Global Transitions 8 (2026) 279–285

Contents lists available at ScienceDirect

Global Transitions

journal homepage: www.keaipublishing.com/en/journals/global-transitions/

Research Article

Job strain, social support, and changes in disability among workers after stroke: Evidence from a longitudinal study in Thailand

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ARTICLE INFO

Article history:
Received 7 September 2025
Received in revised form
27 February 2026
Accepted 5 May 2026
Available online 6 May 2026

Keywords:
Disability
Job strain
Longitudinal study
Social support
Stroke
Workers

ABSTRACT

Background: Work-related psychosocial factors can affect cardiovascular health; however, their impact on stroke prognosis among young employed workforce remains understudied. This longitudinal study investigated the relationship of work stress, measured by the Demand-Control-Support model, with changes in disability over a year among 103 Thai workers aged 20 to 59 who had a stroke.
Methods: The study evaluated job strain (combination of high demand and low control) and social support before discharge at baseline. Disability status, using the Barthel index (BI) and modified Rankin Scale (mRS), was measured at baseline, 6 months, and 12 months after discharge. Generalized estimating equations were used to test the hypothesis that job strain and social support at baseline would have direct effects on disability throughout a year.
Results: The results showed that job strain was not significantly associated with disability (both BI and mRS), while low social support was significantly associated with worse disability over a year, particularly mRS (Coefficient 0.10; 95% CI: 0.0063, 0.20). The interaction between job strain and social support was not significant.
Conclusion: These findings suggest the potential importance of social support in the recovery process from stroke, particularly in the workplace. Given the rising global burden of stroke in working-age adults, these findings underscore the crucial role of worksite health promotion for stroke management.

1. Introduction

Globally, stroke remains one of the leading causes of disability and death, with increasing burdens in incidence, prevalence, morbidity, and mortality [1]. Among the health consequences of stroke, impaired physical function is one of the most prominent and burdensome outcomes for survivors [2]. Stroke-related disability-adjusted life years (DALYs), which combine years lived with disability and years of life lost prematurely, have escalated to 143 million in 2019, representing a 32.4% increase since 1990 [3]. Although stroke is traditionally considered a disease of older adults, its incidence has risen among individuals under 50 years of

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Peer review under the responsibility of KeAi Communications Co., Ltd

Production and Hosting by Elsevier on behalf of KeAi

https://doi.org/10.1016/j.glt.2026.05.001

age, termed “young” adult stroke [4]. While the prognosis of young stroke reflects lower mortality and higher functional recovery outcomes compared to older populations [5], long-term disability among the young stroke population remains a notable concern, considering societal demands and longer life expectancy within this age group [4]. Among working-age young stroke survivors, up to one-third experience moderate to severe functional disability, as well as psychosocial issues affecting return to work and work modifications [6]. Evidence further suggests that the window of the first-year post-stroke may shape long-term functional limitations, as demonstrated by a 15-year follow-up study [7].

Risk factors for stroke include hypertension, hyperlipemia, diabetes mellitus, smoking, and obesity [8]. Psychosocial work environments have recently been linked to the development of cardiovascular disease [9]. Karasek's Demand-Control model is a widely-used framework for examining work stress and cardiovascular disease [10]. The model emphasizes the combination of high psychological job demands and low job control, also termed as ‘job strain’, which exerts negative effects on health [10,11]. In 1988, Jeffery Johnson expanded the model by incorporating the social support dimension, forming the Job Demand-Control-Support model [12]. Social support refers to an individual's perceived support at work from supervisors and coworkers. Accordingly, it is hypothesized that job strain and social support may independently affect health, while social support could moderate the effect of job strain on health. Several longitudinal studies reported that job strain was associated with a high risk of onset of the first stroke among initially healthy workers. For instance, an 11-year follow-up study in Japan found over a two-fold increase in the risk of stroke among men with job strain [13]; another large study including 14 European cohorts with a mean follow-up of 9.2 years revealed that job strain was associated with 24% increased risk of ischemic stroke [14]. Regarding workplace social support, one study from Sweden with an average 7.8-year follow-up period suggested that low social support at work was significantly associated with elevated risk of stroke by 80% in women; however, job strain did not have a significant relationship with stroke, and social support did not moderate the effect between job strain and stroke [15].

Despite substantial evidence linking psychosocial work factors to stroke incidence, their role in stroke prognosis remains unclear. To the best of our knowledge, no study has examined whether job strain is associated with post-stroke functional outcomes among employed stroke survivors. Research in related cardiovascular conditions suggests that work stress may influence disease progression. For example, studies from Sweden and Canada discovered significant effects of job strain on the increased risk of recurrent coronary heart disease events [16]. In a multi-cohort study including three European cohorts, among workers with diabetes, job strain was prospectively associated with work disability in terms of sickness absence, whereas social support at work did not show any effect on work disability [17]. Although some pioneer research has initiated causal explorations of disability after stroke over two decades ago, the workplace and its contribution to post-stroke research are understudied [18]. Most existing studies focused on older adults (>65 years) and non-work-related psychosocial factors. Interestingly, in studies with 5-year follow-up, general psychological stress was not associated with consequent disability status after stroke onset [19], whereas social isolation was significantly associated with 40% higher risk of recurrent events among patients with first-ever stroke [20]. Yet, the contribution of psychosocial work factors, such as job strain and workplace social support, to the stroke prognosis among young individuals who are still engaged in employment is largely unknown. To address this gap, we conducted a one-year longitudinal study among workers who had experienced a stroke in Thailand. Thailand has undergone rapid industrialization, and high work stress has been identified as an emerging mental health concern [21]. Work stress has been linked to increased morbidity and mortality rates of stroke in the working-age group in the country [22]. We aimed to provide preliminary research evidence on longitudinal associations of a work stress measure by the Job Demand-Control-Support model with disability changes over one year after stroke onset. The conceptual framework that underpins this study is depicted in Fig. 1.

2. Materials and methods

2.1. Study design and participants

The details of this study have been described elsewhere [23]. In brief, this longitudinal study followed 103 participants aged 20-59 years who were employed before stroke onset and were able to communicate and complete surveys in Thai language. Participants

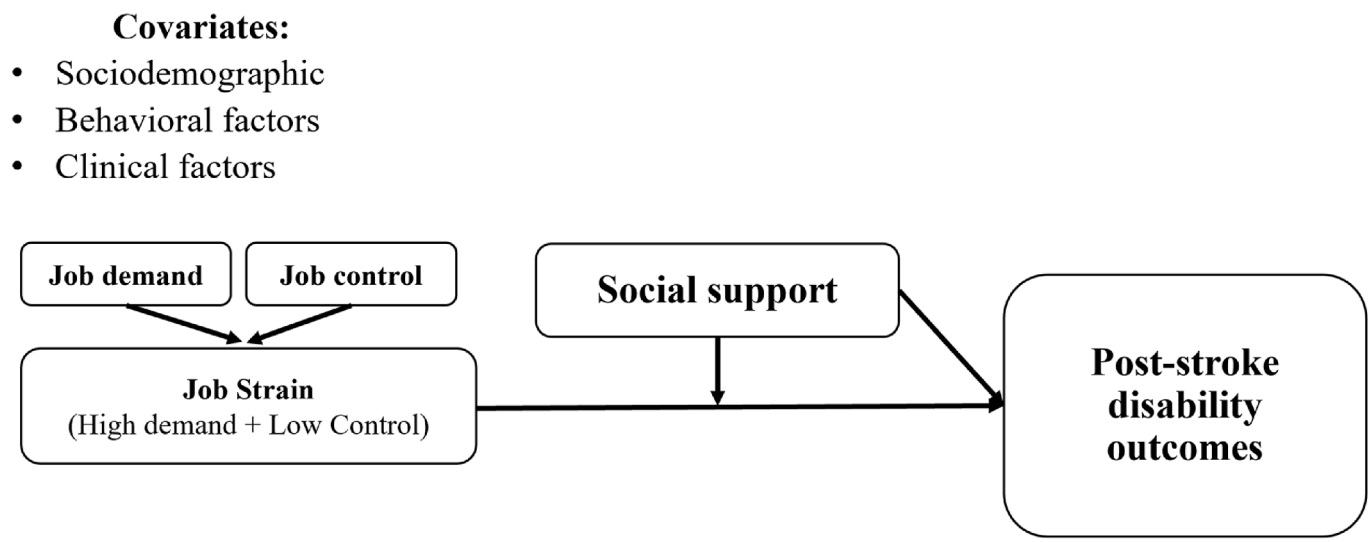

Fig. 1. Job demand-control-support model as analytical framework.

were admitted with first-time diagnosis of transient ischemic attack (TIA) or ischemic stroke (IS) in a tertiary hospital with a stroke unit in Bangkok between December 2020 and August 2022. Stroke diagnoses were determined by neurologists, based on the International Classification of Diseases, 10th revision (ICD-10). During hospitalization before discharge, job strain, social support, sociodemographic, behavioral, and clinical data were collected in the baseline survey; disability was assessed at baseline and at follow-up surveys at 6 months and 12 months via face-to-face interview.

The study was approved by the Ethics Committee for Human Research of the Faculty of Tropical Medicine, Mahidol University, Thailand (No. MUTM 2020-066-01). All procedures were performed in accordance with the Declaration of Helsinki, ICH Guidelines for Good Clinical Practice, and other International Guidelines for Human Research Protection. Written informed consent was obtained from all participants after they had been informed of the objectives, benefits, data collection method, and confidentiality agreement. Participants were right to withdraw from the study at any stage. All questionnaire data were de-identified to ensure confidentiality.

2.2. Measures of work stress

The validated 22-item Thai version of the Job Content Questionnaire (JCQ)was used in to assess psychosocial work characteristics [24]. The JCQ includes three scales for psychological job demand (5 items), decision latitude at work or job control (9 items), and social support (8 items) [24]. Respondents rated their perceptions on each item using four-category response options ranging from 1 (strongly disagree) to 4 (strongly agree). The scores of the three dimensions were calculated by summing the ratings of items for each scale [25]. Job strain (continuous) was calculated as the ratio between job demand and job control, by weighting the item numbers of these two scales, i.e., [(job demand * 9)/(job control * 5)]. High values of job strain and social support reflect high levels of stressful experience and support, respectively. The Cronbach's alpha coefficients were 0.79 for job demand, 0.67 for job control, and 0.78 for social support.

2.3. Measures of disability

Both the Barthel index (BI) [26] and the modified Rankin Scale (mRS) [27] were administered by trained study nurses to measure disability. The BI is a widely used standardized instrument to assess the status of functional disability among stroke survivors, with the primary goal of measuring self-care and mobility in activities of daily living or functional dependence in stroke patients. The BI questionnaire consists of 10 items covering personal hygiene, self-bathing, feeding, toilet use, stair-climbing, bowel control, bladder control, transfers, and mobility. The sum score of BI ranges from 0 to 100, with higher scores reflecting better function. The Cronbach's alpha coefficient was 0.818 in our study. The mRS generally categorizes 7 levels of disability: 0 (no symptoms), 1 (no significant disability), 2 (slight disability), 3 (moderate disability), 4 (moderately severe disability), 5 (severe disability), and 6 (death) [28].

2.4. Collection of sociodemographic, behavioral, and clinical information

Sociodemographic and behavioral data were collected through questionnaire-based interviews. Sociodemographic data included age, sex, marital status, income, and education. Behavioral factors were body mass index (BMI; kg/m^2), current smoking status, and alcohol intake. Clinical characteristics were gathered from medical records, including family history of stroke, the National Institutes of Health Stroke Scale (NIHSS) score at admission, and cardiometabolic diseases (including hypertension, diabetes, hyperlipemia, and cardiovascular disease) at baseline.

2.5. Statistical analysis

Statistical analyses were performed using SAS 9.4. First, mean values were presented for continuous variables, and frequencies and percentages were presented for categorical variables. Second, correlations between work characteristics (job strain and social support) at baseline and disability (BI and mRS) at baseline, 6-month, and 12-month follow-up surveys were tested by Pearson correlation analysis. Third, generalized linear models and generalized estimating equations (GEEs) were applied to examine longitudinal associations of baseline job strain and social support with changes in BI and mRS over the one-year course. Job strain and social support were treated as continuous variables, and regression coefficients were reported by job strain and social support with increase per one standard deviation (SD). Finally, the interaction between job strain and social support on the disability outcomes was tested by adding an interaction term. Model I was unadjusted. Model II adjusted for baseline sociodemographic factors (age, sex, marital status, income, and education). Model III further adjusted for behavioral factors (BMI, smoking, and alcohol consumption). Model IV additionally adjusted for clinical characteristics (family history of stroke, cardiometabolic diseases, and NIHSS at admission).

3. Results

3.1. Baseline characteristics of the participants

Between December 2020 and August 2022, 103 employed stroke patients met the inclusion criteria in this study. The sample consisted primarily of workers (n = 79), with a smaller number of managers/supervisors (n = 16) and lead workers (n = 2). Among the participants, 68 were men and 35 were women, with a mean age of 46.83 years (*SD* = 9.23). Most workers possessed a bachelor's degree or higher (83.50%), were married (79.61%), and earned an average monthly income of 16,624.76 Thai Baht (approximately equivalent to 536 U S. dollars). For behavioral factors, the mean BMI was 24.28 (*SD* = 3.80) kg/m^2. Thirty-one (30.10%) of participants were current smokers, and 52.43% (n = 54) were alcohol drinkers. In terms of medical history, 11 patients (10.68%) had a family history of stroke, and 22 patients (21.36%) had cardiometabolic diseases. The mean score of NIHSS at hospital admission was 5.33 ± 4.05 (Table 1).

3.2. Correlation matrix between job strain, social support at baseline, and disability over one year

The BI scores increased over time, from 87.9 ± 14.0 at baseline to 96.3 ± 6.9 at 6 months and 97.3 ± 4.8 at 12 months, and the mRS scores decreased from 1.2 ± 0.9 at baseline to 0.8 ± 1.0 at 6 months and 0.5 ± 0.8 at 12 months. BI at baseline was correlated with BI at 6 months ($p < 0.001$) and 12 months ($p < 0.001$), as well as mRS at baseline ($p < 0.001$), 6 months ($p < 0.001$), and 12 months ($p < 0.001$). Social support at baseline was correlated with mRS at 12 months ($p < 0.05$). Job strain at baseline was not correlated with either social support at baseline or any of the disability measures (Table 2).

Table 1
Sociodemographic and clinical characteristics at baseline (n = 103).

	N (%)
Age (years), mean ± SD	46.83 ± 9.23
Male, N (%)	68 (66.02)
Monthly income (Thai baht), mean ± SD	16,624.76 ± 9,216.12
Education level,	
Less than a bachelor's degree	17 (16.50)
Bachelor's degree or more	86 (83.50)
Marital status, N (%)	
Single	15 (14.56)
Married	82 (79.61)
Divorced/widowed	6 (5.83)
Current smokers, N (%)	31 (30.10)
Alcohol drinkers, N (%)	54 (52.43)
BMI, mean ± SD	24.28 ± 3.80
Family history of stroke, N (%)	11 (10.68)
Cardiometabolic diseases, N (%)	22 (21.36)
NIH stroke scale at admit to the hospital, mean ± SD	5.33 ± 4.05

BMI: body mass index; Cardiometabolic diseases: (hypertension, diabetes, hyperlipemia, cardiovascular disease); NIHSS: National Institutes of Health Stroke Scale; SD: standard deviation.

3.3. Longitudinal associations of job strain and social support at baseline with changes in disability over one year after stroke

In Table 3, during the one-year post-stroke, all four GEE models indicated that there were no significant associations between continuous job strain score (increased per SD) at baseline and both BI and mRS scores after adjusting for sociodemographic, behavioral, and clinical characteristics (all $p > 0.05$). For overall social support (decreased per SD) at baseline, there were no significant associations between social support and BI scores after adjusting for sociodemographic, behavioral, and clinical characteristics (all $p > 0.05$). However, for every 1-SD decrease in social support at baseline, mRS scores were significantly increased after adjusting for sociodemographic (0.11 points increased, $p = 0.0412$), behavioral (0.13 points increased, $p = 0.0131$), and clinical characteristics (0.10 points increased, $p = 0.0369$). To further examine whether different sources of workplace support had differential effects, we conducted additional analyses separating supervisor support and coworker support. Neither supervisor nor coworker support was significantly associated with BI scores in crude or fully adjusted models. For mRS, lower supervisor support was significantly associated with higher disability scores in the crude model (0.15 points increased, $p = 0.0179$), whereas coworker support was not significantly associated with mRS. However, after full adjustment for sociodemographic, behavioral, and clinical covariates, the association between supervisor support and mRS was attenuated to be marginally significant only (0.10 points increased, $p = 0.0665$). Coworker support remained non-significant in all models (please see Supplementary Table 1). There were no significant interactions between job strain and social support on disability outcomes (all $p > 0.05$).

4. Discussion

This study, which examined psychosocial work factors in post-stroke care, aligns with global public health priorities by supporting inclusive employment and reducing disability related to chronic health conditions [29]. To our knowledge, it was the first theory-based investigation to test the long-term effects of work stress on disability following a stroke. Although this study was conducted in Thailand, findings have broader relevance to other low- and middle-income countries (LMICs) undergoing rapid industrialization, where high job stress, weak workplace protections, and limited access to post-stroke rehabilitation services are common.

Table 2
Correlation matrix between job strain, social support at baseline and disability over one year (N = 103).

	Mean ± SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Job strain at baseline	0.91 ± 0.11	1.00							
(2) Social support at baseline	24.49 ± 2.67	−0.07 (0.49)	1.00						
(3) BI at baseline	87.90 ± 14.00	−0.00 (0.97)	0.06 (0.53)	1.00					
(4) BI at 6 months	96.30 ± 6.90	−0.05 (0.60)	−0.12 (0.22)	0.46 (<0.001)	1.00				
(5) BI at 12 months	97.30 ± 4.80	0.04 (0.72)	0.19 (0.07)	0.57 (<0.001)	0.63 (<0.001)	1.00			
(6) mRS at baseline	1.20 ± 0.90	0.11 (0.28)	−0.15 (0.14)	−0.67 (<0.001)	−0.40 (<0.001)	−0.44 (<0.001)	1.00		
(7) mRS at 6 months	0.80 ± 1.00	0.03 (0.77)	−0.12 (0.24)	−0.60 (<0.001)	−0.72 (<0.001)	−0.68 (<0.001)	0.55 (<0.001)	1.00	
(8) mRS at 12 months	0.50 ± 0.80	0.02 (0.84)	−0.24 (0.02)	−0.57 (<0.001)	−0.57 (<0.001)	−0.82 (<0.001)	0.43 (<0.001)	0.75 (<0.001)	1.00

Note: SD, standard deviation. Values in parentheses represent p-values.
Pearson's correlation.

Table 3
The regression coefficients and 95% CIs of repeated measures of disability during one-year follow-up by job strain and social support at baseline.

	Model I	Model II	Model III	Model IV
	Coefficient (95% CIs)	Coefficient (95% CIs)	Coefficient (95% CIs)	Coefficient (95% CIs)
BI				
Job strain (increase per SD)	−0.16 (−1.78, 1.47)	0.19 (−1.38, 1.76)	0.05 (−1.44, 1.54)	0.37 (−0.95, 1.69)
Social support (decrease per SD)	−0.41 (−1.84, 1.03)	−0.02 (−1.39, 1.36)	−0.13 (−1.25, 1.00)	0.34 (−0.66, 1.34)
P-value for interaction	0.60	0.44	0.43	0.43
mRS				
Job strain (increase per SD)	0.05 (−0.10, 0.20)	0.02 (−0.12, 0.16)	0.02 (−0.10, 0.15)	−0.00 (−0.12, 0.12)
Social support (decrease per SD)	0.16 (0.05, 0.26) **	0.11 (0.00, 0.22) *	0.13 (0.03, 0.22) *	0.10 (0.01, 0.20) *
P-value for interaction	0.97	0.98	0.92	0.77

Model I: unadjusted.
Model II: adjusted for sociodemographic factors at baseline (age, sex, marital status, income, and education).
Model III: Model II + additionally adjusted for behavioral factors at baseline (smoking, alcohol drinking, and BMI).
Model IV: Model III + additionally adjusted for clinical characteristics at baseline (family history of stroke, cardiometabolic diseases, and NIHSS at admission).
Generalized linear models and generalized estimating equations, *$p < 0.05$, **$p < 0.01$.

Our study did not find a significant association between baseline job strain and disability trajectories over one year. This contrasts with prior cohort studies among initially healthy workers demonstrating that job strain increases the risk of incident stroke [13,14]. However, the mechanisms linking work stress to stroke onset may differ from those influencing recovery after stroke, during which patients' outcomes may be shaped by stroke-related anxiety, difficulties in coping with disability, fears of recurrence, and role limitations [30]. Our findings also contrast with a prior multi-cohort study among European workers with diabetes, in which job strain was prospectively associated with work disability measured by sickness absence [17]. However, the study population and outcome differed substantially from ours, as sickness absence reflects employment participation rather than clinical disability progression after a cardiovascular event [17]. Nevertheless, our results are consistent with prior research among a sample of individuals who had experienced stroke, where nonspecific psychological stress was not associated with the subsequent 5-year disability status following stroke onset in a recent study in Iran [19]. Similarly, in our previous study among our population of patients using the effort-reward imbalance psychosocial work model, the ratio of effort and reward, or stressful work experience at baseline, was likewise not significantly associated with changes in quality of life [23]. It is possible that psychosocial work status at baseline does not necessarily capture the trajectory of psychosocial work experiences over time, especially among a worker population affected by cardiovascular events such as stroke. In other research that has investigated the reverse relationship of cardiovascular disease diagnosis at baseline with changes in both job demand-control and effort-reward imbalance perceptions, cardiovascular disease was longitudinally associated with increased work stress [31]. Another possible explanation for the null finding is that stroke survivors may modify their work roles, reduce working hours, or receive workplace accommodations after the event, thereby altering their exposure to job strain during the recovery period [32].

In contrast, lower workplace social support was independently associated with worsening disability over time, particularly when disability was measured using mRS. This finding supports the direct-effect hypothesis of the Job Demand–Control–Support model [12]. While we did not find results supporting the moderating effect, our study aligns with previous research on the association between low social support and increased risk of stroke [15]. The literature supports a related concept that social isolation, characterized by low social support and limited connectedness outside the workplace, has been associated with an increased risk of recurrent stroke among first-ever stroke patients during a 5-year follow-up period [20]. Among worker populations, coworker social support has also been associated with better mental health outcomes, including decreased psychological distress [33]. For individuals with general disability, overall social support has similarly been linked with mental health [34]. Workers with physical disability have expressed lower coworker and supervisor support than those without disability, highlighting the vulnerability of this population within workplace contexts [35]. Because our cohort consisted primarily of relatively young stroke survivors, age-related differences in perceived support may also be relevant. Individuals with disability under 60 years of age perceived higher meaningfulness of peer social support during rehabilitation compared to their older counterparts [36]. In the context of work, younger workers with disability perceived higher supervisor support than both their counterparts without disability and older workers with disability [37]. Given that individuals that had young stroke may have better functional recovery [5], lower levels of disability may, in turn, facilitate greater engagement in social and workplace interaction, which could enhance perception of available social support.

An intriguing aspect of our study is that social support at baseline was significantly associated with one disability measure, mRS, but not with the other disability measure, BI, over a one-year period. These two scales capture related but distinct constructs of disability. The mRS serves as a measure of neurological outcomes and disability following a stroke, evaluating the individual's degree of disability and accounting for their level of independence [27,28]. In contrast, BI focuses on general self-care and mobility in activities of daily living, such as feeding, bathing, toileting, transfers, and mobility [26]. In our study among relatively young stroke populations with mild to moderate severity, ceiling effects are common with the BI, as many individuals regain independence in basic daily activities within the first months after stroke [35]. The mRS has been shown to be more sensitive to subtle but clinically meaningful differences in global functional status, particularly in minor stroke or high-functioning populations [38], thus providing a more comprehensive evaluation of an individual's clinical state during stroke recovery [39]. Our findings suggest that workplace social support (particularly supervisor support) may influence broader aspects of independence and societal participation rather than basic physical self-care functions. In a working-age cohort, returning to employment, maintaining role identity, and navigating social interactions may be more strongly reflected in mRS scores than in BI scores.

Our study has several limitations, which necessitate that findings should be interpreted with caution. First, the relatively small sample was drawn from a single hospital in one city. The inclusion eligibility criterion that participants be able to communicate and complete surveys may have excluded individuals with more severe stroke conditions, and the sample consisted predominantly of relatively well-educated, urban professional workers. Together, these factors may limit the generalizability of the findings to the broader working-age stroke population in Thailand and other LMIC. Second, data collection was conducted during the COVID-19 pandemic, in which social distancing during lockdown policies and loneliness may have affected study participants' perceptions of job strain, disability, and social support. Third, several important potential confounders, such as family-related stress and support, work hours, sleep patterns, and physical activity, were not available to be included in the analysis. Fourth, the exposure variables psychosocial work factors were measured via self-report and may be subject to reporting or recall bias. Lastly, pre-stroke perceptions of job strain were only collected once at baseline, and may not account for changes in perceptions over the one-year post-stroke.

On the other hand, our study also has strengths. First, our study is the first longitudinal study assessing the Demand-Control-Support model and disability among workers after stroke in Thailand. This study highlights that high work stress is a relevant mental health issue, especially in the context of the country's transformation to industrialization [21], and additionally links work stress to increased morbidity and mortality rates of stroke in the working-age group [22]. Our findings further underscore the importance of social support in the recovery process among Thai stroke survivors, suggesting that supportive interpersonal and workplace networks may play a meaningful role in promoting both psychological adjustment and functional recovery after stroke. Second, our research design over a one-year period with 3-time repeated measures implies a causal link between the risk factor at baseline and the outcomes at follow-ups. Third, disability was measured by BI and mRS, which are globally used to evaluate long-term outcomes after stroke and cover both functional tasks and clinical aspects.

5. Conclusions

In summary, in this one-year longitudinal study among workers who had experienced stroke, job strain was not significantly associated with disability changes, but social support was significantly associated with changes in disability status, particularly mRS. These results indicate the potential importance of social support at work in the recovery process of stroke. Future research should include larger and more diverse cohorts across multiple sites, incorporate longer follow-up periods, and employ repeated measures of psychosocial work characteristics over time. Additionally, proactive workplace interventions that enhance supervisor and coworker support and foster supportive organizational cultures may help promote functional recovery and sustained independence among working-age stroke survivors.

CRediT authorship contribution statement

Siripan Naknoi: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Orawan Kaewboonchoo:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Pongrama Ramasoota:** Writing – review & editing, Supervision. **Xinyue Liu:** Writing – review & editing, Formal analysis. **Megan Guardiano:** Writing – review & editing. **Liwei Chen:** Writing – review & editing, Methodology. **Chunqing Lin:** Writing – review & editing. **Suparat Phuanukoonnon:** Writing – review & editing, Supervision. **Ngamphol Soonthornworasiri:** Writing – review & editing, Supervision. **Jian Li:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Funding acquisition, Conceptualization.

Ethics approval

The study was approved by the Ethics Committee for Human Research of the Faculty of Tropical Medicine, Mahidol University, Thailand (No. MUTM 2020-066-01). All procedures were performed in accordance with the Declaration of Helsinki, ICH Guidelines for Good Clinical Practice, and other International Guidelines for Human Research Protection.

Funding

This research project was funded by the Royal Golden Jubilee PhD Program (RGJ-PhD), Thailand (Grant No. PHD/0136/2559). The data analysis and scientific writing were partially supported by the Southern California Education and Research Center (SCERC), Grant Agreement Number T42 OH008412 from the Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health, CDC/NIOSH). Its contents are solely the responsibility of the authors and do not necessarily represent the official view of the US CDC. The sponsors had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to the work reported in this paper.

Acknowledgments

We would like to thank all the patients who participated in this study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.glt.2026.05.001.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author (O. Kaewboonchoo) on reasonable request.

References

[1] V.L. Feigin, M. Brainin, B. Norrving, et al., World stroke organization (WSO): global stroke fact sheet 2022, Int. J. Stroke 17 (1) (2022) 18–29, https://doi.org/10.1177/17474930211065917.
[2] I.L. Katzan, N.R. Thompson, K. Uchino, B. Lapin, The Most affected health domains after ischemic stroke, Neurology 90 (16) (2018) e1364–e1371, https://doi.org/10.1212/WNL.0000000000005327.
[3] G.A. Roth, G.A. Mensah, C.O. Johnson, et al., Global burden of cardiovascular diseases and risk factors, 1990-2019: update from the GBD 2019 Study, J. Am. Coll. Cardiol. 76 (25) (2020) 2982–3021, https://doi.org/10.1016/j.jacc.2020.11.010.
[4] N.A. Maaijwee, L.C. Rutten-Jacobs, P. Schaapsmeerders, E.J. van Dijk, F.E. de Leeuw, Ischaemic stroke in young adults: risk factors and long-term consequences, Nat. Rev. Neurol. 10 (6) (2014) 315–325, https://doi.org/10.1038/nrneurol.2014.72.
[5] T.B.H. Potter, J. Tannous, F.S. Vahidy, A contemporary review of epidemiology, risk factors, etiology, and outcomes of premature stroke, Curr. Atheroscler. Rep. 24 (12) (2022) 939–948, https://doi.org/10.1007/s11883-022-01067-x.
[6] T. Yahya, M.H. Jilani, S.U. Khan, et al., Stroke in young adults: current trends, opportunities for prevention and pathways forward, Am. J. Prev. Cardiol. 3 (2020) 100085, https://doi.org/10.1016/j.ajpc.2020.100085. Published 2020 Sep. 9.
[7] A. Gil-Salcedo, A. Dugravot, A. Fayosse, et al., Long-Term evolution of functional limitations in stroke survivors compared with stroke-free controls: findings from 15 years of Follow-Up across 3 international surveys of aging, Stroke 53 (1) (2022) 228–237, https://doi.org/10.1161/STROKEAHA.121.034534.
[8] M.G. George, Risk factors for ischemic stroke in younger adults: a focused update, Stroke 51 (3) (2020) 729–735, https://doi.org/10.1161/STROKEAHA.119.024156.
[9] P.L. Schnall, M. Dobson, P. Landsbergis, Globalization, work, and cardiovascular disease, Int. J. Health Serv. 46 (4) (2016) 656–692, https://doi.org/10.1177/0020731416664687.
[10] R.A. Karasek, Job demands, job decision latitude, and mental strain: implications for job redesign, Adm. Sci. Q. 24 (2) (1979) 285–308.
[11] R. Karasek, D. Baker, F. Marxer, A. Ahlbom, T. Theorell, Job decision latitude, job demands, and cardiovascular disease: a prospective study of Swedish men, Am J Public Health 71 (7) (1981) 694–705, https://doi.org/10.2105/ajph.71.7.694.
[12] J.V. Johnson, E.M. Hall, Job strain, work place social support, and cardiovascular disease: a cross-sectional study of a random sample of the Swedish working population, Am J Public Health 78 (10) (1988) 1336–1342, https://doi.org/10.2105/ajph.78.10.1336.
[13] A. Tsutsumi, K. Kayaba, K. Kario, S. Ishikawa, Prospective study on occupational stress and risk of stroke, Arch. Intern. Med. 169 (1) (2009) 56–61, https://doi.org/10.1001/archinternmed.2008.503.
[14] E.I. Fransson, S.T. Nyberg, K. Heikkilä, et al., Job strain and the risk of stroke: an individual-participant data meta-analysis, Stroke 46 (2) (2015) 557–559, https://doi.org/10.1161/STROKEAHA.114.008019.
[15] L. André-Petersson, G. Engström, B. Hedblad, L. Janzon, M. Rosvall, Social support at work and the risk of myocardial infarction and stroke in women and men, Soc. Sci. Med. 64 (4) (2007) 830–841, https://doi.org/10.1016/j.socscimed.2006.10.020.
[16] J. Li, M. Zhang, A. Loerbroks, P. Angerer, J. Siegrist, Work stress and the risk of recurrent coronary heart disease events: a systematic review and meta-analysis, Int. J. Occup. Med. Environ. Health 28 (1) (2015) 8–19, https://doi.org/10.2478/s13382-014-0303-7.
[17] J. Ervasti, M. Kivimäki, R. Dray-Spira, et al., Psychosocial factors associated with work disability in men and women with diabetes: a pooled analysis of three occupational cohort studies, Diabet. Med. 33 (2) (2016) 208–217, https://doi.org/10.1111/dme.12821.
[18] G. Kwakkel, R.C. Wagenaar, B.J. Kollen, G.J. Lankhorst, Predicting disability in

stroke–a critical review of the literature, Age Ageing 25 (6) (1996) 479–489, https://doi.org/10.1093/ageing/25.6.479.
[19] N. Mokhber, M.S. Sheikh Andalibi, N. Morovatdar, et al., Self-perceived acute psychological stress and risk of mortality, recurrence and disability after stroke: mashhad stroke incidence study, Stress Health 37 (4) (2021) 819–825, https://doi.org/10.1002/smi.3031.
[20] B. Boden-Albala, E. Litwak, M.S. Elkind, T. Rundek, R.L. Sacco, Social isolation and outcomes post stroke, Neurology 64 (11) (2005) 1888–1892, https://doi.org/10.1212/01.WNL.0000163510.79351.AF.
[21] V. Yiengprugsawan, L. Strazdins, L.L. Lim, et al., Physically and psychologically hazardous jobs and mental health in Thailand, Health Promot. Int. 30 (3) (2015) 531–541, https://doi.org/10.1093/heapro/dat080.
[22] Health Data center (HDC) -Thailand 2017 – 2020. https://hdcservice.moph.go.th/hdc/main/index.php. (Accessed 18 January 2023).
[23] S. Naknoi, J. Li, P. Ramasoota, et al., Associations of effort-reward imbalance at work and quality of life among workers after stroke: a one-year longitudinal study in Thailand, BMC Public Health 23 (1) (2023) 1910, https://doi.org/10.1186/s12889-023-16784-4. Published 2023 Oct 3.
[24] P. Phakthongsuk, N. Apakupakul, Psychometric properties of the Thai version of the 22-item and 45-item Karasek job content questionnaire, Int. J. Occup. Med. Environ. Health 21 (4) (2008) 331–344, https://doi.org/10.2478/v10001-008-0036-6.
[25] R. Karasek, C. Brisson, N. Kawakami, I. Houtman, P. Bongers, B. Amick, The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics, J. Occup. Health Psychol. 3 (4) (1998) 322–355, https://doi.org/10.1037//1076-8998.3.4.322.
[26] F.I. Mahoney, D.W. Barthel, Functional evaluation: the barthel index, Md. State Med. J. 14 (1965) 61–65.
[27] J. Rankin, Cerebral vascular accidents in patients over the age of 60. II. Prognosis, Scott. Med. J. 2 (5) (1957) 200–215.
[28] J.L. Saver, N. Chaisinanunkul, B.C.V. Campbell, et al., Standardized nomenclature for modified rankin Scale global disability outcomes: consensus recommendations from stroke therapy academic industry roundtable XI, Stroke 52 (9) (2021) 3054–3062, https://doi.org/10.1161/STROKEAHA.121.034480.
[29] United Nations, *Sustainable development goals – the 17 goals*. United nations sustainable development goals platform. https://sdgs.un.org/goals. (Accessed 17 August 2025).
[30] E.J. Choi, H.Y. Kim, Relationship between multidimensional stressors and quality of life in people with stroke, Nurs. Health Sci. 24 (3) (2022) 764–773, https://doi.org/10.1111/nhs.12976.
[31] J. Li, M.F. Dollard, A. Loerbroks, P. Angerer, Cardiovascular disease is associated with the perception of worsening psychosocial work characteristics, Int. J. Cardiol. 186 (2015) 149–151, https://doi.org/10.1016/j.ijcard.2015.03.222.
[32] F.H. Chang, Y.N. Lin, T.H. Liou, Recovery after stroke: perspectives of young stroke survivors in Taiwan, Disabil. Rehabil. 44 (10) (2022) 1976–1983, https://doi.org/10.1080/09638288.2020.1817157.
[33] R. Inoue, H. Hikichi, A. Inoue, et al., Workplace social support and reduced psychological distress: a 1-Year occupational cohort Study, J. Occup. Environ. Med. 64 (11) (2022) e700–e704, https://doi.org/10.1097/JOM.0000000000002675.
[34] H. Tough, J. Siegrist, C. Fekete, Social relationships, mental health and well-being in physical disability: a systematic review, BMC Public Health 17 (1) (2017) 414, https://doi.org/10.1186/s12889-017-4308-6. Published 2017 May 8.
[35] D. Carr, E.H. Namkung, Physical disability at work: how functional limitation affects perceived discrimination and interpersonal relationships in the workplace, J. Health Soc. Behav. 62 (4) (2021) 545–561, https://doi.org/10.1177/00221465211023424.
[36] R. Wobma, R. Nijland, G. Kwakkel, Patient characteristics related to the need for peer support in rehabilitation after acquired brain injury: a prospective cohort study in the Netherlands, BMJ Open 9 (7) (2019) e025665, https://doi.org/10.1136/bmjopen-2018-025665. Published 2019 Jul 17.
[37] C. Weimar, T. Kurth, K. Kraywinkel, et al., Assessment of functioning and disability after ischemic stroke, Stroke 33 (8) (2002) 2053–2059, https://doi.org/10.1161/01.str.0000022808.21776.bf.
[38] S. Kwon, A.G. Hartzema, P.W. Duncan, S. Min-Lai, Disability measures in stroke: relationship among the barthel index, the functional Independence measure, and the modified rankin scale, Stroke 35 (4) (2004) 918–923, https://doi.org/10.1161/01.STR.0000119385.56094.32.
[39] S. Balu, Differences in psychometric properties, cut-off scores, and outcomes between the barthel index and modified rankin scale in pharmacotherapy-based stroke trials: systematic literature review, Curr. Med. Res. Opin. 25 (6) (2009) 1329–1341, https://doi.org/10.1185/03007990902875877.