manuscript and approved the final version.

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PEER REVIEW

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REFERENCES

Aarnes, R., Stubberud, J., & Lerdal, A. (2020). A literature review of factors associated with fatigue after stroke and a proposal for a framework for clinical utility. *Neuropsychological Rehabilitation*, *30*(8), 1449–1476. https://doi.org/10.1080/09602011.2019.1589530

Acciarresi, M., Bogousslavsky, J., & Paciaroni, M. (2014). Post-stroke fatigue: Epidemiology, clinical characteristics and treatment. *European Neurology*, *72*(5–6), 255–261. https://doi.org/10.1159/000363763

Al-Majid, S., & McCarthy, D. O. (2001). Cancer-induced fatigue and skeletal muscle wasting: The role of exercise. *Biological Research for Nursing*, *2*(3), 186–197. https://doi.org/10.1177/109980040100200304

Andersen, G., Christensen, D., Kirkevold, M., & Johnsen, S. P. (2012). Post-stroke fatigue and return to work: A 2-year follow-up. *Acta Neurologica Scandinavica*, *125*(4), 248–253. https://doi.org/10.1111/j.1600-0404.2011.01557.x

Annunziata, M. A., Muzzatti, B., & Altoe, G. (2011). Defining hospital anxiety and depression scale (HADS) structure by confirmatory factor analysis: A contribution to validation for oncological settings. *Annals of Oncology*, *22*, 2330–2333. https://doi.org/10.1093/annonc/mdq750

Appelros, P. (2006). Prevalence and predictors of pain and fatigue after stroke: A population-based study. *International Journal of Rehabilitation Research*, *29*(4), 329–333. https://doi.org/10.1097/MRR.0b013e328010c7b8

Barbour, V. L., & Mead, G. E. (2012). Fatigue after stroke: The patient's perspective. *Stroke Research and Treatment*, *2012*, 863031. https://doi.org/10.1155/2012/863031

Bastien, C. H., Vallières, A., & Morin, C. M. (2001). Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Medicine*, *2*(4), 297–307. https://doi.org/10.1016/s1389-9457(00)00065-4

Bentler, P. M., & Chou, C. H. (1987). Practical issues in structural modeling. *Sociological Methods & Research*, *16*, 78–117. https://doi.org/10.1177/0049124187016001004

Beunder, C., Dekker, J. H., Brasser, J. A., & Depla, M. F. (2015). Home after a stroke; 'that's when it really begins'. A qualitative study into the needs for aftercare of stroke patients after being discharged home. *Tijdschrift Voor Gerontologie En Geriatrie*, *46*(4), 196–203.

Bjelland, I., Dahl, A. A., Haug, T. T., & Neckelmann, D. (2002). The validity of the Hospital Anxiety and Depression Scale. An updated literature review. *Journal of Psychosomatic Research*, *52*(2), 69–77. https://doi.org/10.1016/s0022-3999(01)00296-3

Bohannon, R. W. (2007). Muscle strength and muscle training after stroke. *Journal of Rehabilitation Medicine*, *39*(1), 14–20. https://doi.org/10.2340/16501977-0018

Broderick, J. P., & Abir, M. (2015). Transitions of care for stroke patients: Opportunities to improve outcomes. *Circulation: Cardiovascular Quality and Outcomes*, *8*(6 Suppl 3), S190–S192. https://doi.org/10.1161/CIRCOUTCOMES.115.002288

Burton, L. J., & Tyson, S. (2015). Screening for mood disorders after stroke: A systematic review of psychometric properties and clinical utility. *Psychological Medicine*, *45*(1), 29–49. https://doi.org/10.1017/S0033291714000336

Bye, A., Sjøblom, B., Wentzel-Larsen, T., Grønberg, B. H., Baracos, V. E., Hjermstad, M. J., Aass, N., Bremnes, R. M., Fløtten, Ø., & Jordhøy, M. (2017). Muscle mass and association to quality of life in non-small cell lung cancer patients. *Journal of Cachexia, Sarcopenia and Muscle*, *8*(5), 759–767. https://doi.org/10.1002/jcsm.12206

Chaudhuri, A., & Behan, P. O. (2004). Fatigue in neurological disorders. *Lancet*, *363*(9413), 978–988. https://doi.org/10.1016/S0140-6736(04)15794-2

Chen, Y.-K., Qu, J.-F., Xiao, W.-M., Li, W.-Y., Weng, H.-Y., Li, W., Liu, Y.-L., Luo, G.-P., Fang, X.-W., Ungvari, G. S., & Xiang, Y.-T. (2015). Poststroke fatigue: Risk factors and its effect on functional status and health-related quality of life. *International Journal of Stroke*, *10*(4), 506–512. https://doi.org/10.1111/ijs.12409

Choi-Kwon, S., Han, S. W., Kwon, S. U., & Kim, J. S. (2005). Poststroke fatigue: Characteristics and related factors. *Cerebrovascular Disease*, *19*(2), 84–90. https://doi.org/10.1159/000082784

Christensen, D., Johnsen, S. P., Watt, T., Harder, I., Kirkevold, M., & Andersen, G. (2008). Dimensions of post-stroke fatigue: A two-year follow-up study. *Cerebrovascular Disease*, *26*(2), 134–141. https://doi.org/10.1159/000139660

Cumming, T. B., & Mead, G. (2017). Classifying post-stroke fatigue: Optimal cut-off on the fatigue assessment scale. *Journal of Psychosomatic Research*, *103*, 147–149. https://doi.org/10.1016/j.jpsychores.2017.10.016

Cumming, T. B., Packer, M., Kramer, S. F., & English, C. (2016). The prevalence of fatigue after stroke: A systematic review and meta-analysis. *International Journal of Stroke*, *11*(9), 968–977. https://doi.org/10.1177/1747493016669861

Curtis, M. J., Bond, R. A., Spina, D., Ahluwalia, A., Alexander, S. P., Giembycz, M. A., Gilchrist, A., Hoyer, D., Insel, P. A., Izzo, A. A., & Lawrence, A. J. (2015). Experimental design and analysis and their reporting: New guidance for publication in BJP. *British Journal of Pharmacology*, *172*(14), 3461–3471. https://doi.org/10.1111/bph.12856

De Doncker, W., Dantzer, R., Ormstad, H., & Kuppuswamy, A. (2018). Mechanisms of poststroke fatigue. *Journal of Neurology, Neurosurgery*

and Psychiatry, *89*(3), 287–293. https://doi.org/10.1136/jnnp-2017-316007

Dhillon, R. J., & Hasni, S. (2017). Pathogenesis and Management of Sarcopenia. *Clinics in Geriatric Medicine*, *33*(1), 17–26. https://doi.org/10.1016/j.cger.2016.08.002

Duncan, F., Wu, S., & Mead, G. E. (2012). Frequency and natural history of fatigue after stroke: A systematic review of longitudinal studies. *Journal of Psychosomatic Research*, *73*(1), 18–27. https://doi.org/10.1016/j.jpsychores.2012.04.001

Elf, M., Eriksson, G., Johansson, S., von Koch, L., & Ytterberg, C. Self-reported fatigue and associated factors six years after stroke. *PLoS One*, *11*(8), e0161942. https://doi.org/10.1371/journal.pone.0161942

Eskes, G. A., Lanctôt, K. L., Herrmann, N. et al (2015). Canadian Stroke Best Practice Recommendations: Mood, Cognition and Fatigue Following Stroke practice guidelines, update 2015. *International Journal of Stroke*, *10*(7), 1130–1140. https://doi.org/10.1111/ijs.12557

Fukuhara, S., & Suzukamo, Y. (2004). *Manual of the SF-8 Japanese version: Institute for Health Outcomes & Process Evaluation research, Kyoto*.

Glader, E. L., Stegmayr, B., & Asplund, K. (2002). Poststroke fatigue: A 2-year follow-up study of stroke patients in Sweden. *Stroke*, *33*(5), 1327–1333. https://doi.org/10.1161/01.str.0000014248.28711.d6

Gulati, S., Coughlin, P. A., Hatfield, J., & Chetter, I. C. (2009). Quality of life in patients with lower limb ischemia; revised suggestions for analysis. *Journal of Vascular Surgery*, *49*(1), 122–126. https://doi.org/10.1016/j.jvs.2008.08.011

Hatta, H., Higashi, A., Yashiro, H., Ozasa, K., Hayashi, K., Kiyota, K., Inokuchi, H., Ikeda, J., Fujita, K., Watanabe, Y., & Kawai, K. (1998). A validation of the hospital anxiety and depression scale. *Japanese Journal of Psychosomatic Medicine*, *38*(5), 309–315.

Hendriks, C., Drent, M., Elfferich, M., & De Vries, J. (2018). The Fatigue Assessment Scale: Quality and availability in sarcoidosis and other diseases. *Current Opinion in Pulmonary Medicine*, *24*(5), 495–503. https://doi.org/10.1097/MCP.0000000000000496

Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural equation modeling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods*, *6*, 53–60. https://doi.org/10.21427/D7CF7R

Hu, L.-T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Ida, S., Murata, K., Nakadachi, D., Ishihara, Y., Imataka, K., Uchida, A., Monguchi, K., Kaneko, R., Fujiwara, R., & Takahashi, H. (2017). Development of a Japanese version of the SARC-F for diabetic patients: an examination of reliability and validity. *Aging Clinical and Experimental Research*, *29*(5), 935–942. https://doi.org/10.1007/s40520-016-0668-5

Ingles, J. L., Eskes, G. A., & Phillips, S. J. (1999). Fatigue after stroke. *Archives of Physical Medicine and Rehabilitation*, *80*(2), 173–178. https://doi.org/10.1016/s0003-9993(99)90116-8

Ishak, W. W., Bagot, K., Thomas, S., Magakian, N., Bedwani, D., Larson, D., Brownstein, A., & Zaky, C. (2012). Quality of life in patients suffering from insomnia. *Innovations in Clinical Neuroscience*, *9*(10), 13–26.

Kim, E.-S., Kim, J.-W., Kang, H.-J., Bae, K.-Y., Kim, S.-W., Kim, J.-T., Park, M.-S., Cho, K.-H., & Kim, J.-M. (2018). Longitudinal impact of depression on quality of life in stroke patients. *Psychiatry Investigation*, *15*, 141–146. https://doi.org/10.30773/pi.2017.10.11

Kjeverud, A., Østlie, K., Schanke, A.-K., Gay, C., Thoresen, M., & Lerdal, A. (2020). Trajectories of fatigue among stroke patients from the acute phase to 18 months post-injury: A latent class analysis. *PLoS One*, *15*(4), e0231709. https://doi.org/10.1371/journal.pone.0231709

Lamers, F., Hickie, I., & Merikangas, K. R. (2013). Prevalence and correlates of prolonged fatigue in a U.S. sample of adolescents. *American Journal of Psychiatry*, *170*(5), 502–510. https://doi.org/10.1176/appi.ajp.2012.12040454

Lanctôt, K. L., Lindsay, M. P., Smith, E. E., Sahlas, D. J., Foley, N., Gubitz, G., Austin, M., Ball, K., Bhogal, S., Blake, T., & Herrmann, N. (2020). Canadian stroke best practice recommendations: Mood, cognition and fatigue following stroke. 6th edition update 2019. *International Journal of Stroke*, *15*(6), 668–688. https://doi.org/10.1177/1747493019847334

Leppävuori, A., Pohjasvaara, T., Vataja, R., Kaste, M., & Erkinjuntti, T. (2002). Insomnia in ischemic stroke patients. *Cerebrovascular Disease*, *14*(2), 90–97. https://doi.org/10.1159/000064737

Lerdal, A., Bakken, L. N., Kouwenhoven, S. E., Pedersen, G., Kirkevold, M., Finset, A., & Kim, H. S. (2009). Poststroke fatigue—A review. *Journal of Pain and Symptom Management*, *38*(6), 928–949. https://doi.org/10.1016/j.jpainsymman.2009.04.028

Lerdal, A., Bakken, L. N., Rasmussen, E. F., Beiermann, C., Ryen, S., Pynten, S., Drefvelin, Å. S., Dahl, A. M., Rognstad, G., Finset, A., Lee, K. A., & Kim, H. S. (2011). Physical impairment, depressive symptoms and pre-stroke fatigue are related to fatigue in the acute phase after stroke. *Disability and Rehabilitation*, *33*(4), 334–342. https://doi.org/10.3109/09638288.2010.490867

Lerdal, A., & Gay, C. L. (2013). Fatigue in the acute phase after first stroke predicts poorer physical health 18 months later. *Neurology*, *81*(18), 1581–1587. https://doi.org/10.1212/WNL.0b013e3182a9f471

Lerdal, A., Wahl, A., Rustøen, T., Hanestad, B. R., & Moum, T. (2005). Fatigue in the general population: A translation and test of the psychometric properties of the Norwegian version of the fatigue severity scale. *Scandinavian Journal of Public Health*, *33*(2), 123–130. https://doi.org/10.1080/14034940410028406

Loge, J. H., & Kaasa, S. (1998). Short form 36 (SF-36) health survey: Normative data from the general Norwegian population. *Scandinavian Journal of Social Medicine*, *26*(4), 250–258. https://doi.org/10.1177/14034948980260040401

Lynch, J., Mead, G., Greig, C., Young, A., Lewis, S., & Sharpe, M. (2007). Fatigue after stroke: The development and evaluation of a case definition. *Journal of Psychosomatic Research*, *63*, 539–544. https://doi.org/10.1016/j.jpsychores.2007.08.004

MacIntosh, B. J., Edwards, J. D., Kang, M., Cogo-Moreira, H., Chen, J. L., Mochizuki, G., Herrmann, N., & Swardfager, W. (2017). Post-stroke fatigue and depressive symptoms are differentially related to mobility and cognitive performance. *Frontiers in Aging Neuroscience*, *9*, 343. https://doi.org/10.3389/fnagi.2017.00343

Malmstrom, T. K., & Morley, J. E. (2013). SARC-F: A simple questionnaire to rapidly diagnose sarcopenia. *Journal of the American Medical Directors Association*, *14*(8), 531–532. https://doi.org/10.1016/j.jamda.2013.05.018

Marcell, T. J. (2003). Sarcopenia: Causes, consequences, and preventions. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, *58*(10), M911–M916. https://doi.org/10.1093/gerona/58.10.m911

Marsh, E. B., Lawrence, E., Hillis, A. E., Chen, K., Gottesman, R. F., & Llinas, R. H. (2018). Pre-stroke employment results in better patient-reported outcomes after minor stroke: Short title: Functional outcomes after minor stroke. *Clinical Neurology and Neurosurgery*, *165*, 38–42. https://doi.org/10.1016/j.clineuro.2017.12.020

McKevitt, C., Fudge, N., Redfern, J., Sheldenkar, A., Crichton, S., Rudd, A. R., Forster, A., Young, J., Nazareth, I., Silver, L. E., Rothwell, P. M., & Wolfe, C. D. A. (2011). Self-reported long-term needs after stroke. *Stroke*, *42*(5), 1398–1403. https://doi.org/10.1161/STROKEAHA.110.598839

Mead, G., Lynch, J., Greig, C., Young, A., Lewis, S., & Sharpe, M. (2007). Evaluation of fatigue scales in stroke patients. *Stroke*, *38*(7), 2090–2095. https://doi.org/10.1161/STROKEAHA.106.478941

Michielsen, H. J., De Vries, J., & Van Heck, G. L. (2003). Psychometric qualities of a brief self-rated fatigue measure: The Fatigue Assessment

Scale. *Journal of Psychosomatic Research*, *54*(4), 345–352. https://doi.org/10.1016/s0022-3999(02)00392-6

Michielsen, H. J., De Vries, J., Van Heck, G. L., Van de Vijver, F. J. R., & Sijtsma, K. (2004). Examination of the dimensionality of fatigue: The construction of the Fatigue Assessment Scale (FAS). *European Journal of Psychological Assessment*, *20*, 39–48. https://doi.org/10.1027/1015-5759.20.1.39

Morgado, P. C., Giorlando, A., Castro, M., & Navigante, A. (2016). Relationship between weight loss and parameters of skeletal muscle function in patients with advanced cancer and fatigue. *Supportive Care in Cancer*, *24*(9), 3961–3966. https://doi.org/10.1007/s00520-016-3236-9

Morin, C. M., Belleville, G., Bélanger, L., & Ivers, H. (2011). The Insomnia Severity Index: Psychometric indicators to detect insomnia cases and evaluate treatment response. *Sleep*, *34*(5), 601–608. https://doi.org/10.1093/sleep/34.5.601

Munezawa, T., Morin, C. M., Inoue, Y., & Nedate, K. (2009). Development of the Japanese version of the Insomnia Severity Index (ISI-J). *Japanese Journal of Psychiatric Treatment*, *24*(2), 219–225.

Nadarajah, M., & Goh, H. T. (2015). Post-stroke fatigue: A review on prevalence, correlates, measurement, and management. *Topics in Stroke Rehabilitation*, *22*(3), 208–220. https://doi.org/10.1179/1074935714Z.0000000015

Naess, H., & Nyland, H. (2013). Poststroke fatigue and depression are related to mortality in young adults: A cohort study. *British Medical Journal Open*, *3*(3), e002404. https://doi.org/10.1136/bmjopen-2012-002404

Naess, H., Nyland, H. I., Thomassen, L., Aarseth, J., & Myhr, K. M. (2005). Fatigue at long-term follow-up in young adults with cerebral infarction. *Cerebrovascular Disease*, *20*(4), 245–250. https://doi.org/10.1159/000087706

Naess, H., Waje-Andreassen, U., Thomassen, L., Nyland, H., & Myhr, K. M. (2006). Health-related quality of life among young adults with ischemic stroke on long-term follow-up. *Stroke*, *37*(5), 1232–1236. https://doi.org/10.1161/01.STR.0000217652.42273.02

Neefjes, E. C. W., van den Hurk, R. M., Blauwhoff-Buskermolen, S., van der Vorst, M. J. D. L., Becker-Commissaris, A., de van der Schueren, M. A. E., Buffart, L. M., & Verheul, H. M. W. (2017). Muscle mass as a target to reduce fatigue in patients with advanced cancer. *Journal of Cachexia, Sarcopenia and Muscle*, *8*(4), 623–629. https://doi.org/10.1002/jcsm.12199

Neefjes, E. C., van der Vorst, M. J., Blauwhoff-Buskermolen, S., & Verheul, H. M. (2013). Aiming for a better understanding and management of cancer-related fatigue. *The Oncologist*, *18*(10), 1135–1143. https://doi.org/10.1634/theoncologist.2013-0076

Oliveira, D. V., Souza, A. M., Ferreira, Á. G., Antunes, M. D., Lovato, N. S., & Nascimento Júnior, J. R. (2019). Evaluating the muscular strength, functional capacity, and risk of sarcopenia in elderly women who practice Mat Pilates. *Fisioterapia Em Movimento*, *32*, e003222. https://doi.org/10.1590/1980-5918.032.ao22

Ponchel, A., Bombois, S., Bordet, R., & Hénon, H. (2015). Factors associated with poststroke fatigue: A Systematic review. *Stroke Research and Treatment*, *2015*, 347920. https://doi.org/10.1155/2015/347920

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*, 879–891.

Rittman, M., Faircloth, C., Boylstein, C., Gubrium, J. F., Williams, C., Puymbroeck, M. V., & Ellis, C. (2004). The experience of time in the transition from hospital to home following stroke. *Journal of Rehabilitation Research and Development*, *41*(3A), 259–268. https://doi.org/10.1682/jrrd.2003.06.0099

Rowat, A., Pollock, A., St George, B., Cowey, E., Booth, J., & Lawrence, M. (2016). Top 10 research priorities relating to stroke nursing: A rigorous approach to establish a national nurse-led research agenda. *Journal of Advanced Nursing*, *72*(11), 2831–2843. https://doi.org/10.1111/jan.13048

Schepers, V. P., Visser-Meily, A. M., Ketelaar, M., & Lindeman, E. (2006). Poststroke fatigue: Course and its relation to personal and stroke-related factors. *Archives of Physical Medicine and Rehabilitation*, *87*(2), 184–188. https://doi.org/10.1016/j.apmr.2005.10.005

Schreider, J. B., Stage, F. K., King, J., Nora, A., & Barlow, E. A. (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. *The Journal of Education Research.*, *99*(6), 323–337. https://doi.org/10.3200/JOER.99.6.323-338

Smith, O. R., van den Broek, K. C., Renkens, M., & Denollet, J. (2008). Comparison of fatigue levels in patients with stroke and patients with end-stage heart failure: Application of the fatigue assessment scale. *Journal of the American Geriatrics Society*, *56*(10), 1915–1919. https://doi.org/10.1111/j.1532-5415.2008.01925.x

Snaphaan, L., van der Werf, S., & de Leeuw, F. E. (2011). Time course and risk factors of post-stroke fatigue: A prospective cohort study. *European Journal of Neurology*, *18*(4), 611–617. https://doi.org/10.1111/j.1468-1331.2010.03217.x

Staub, F., & Bogousslavsky, J. (2001). Fatigue after stroke: A major but neglected issue. *Cerebrovascular Disease*, *12*(2), 75–81. https://doi.org/10.1159/000047685

Streiner, D. L. (2005). Finding our way: An introduction to path analysis. *Canadian Journal of Psychiatry*, *50*(2), 115–122. https://doi.org/10.1177/070674370505000207

Su, Y., Yuki, M., & Otsuki, M. (2020). Prevalence of stroke-related sarcopenia: A systematic review and meta-analysis. *Journal of Stroke and Cerebrovascular Diseases*, *29*(9), 105092. https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.105092

Tang, W. K., Lu, J. Y., Chen, Y. K., Mok, V. C., Ungvari, G. S., & Wong, K. S. (2010). Is fatigue associated with short-term health-related quality of life in stroke? *Archives of Physical Medicine and Rehabilitation*, *91*(10), 1511–1515. https://doi.org/10.1016/j.apmr.2010.06.026

Tsekoura, M., Kastrinis, A., Katsoulaki, M., Billis, E., & Gliatis, J. (2017). Sarcopenia and its impact on quality of life. *Advances in Experimental Medicine and Biology*, *987*, 213–218. https://doi.org/10.1007/978-3-319-57379-3_19

van de Port, I. G., Kwakkel, G., Schepers, V. P., Heinemans, C. T., & Lindeman, E. (2007). Is fatigue an independent factor associated with activities of daily living, instrumental activities of daily living and health-related quality of life in chronic stroke? *Cerebrovascular Disease*, *23*(1), 40–45. https://doi.org/10.1159/000095757

van der Werf, S. P., van den Broek, H. L., Anten, H. W., & Bleijenberg, G. (2001). Experience of severe fatigue long after stroke and its relation to depressive symptoms and disease characteristics. *European Neurology*, *45*(1), 28–33. https://doi.org/10.1159/000052085

Vincent-Onabajo, G., & Adamu, A. (2014). Impact of poststroke fatigue on health-related quality of life of Nigerian stroke survivors. *Journal of Stroke*, *16*(3), 195–201. https://doi.org/10.5853/jos.2014.16.3.195

Wagner, L. I., & Cella, D. (2004). Fatigue and cancer: Causes, prevalence and treatment approaches. *British Journal of Cancer*, *91*(5), 822–828. https://doi.org/10.1038/sj.bjc.6602012

Wang, B., Thapa, S., Zhou, T., Liu, H., Li, L. U., Peng, G., & Yu, S. (2020). Cancer-related fatigue and biochemical parameters among cancer patients with different stages of sarcopenia. *Supportive Care in Cancer*, *28*(2), 581–588. https://doi.org/10.1007/s00520-019-04717-0

Winstein, C. J., Stein, J., Arena, R., Bates, B., Cherney, L. R., Cramer, S. C., Deruyter, F., Eng, J. J., Fisher, B., Harvey, R. L., Lang, C. E., MacKay-Lyons, M., Ottenbacher, K. J., Pugh, S., Reeves, M. J., Richards, L. G., Stiers, W., & Zorowitz, R. D. (2016). Guidelines for adult stroke rehabilitation and recovery. *Stroke*, *47*(6), e98–e169. https://doi.org/10.1161/STR.0000000000000098

Wolf, E. J., Harrington, K. M., Clark, S. L., & Miller, M. W. (2013). Sample size requirements for structural equation models: An evaluation of power,

bias, and solution propriety. *Educational and Psychological Measurement*, *76*(6), 913–934. https://doi.org/10.1177/0013164413495237

Wu, S., Kutlubaev, M. A., Chun, H.-Y.-Y., Cowey, E., Pollock, A., Macleod, M. R., Dennis, M., Keane, E., Sharpe, M., & Mead, G. E. (2015). Interventions for post-stroke fatigue. *Cochrane Database of Systematic Reviews*, *2015*(7), CD007030. https://doi.org/10.1002/14651858.CD007030.pub3

Wu, S., Mead, G., Macleod, M., & Chalder, T. (2015). Model of understanding fatigue after stroke. *Stroke*, *46*(3), 893–898. https://doi.org/10.1161/STROKEAHA.114.006647

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica*, *67*(6), 361–370. https://doi.org/10.1111/j.1600-0447.1983.tb09716.x

Zigmond, A. S., Snaith, R. P., & Kitamura, T. (1993). Hospital anxiety and depression scale (HAD Scale). *Archives of Psychiatric Diagnostics and Clinical*, *4*, 371–372.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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