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Prevalence and Factors Associated with Sick Leave After Stroke: A Long-term Registry-Based Case-Control Study in Sweden

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Abstract

Background:

The increasing incidence of stroke among working-age adults leads to long-term disabilities, contributing to prolonged sick leave and imposing substantial societal and economic burdens. This study aimed to examine the trajectory of sick leave among working-age stroke cases, spanning from 1 year before to 3 years after the event, and to compare these patterns with matched controls. It also sought to identify factors associated with prolonged sick leave after stroke.

Methods:

This registry-based, retrospective longitudinal study utilized data from a local and a registry in Gothenburg, Sweden. Individuals aged 18–65 years with a first-ever stroke who survived at least 30 days after the event (2014–2019) were identified. Each case was matched 1:4 by age and sex with controls provided by Statistics Sweden database. Data on sick leave lasting ≥ 14 days were obtained from the Swedish Social Insurance Agency register. Statistical analyses included descriptive and comparative statistics, visualization of sick leave trajectories, and multivariable linear regression.

Results:

A total of 1,502 cases with a first-ever stroke and 6,008 matched controls were included. The mean age at stroke was 54.3 years, and 65.8% were men. The proportion of stroke cases on sick leave was consistently higher than that of controls throughout the entire follow-up period. Stroke cases had approximately 2.5 times more pre-stroke sick leave than their matched controls during the same period (50.7% of cases versus 19.7% of controls) and received more often sick leave compensation for cardiovascular, mental, and endocrine or metabolic disorders. Longer pre-stroke sick leave, intracerebral hemorrhage, impaired oral communication ability, dominant or both hands deficits, and increased fall risk were factors associated with prolonged post-stroke sick leave, explaining approximately 17% of the variance.

Conclusions:

Working-age individuals with stroke had at least two-fold higher need for sick leave compensation prior to their stroke, as well as a significantly more persistent sick leave burden after the event. These findings indicate that multiple aspects of underlying health vulnerabilities need to be taken into account during the post-stroke rehabilitation phase.

Introduction

Stroke remains a major contributor to the global disease burden among working-age adults (1). Between 2000 and 2023, the incidence and prevalence of stroke increased markedly among younger populations (1, 2). Along with improved survival rates and population aging, this trend has resulted in a 32% increase in disability-adjusted life years (DALYs) attributable to stroke (3). The increasing DALY burden indicates that more individuals are living with long-term functional impairments that reduce work capacity and contribute to prolonged sick leave, leading to substantial societal and economic costs (4). In Sweden, although the age-standardized DALY rate declined by 48% over the past three decades, reflecting major advances in stroke care, the total stroke-related DALY burden remains considerable (5). Notably, a large proportion of this burden in Sweden is attributable to work absence and prolonged sick leave (6, 7).

Alternatively, sick leave patterns may reflect not only the direct impact of stroke but also underlying health vulnerabilities that contribute to both stroke risk and the likelihood of prolonged sick leave(8). Despite its potential to provide valuable insights, the trajectory of sick leave before and after a stroke remains poorly understood (9). Furthermore, although previous research has examined factors influencing post-stroke sick leave, findings remain inconclusive and have largely overlooked specific functional domains, such as postural balance and communication abilities, as potential predictors of sick leave (10–14).

To address these gaps, this registry-based longitudinal case–control study examined sick leave trajectories from 1 year before to 3 years after stroke among working-age adults in the Gothenburg metropolitan area, Sweden. The first aim was to compare sick leave trajectories between stroke cases and matched controls. The second aim was to identify factors associated with prolonged sick leave after stroke, including baseline demographic characteristics, pre-stroke physical activity and work incapacity, and post-stroke clinical and functional factors.

Methods

Definitions

In Sweden, sickness absence refers to temporary work ability being reduced due to illness and is registered as sickness benefit. Disability pension refers to long-term or permanent illness-related work disability and is registered as sickness compensation. In this study, both sickness absence and disability pension were included in the outcome measure and collectively referred to as sick leave, as the aim was to assess the total occupational burden after stroke. The national social insurance register captures sickness absence periods longer than 14 days, since the first 14 days are generally covered by the employer for employed individuals, as well as disability pension episodes. For sickness absence episodes lasting more than 14 days, the register includes the date on which the sickness absence began, including the initial employer-paid period when applicable.

Both sickness absence and disability pension can be granted at different degrees, depending on the extent of reduced work capacity. The levels of 25%, 50%, 75%, and 100% indicate the proportion of full-

time work for which the individual is considered unable to work. Accordingly, each calendar day was converted into net sick leave days by multiplying the day by the corresponding degree of reduced work capacity: one day at 100% corresponded to 1 net day, one day at 75% to 0.75 net days, one day at 50% to 0.5 net days, and one day at 25% to 0.25 net days. The index date for cases was defined as the date of the first-ever stroke recorded in Väststroke registry. Controls were assigned the same index date as their corresponding cases. The follow-up period was divided into three intervals: (1) pre-index period: the year before the index date, (2) post-index period: 3 years after the index date, and (3) total: the combined pre-index and post-index periods.

Study Design

This registry-based, retrospective, longitudinal study employed two complementary designs: (1) a case-control analysis examining sick leave trajectories from 1 year before to 3 years after stroke, and (2) a cohort analysis evaluating factors associated with prolonged sick leave among stroke cases.

Study Sample

Between November 1, 2014, and December 31, 2019, the Väststroke quality registry consecutively enrolled 6,918 patients with valid Swedish identification numbers who had been diagnosed with ischemic stroke (ICD-10 codes I63 or I64) or intracerebral hemorrhage (ICD-10 code I61) at three stroke units of Sahlgrenska University Hospital in Gothenburg, Sweden. Each case was matched at 1:4 ratio to controls based on age and sex, with controls provided by Statistics Sweden (SCB). Participants aged < 18 or > 65 years, those who died within 30 days after their stroke, those with a history of a prior stroke among either cases or controls were excluded. For the cohort analysis, cases with any registered sick leave episode with > 50% work incapacity during the year preceding the stroke were also excluded to reduce the influence of substantial pre-baseline work incapacity on post-stroke sick leave outcomes. The project is part of COAST-GOT (Consequences After Stroke in Gothenburg) and is registered in Researchweb (researchweb.org, #277954). Ethical approval for the study was received on July 7, 2021 (Registry no. Dnr 2021–03324) from the Swedish Ethical Review Authority in Stockholm, Sweden.

Data Sources and Variables

The primary data source was Väststroke, a regional quality registry that records information on acute hospital care and 3-month follow-ups for stroke cases. These data were supplemented with information from the Swedish Stroke Registry, which provides follow-up assessments at 3 and 12 months. Trained staff conducted assessments at admission, within the first 48 h of hospitalization, and throughout the hospital stay, documenting all findings. Data on pre-stroke physical activity and rehabilitation outcomes were provided by rehabilitation professionals, including occupational, physical, and speech-language therapists. From these registries, the following independent variables were extracted: age, sex, pre-stroke physical activity, stroke type (ischemic vs. intracerebral hemorrhage), stroke severity, functional oral

communication ability, mobility (dependent vs. independent), walking (dependent vs. independent), laterality of the affected hand (dominant or bilateral, nondominant vs. neither), fall risk (yes/no), and cognition. Pre-stroke physical activity was assessed using the Saltin-Grimby Physical Activity Level Scale (SGPALS) and categorized as sedentary (level 1) versus non-sedentary, the later including light physical activity (level 2), moderate activity (level 3), or intense training (level 4)(15). Stroke severity was evaluated using the National Institutes of Health Stroke Scale (NIHSS) and categorized as < 6 (mild), 6–10 (moderate), 11–15, ≥ 16 (severe)(16). Functional oral communication ability was evaluated using the Reinvang scale, where scores of 0–1 indicate normal or mildly impaired communication without assistance, whereas scores of 2–4 indicate impaired communication requiring assistance(17). NIHSS language (0–3) and dysarthria (0–2) scores, along with reported language or speech difficulties at 3- and 12-month follow-ups (yes/no), were used to impute missing Reinvang scale data. Mobility was defined as the ability to move in bed and transfer to or from a chair or wheelchair independently. Walking was defined as the ability to ambulate 10 meters indoors independently. Cognitive function was screened using the Montreal Cognitive Assessment (MoCA) and categorized as impaired cognition (score ≤ 25) or normal (score > 25) (18).

Demographic and socioeconomic data for stroke cases and their matched controls were obtained from SCB (19). Extracted variables included civil status (single, married, divorced or widowed), disposable income, and education level. Disposable income for the index year (both total and per household/consumption unit) was reported as after-tax income in Euros. Education level was classified as primary (≤ 9 years), secondary (≤ 3 years beyond primary school), short university (< 2 years), and long university (≥ 2 years).

Data on stroke cases with a history of prior stroke and on those who died within 30 days of the event were obtained from the National Patient Register and the National Cause of Death Register, respectively, both maintained by the Swedish National Board of Health and Welfare (22, 23).

Data on sick leave for the pre- and post-index periods were obtained from the Swedish Social Insurance Agency database, covering the period from November 2, 2013, to December 28, 2022. The dataset included all episodes of sickness benefits and disability pensions lasting ≥ 14 days, with specified levels of impaired work capacity (100% full-time or part-time at 75%, 50%, or 25%), as well as the corresponding diagnosis code (ICD-10 code) for each episode of sick leave. Sick leave diagnoses were categorized according to the main ICD-10 chapter based on the first letter of the diagnosis code. The diagnostic categories were defined as cardiovascular diseases (I00–I99, excluding I61, I63, and I64), mental and behavioural disorders (F01–F99), musculoskeletal disorders (M00–M99), endocrine and metabolic diseases (E00–E89), and malignancies (C00–C97). All remaining ICD-10 codes were grouped as “other diagnoses”.

Statistical Analysis:

Data was analyzed using R version 4.5.0. For the case-control analysis, the primary outcome was the total number of net sick leave days during the pre- and post-index periods. Additionally, the percentages of cases and controls with sick leave, as well as the proportions of diagnoses receiving compensation during these periods, were analyzed as secondary outcomes. Sociodemographic variables were primarily included to describe the study population and to compare cases with controls. Descriptive statistics, including frequency (percentage), mean (standard deviation, SD), and median (interquartile range, IQR) were used to summarize stroke cases and their matched controls by socioeconomic characteristics in the index year, and by the outcomes in the pre- and post-index periods. Case-control comparisons were conducted using the Wilcoxon rank-sum test for continuous variables and the Chi-square test for categorical variables. To demonstrate sick leave trajectories, daily counts of cases and controls with ≤ 50% and > 50% sick leave across the follow-up period were plotted. A Sankey diagram was used to visualize the year-by-year transitions of diagnoses receiving sick leave compensation. To address the second aim of the study, independent variables representing baseline demographic characteristics, pre-stroke physical activity and work incapacity, and post-stroke clinical and functional factors were considered. To reduce the risk of overfitting, and in line with the main aim of the study, socioeconomic and other potential covariates were not included in the regression models. Univariable and multivariable linear regression analyses were performed to estimate associations between independent variables and the outcome. The outcome variable was the total number of net sick leave days during the post-index period. Because of marked right-skewness and the presence of zero values (indicating no sick leave), the outcome variable was logarithmically transformed using log(x + 1). Owing to substantial missing MoCA data, the first multivariable model was analyzed without MoCA, and a separate model was fitted for the subgroup with available MoCA scores. The β coefficient (ordinary least squares model) represented the mean difference in log-transformed net sick leave days between each group and the reference category and are reported together with 95% confidence intervals, whereas the R^2 statistic indicated the proportion of variance in the transformed outcome explained by the model. Missing Reinvang scale values for communication ability were imputed as communicatively independent (score 0–1) when a score of 0 was recorded in both the language and dysarthria domains of the NIHSS, and no language or speech difficulties were reported at the 3- and 12-month follow-ups. Before fitting the multivariable models, a directed acyclic graph was used to identify potential confounders based on clinically meaningful causal assumptions. Results were generated using the summary () function in R (stats package). A two-sided p-value of < 0.05 was considered statistically significant.

Results

Characteristics of Study Sample

A total of 1,502 cases with a first-ever stroke from the Väststroke registry and 6,008 matched controls were included in the case-control analysis (Fig. 1). Among the stroke cases, 1,304 (86.8%) had ischemic stroke, whereas 198 (13.2%) had intracerebral hemorrhage. The mean age at stroke onset was 54.3 years, and men accounted for 65.8% of the study sample. Of 1,502 stroke cases, 451 were excluded

because they had > 50% sick leave during the year preceding the stroke, resulting in 1,051 cases eligible for the cohort analysis.

Table 1 presents the demographic and socioeconomic characteristics of stroke cases and their matched controls during the index year. Compared with their controls, stroke cases were more likely to live alone (57.4% vs. 42.6%), had lower disposable income during the index year (€20,678 vs. €25,176), and were more often in the lower education category (21.2% vs. 16.4% with primary education or less).

Table 1
Demographic and socioeconomic characteristics of stroke cases and their matched controls in the index year.

Characteristics	**Cases (n = 1,502)**	**Controls (n = 6,008)**
	Values	**Values**
Age, mean (SD), y	54.3 (9.92)	54.3 (9.92)
Age, range, y	19–65	19–65
Sex, No. (%)		
Female	514 (34.2)	2056 (34.2)
Male	988 (65.8)	3952(65.8)
Civil status, No. (%)		
Married	626 (42.6)	3079 (51.4)
Single	487 (33.1)	1793 (29.9)
Divorced	330 (22.4)	1020 (17)
Widowed	28 (1.9)	98 (1.6)
Disposable income, median (IQR), Euro	20,678 (17,259)	25,176 (16,488)
Disposable income per household, median (IQR), Euro	9,958 (13,413)	20,778 (12,966)
Education, No. (%)		
Primary school or below	306 (21.2)	974 (16.4)
Secondary school	657 (45.6)	2774 (46.8)
Short university education	98 (6.8)	432 (7.3)
Long university education	381 (26.4)	1747 (29.5)

1. The proportion of missing data was ≤ 5% for all variables.

Sick Leave Patterns (Case-Control Analysis)

The proportion of stroke cases on sick leave was consistently higher than that of controls throughout the total follow-up period. Among stroke cases, 24.7% were on sick leave at 1 year before the event, 73.9% at the index date, and 47.8%, 36.9%, and 31.3% at 1, 2, and 3 years after the stroke, respectively. The corresponding proportions among controls were 12.2%, 11.2%, 10.1%, 8.7%, and 7.7%, respectively. As shown in Table 2 and Fig. 2, stroke cases compared with controls exhibited a broader, right-skewed distribution of net sick leave days and higher mean values across all follow-up periods, particularly during the pre-index period (mean 76.1 vs 36.3 days, $p < 0.001$). Similarly, during the pre-index period, 50.7% of cases and 19.7% of controls were on sick leave ($p < 0.001$). During the pre-index period, stroke cases were significantly more likely to receive sick leave compensation for cardiovascular, mental and behavioral, and endocrine/metabolic diseases compared with controls ($p < 0.001$) (Table 2 and Fig. 3). Musculoskeletal disorders were common in both groups but were significantly more prevalent among controls.

Table 2

Comparison of net sick leave days and diagnoses receiving sick leave compensation among stroke cases and matched controls during the pre-index, post-index, and total period (2013–2022).

Net sick leave days & Proportions who were on sick leave (%)	**Cases (n = 1,502)**	**Controls (n = 6,008)**	**p value**
	Values	**Values**	
Pre-index Period (1 year)			
Mean (SD), d	76.1 (135)	36.3 (96)	< 0.001 [a]
Median (IQR), d	1 (90)	0 (0)	< 0.001 [a]
P on sick leave (%)	50.7	19.7	< 0.001 [b]
Post-index Period (3 years)			
Mean (SD), d	434 (428)	86.4 (241)	< 0.001 [a]
Median (IQR), d	262 (860)	0 (21)	< 0.001 [a]
P on sick leave (%)	77.1	27.7	< 0.001 [b]
Total Period (4 years)			
Mean (SD), d	512.3 (560)	122.9 (323)	< 0.001 [a]
Median (IQR), d	306.1 (942)	0 (41)	< 0.001 [a]
P on sick leave (%)	80.1	33	< 0.001 [b]
Diagnoses receiving sick leave compensation, No. (%)			
Pre-index Period (1 year)			
Mental and behavioral disorders	158 (10.5)	341 (5.7)	0.003 [b]
Cardiovascular diseases	61 (4.1)	73 (1.2)	< 0.001 [b]
Musculoskeletal diseases	81 (5.4)	359 (6)	< 0.001 [b]

Net sick leave days & Proportions who were on sick leave (%)	Cases (n = 1,502)	Controls (n = 6,008)	p value
	Values	Values	
Malignancies	16 (1.1)	37 (0.6)	0.8 [b]
Endocrine and metabolic diseases	17 (1.1)	21 (0.3)	0.02 [b]
Other diagnoses	129 (8.6)	344 (5.7)	0.09 [b]

Variable definitions: The index date for each case was defined as the date of the first-ever stroke, and each control was assigned with the same index date as its corresponding case. The pre-index and post-index periods referred to the year preceding and the three years following the index date, respectively. Net sick leave days refer to the net number of sickness absence days within episodes that lasted more than 14 days. During the pre-index period, cardiovascular diseases included all circulatory system diseases classified under ICD–codes beginning with "I", excluding I61, I63, and I64. Abbreviations: SD, standard deviation; d, days; IQR, interquartile range; P on sick leave, proportion of cases and controls on sick leave. P values were obtained using the Wilcoxon rank-sum test ([a]) for continuous variables and the Chi-square test ([b]) for categorical variables. A p value < 0.05 was considered statistically significant.

Association of Covariates and Net Days of Sick Leave After Stroke (Cohort Analysis)

Figure 4 summarizes the associations between each independent variable and the number of net sick leave days during the post-index period, both before and after adjustment for other variables. In the univariable regression model (before adjustment), longer sick leave duration in the pre-index period, higher stroke severity, intracerebral hemorrhage, impaired oral communication requiring assistance, dependence in mobility and walking, dominant or both hands affected, increased fall risk, and cognitive impairment were all associated with a greater number of net sick leave days during the post-index period. Before fitting the multivariable regression model, the variables of mobility, walking and stroke severity were excluded because of collinearity with other functional measures (fall risk and oral communication ability). In the multivariable model without MoCA (after adjustment), sick leave duration in the pre-index period, stroke type, oral communication ability, the laterality of the affected hand, and fall risk remained significant independent determinants, explaining approximately 17% of the variance ($R^2 \sim 0.17$, N = 792). However, after inclusion of MoCA, most covariates were no longer statistically significant, with only pre-stroke net sick leave days remaining associated with the outcome.

Discussion

Amid rising stroke incidence in working-age adults, this study pursued two objectives in this population: to examine sick leave patterns as a key vocational outcome following stroke and to identify their determinants. This large, longitudinal, population-based study demonstrated that working-age stroke cases experienced a substantially greater sick leave burden than their matched controls. As shown in Fig. 2, sick leave increased markedly immediately after stroke and gradually declined over the three-year follow-up, whereas sick leave levels among matched controls remained relatively stable. These findings provide a descriptive overview of both the extent and temporal course of work disability after stroke. Within the 3 years after the index stroke, more than two-thirds of cases (77.1%) had at least one period of sick leave, with a median duration of 262 days (> 8 months), whereas fewer than one-third of matched controls (27.7%) had any sick leave during the same follow-up period (median 0 months) (Table 2). Notably, this pattern was already evident in the year preceding the stroke, with over half of the cases having sick leave before stroke onset, predominantly for diagnoses related to cardiovascular disease, and mental or behavioral disorders.

In the present study, the long-term burden of work disability after stroke was also pronounced. The year-end point prevalence of sick leave among cases remained high, approximately 47.8%, 36.9%, and 31.1% at years 1, 2, and 3 after stroke, respectively, compared with 10.1–7.7% among matched controls at the same time points. This persistent burden, which aligns with findings from two systematic reviews on return to work after stroke (12, 24), highlights the sustained impact of post-stroke work disability on individuals, healthcare systems, and society. The findings also revealed baseline socioeconomic differences between stroke cases and their matched controls, with the stroke group more frequently having lower disposable income and lower education attainment. These patterns are consistent with prior epidemiological evidence indicating that socioeconomic disadvantage contributes substantially to stroke incidence (25).

In the present study, sick leave during the year preceding stroke was approximately 2.5 times more common among cases than among controls (50.7% vs. 19.7%). Further analysis also revealed that the duration of sick leave before stroke onset was strongly correlated with prolonged sick leave after stroke. Building on previous evidence (8, 26), this study demonstrated that pre-stroke sick leave functions both as a marker of declining health and increased stroke risk, and as a determinant of prolonged post-stroke sick leave. Previous research includes a cohort study showing a substantial increase in sick leave days during the year before stroke compared with earlier years in the same population (26), and a case-control study of ischemic stroke reporting nearly a twofold excess in sickness absence and disability pension among cases compared with controls in the year before stroke (8). Figure 3 illustrates that the diagnostic category associated with sick leave among stroke cases changed across follow-up periods rather than remaining within the same category. In contrast, the distribution of diagnostic categories among matched controls was considerably more stable over time. These transitions suggest that longer-term work disability after stroke is not attributable solely to the index stroke diagnosis but may also reflect the contribution of other health conditions during follow-up. In the present study, mental and behavioral disorders and cardiovascular diseases emerged as the first and third most frequent diagnoses leading to sick leave during the year preceding stroke, occurring approximately twofold

(10.5% vs. 5.7%) and threefold (4.1% vs. 1.2%) more frequently, respectively, among cases with stroke than among controls. Musculoskeletal diseases were the second most common diagnosis associated with sick leave among cases with stroke (5.4%), but were significantly more prevalent among controls (6%), ranking first in this group, suggesting no positive association between sick leave owing to musculoskeletal diseases and stroke risk. Similarly, a study reported musculoskeletal diseases as the second most frequent cause of pre-stroke sick leave; however, the absence of a control group in that study limited the ability to evaluate their association with stroke risk (27). The results of this present study indicate that sick leave owing to cardiovascular diseases, mental and behavioral disorders, and endocrine and metabolic diseases may signify increased vulnerability to stroke occurrence and reflect underlying pathophysiological mechanisms contributing to its development.

As shown in Fig. 4, the univariable analyses indicated that, in addition to pre-stroke sick leave, intracerebral hemorrhage (versus ischemic stroke), and greater stroke severity, several neurological and functional impairments were associated with longer sick leave. These included impaired communication ability (aphasia), dominant hand deficits, impaired postural balance, dependence in mobility and walking, and cognitive impairment (MoCA < 26). In the multivariable model without MoCA, pre-stroke sick leave, intracerebral hemorrhage (versus ischemic stroke), aphasia, dominant hand deficit, and impaired postural balance were identified as significant determinants of prolonged sick leave after stroke. The result regarding aphasia aligns with previous research (13, 14, 28), including a scoping review from 2025, which reported that individuals with post-stroke aphasia return to work less frequently than those without aphasia (14). Similarly, a meta-analysis of seven studies confirmed that post-stroke aphasia reduces the likelihood of returning to work, with a pooled odds ratio (OR) of 0.37 (95% CI: 0.20–0.69) (13). With regard to postural balance, balance control is an integrative, multifaceted function that depends on sensory inputs (vision, vestibular input, and proprioception), central nervous system processes (motor planning and cognition), and the musculoskeletal system, thereby encompassing impairments across multiple systems (29). Despite its importance, research specifically examining the impact of balance deficits on sick leave remains scarce. A qualitative study identified postural balance, particularly in tasks such as walking and climbing stairs or ladders, as a key factor influencing return to work among patients with stroke (30). In the present analysis, mobility and walking ability were excluded from the multivariable analysis because it overlapped substantially with postural balance, contributing no independent explanatory value. This approach aligns with prior research indicating that dynamic balance impairments are the predominant form of post-stroke balance deficit (31) and that mobility and walking ability depend substantially on dynamic balance. This may also help explain why risk of falls is highest among patients with intermediate levels of walking ability (32, 33), a group that may be at the threshold of returning to work.

Given the heterogeneity in previous definitions of return to work (10), sick leave was reported directly rather than being converted into return-to-work measure. This approach minimizes definition-driven bias and provides flexibility for future comparisons, as researchers can reinterpret the data into return-to-work metrics if desired, representing a key strength of this study. Additional strengths included the use of high-quality registries and comprehensive population coverage, as all residents of the Gothenburg

metropolitan area who met the inclusion criteria were eligible for inclusion. Potential biases associated with self-reported data were minimized through systematically recorded information by authorized administrators and trained healthcare staff; however, the involvement of multiple personnel may still have introduced some degree of reporting bias. Another notable strength is the long-term follow-up of sick leave using national registry data, encompassing the year preceding the stroke and three subsequent years. Certain limitations of this study should also be acknowledged. First, the dataset on sick leave was restricted to absences > 2 weeks; therefore, sick leaves < 15 days were not captured. However, this limitation applied equally to both stroke cases and controls across all study years. Second, cases with a history of prior stroke were excluded from the registry to minimize confounding from earlier cerebrovascular events. Third, because the cohort analysis aimed to identify factors associated with sick leave after stroke, individuals with marked work incapacity already present before stroke were excluded to better isolate the occupational burden attributable to the stroke event. While this design strengthens internal validity, it may limit generalizability to patients with recurrent stroke or substantial pre-baseline work incapacity, groups that may be at higher risk of prolonged sick leave. In addition, the study was conducted within the Gothenburg region and in the context of the Swedish healthcare and social insurance systems. Differences in access to rehabilitation, return-to-work support, workplace accommodations, and sickness benefit regulations across regions and countries may therefore influence both the duration and patterns of sick leave and should be considered when applying these findings to other settings. Fourth, the multivariable model explained approximately 17% of the variance in post-stroke sick leave. This relatively modest proportion is not unexpected for a complex vocational outcome, particularly given that the analysis was limited to variables available in the registries. Other factors previously shown to be important, such as comorbidities, medications, fatigue, and stroke etiology and location(10), could therefore not be analyzed. These findings further underline the multifactorial nature of work participation after stroke.

Conclusions

In summary, this study demonstrates that working-age individuals with stroke experience a significantly greater and more persistent burden of sick leave compared with the general population. Notably, this increased burden was evident even before stroke onset, suggesting that sick leave may capture not only the direct consequences of stroke but also pre-existing vulnerabilities in the years preceding the event. Moreover, after adjustment in the multivariable model, in addition to pre-stroke work disability, impaired communication (aphasia), dominant hand deficit, and impaired postural balance emerged as key independent determinants of prolonged sick leave. These findings highlight the multifactorial nature of work disability after stroke and suggest that both pre-stroke work-disability patterns and specific post-stroke functional impairments should be considered when identifying individuals at risk of prolonged sick leave. Interventions targeting modifiable pre-stroke health risks, particularly psychiatric, cardiovascular, and metabolic conditions, combined with early post-stroke rehabilitation focused on communication, hand function and postural balance, may help reduce individual and societal burdens of sick leave associated with stroke.

Abbreviations

Disability-adjusted life years (DALYs)

Statistics Sweden (SCB)

Saltin-Grimby Physical Activity Level Scale (SGPALS)

National Institutes of Health Stroke Scale (NIHSS)

Montreal Cognitive Assessment (MoCA)

Standard deviation (SD)

Years (y)

Days (d)

Number (No.)

Interquartile range (IQR)

Confidence intervals (CI)

Proportion (P)

Exponentiated regression coefficients (Exp(β))

Odds ratio (OR)

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki and received ethical approval (registration number Dnr 2021-03324 with approval 7/7 2021) from the Swedish Ethical Review Authority in Stockholm, Sweden. In accordance with the Personal Data Act, Swedish law No. SFS 1998:204 by the Data Inspection Board in Sweden, quality registries are excluded from the rule of the individual informed consent, as the purpose of these registries is to improve quality of care, treatment, and rehabilitation. Inclusion in the quality registries follows an opt-out procedure in accordance with Swedish legislation (Patient Data Act 2008:355, Chapter 7). All patients and their next of kin are informed at the stroke units about the registry, the registry's objectives and the inclusion and processing of their data in the registries. Patients are also informed of their right to decline participation or withdraw at any time (opt-out consent). Patients who do not opt out may be included in the registry. The use of registry data for the

present study was approved by the Swedish Ethical Review Authority. All data used for the present study were pseudonymized, and individuals could not be identified in the research dataset.

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Authors' Contribution

All authors were involved in the design of the study. ME did the statistical analysis with the support of the others. ME did all the figures. ME wrote the manuscript under the guidance of the others. All authors reviewed the manuscript. The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Availability of data and materials

According to the Swedish regulations, data can only be used in accordance with the application for this study that was approved by the Ethical board. Requests to access the dataset can be submitted by qualified researchers to the authors (contact Professor Katharina S. Sunnerhagen, email: ks.sunnerhagen@neuro.gu.se).

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Figures

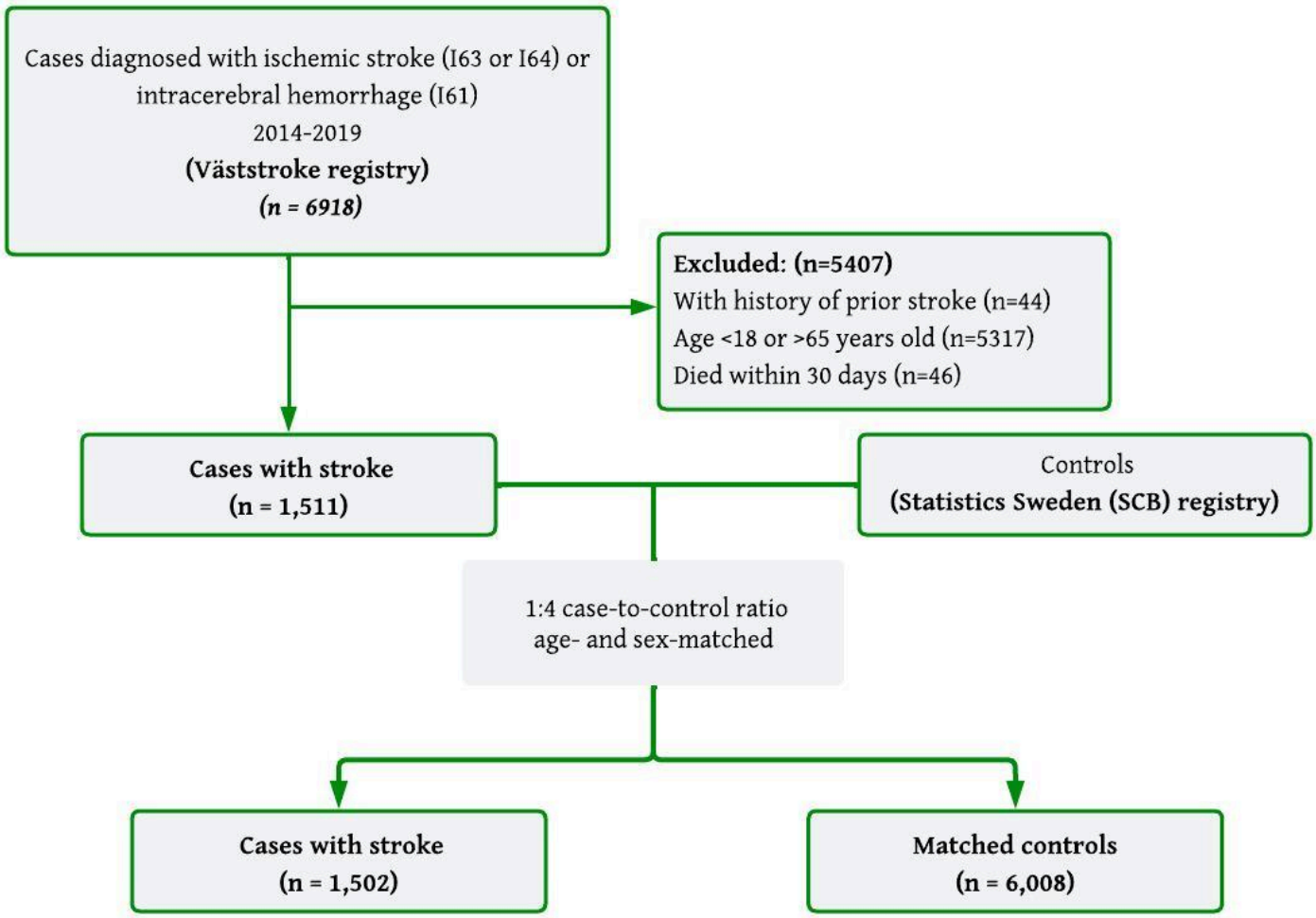


Figure 1

Flow diagram of study sample selection from the Väststroke registry.

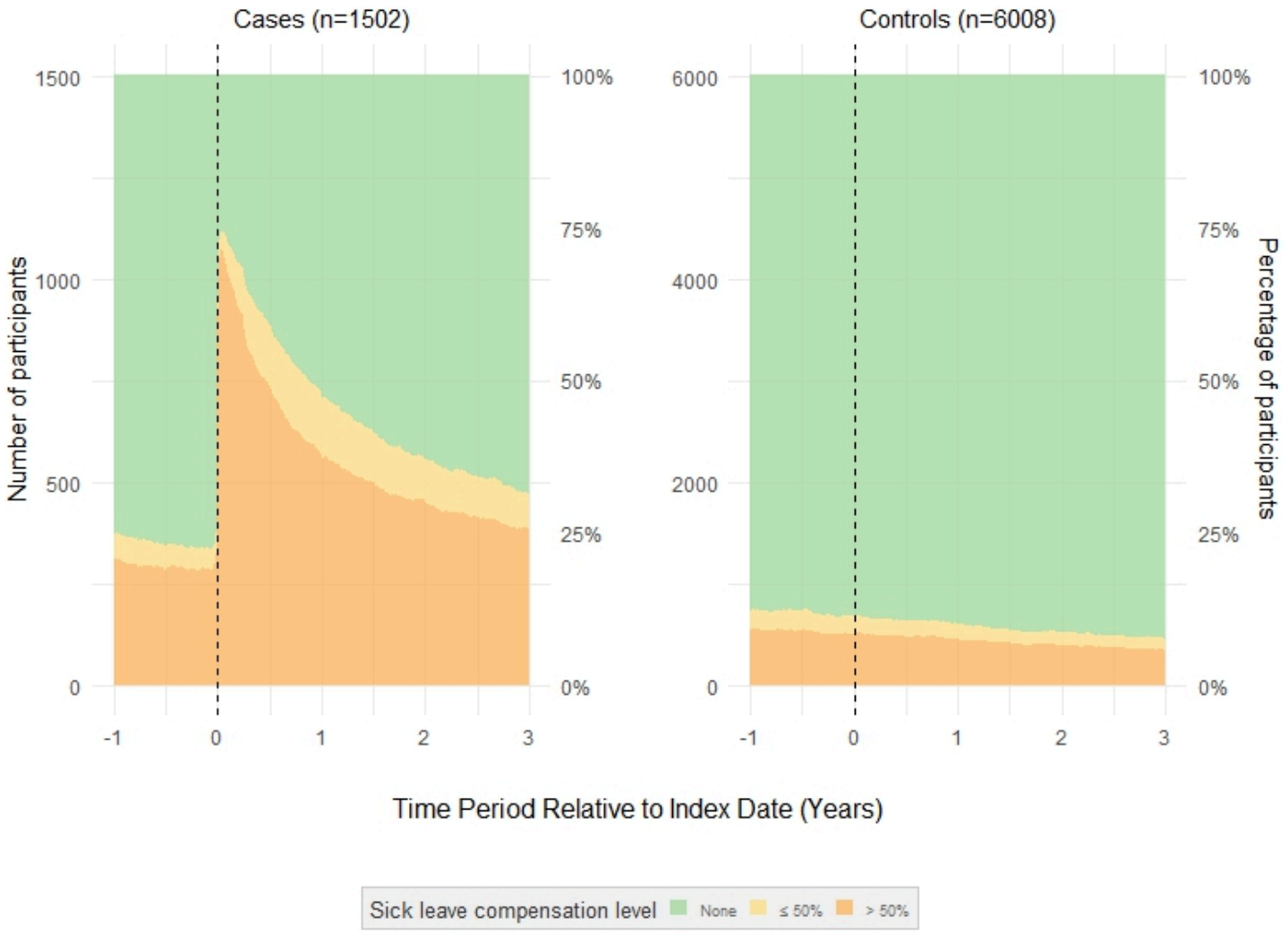


Figure 2

Sick leave trajectories among stroke cases and their matched controls, showing daily counts of cases and controls with ≤50% and >50% sick leave across follow-up period. The categories ≤50% and >50% sick leave indicate the proportion of full-time work for which the individual was considered unable to work on each registered sick leave day, with ≤50% corresponding to 0.25 or 0.5 net sick leave day and >50% corresponding to 0.75 or 1 net sick leave day. The index date for each case was defined as the date of the first-ever stroke, and each control was assigned with the same index date as its corresponding case. The follow-up period was divided into two phases: (i) pre-index (the year before the index date), (ii) post-index (3 years after the index date).

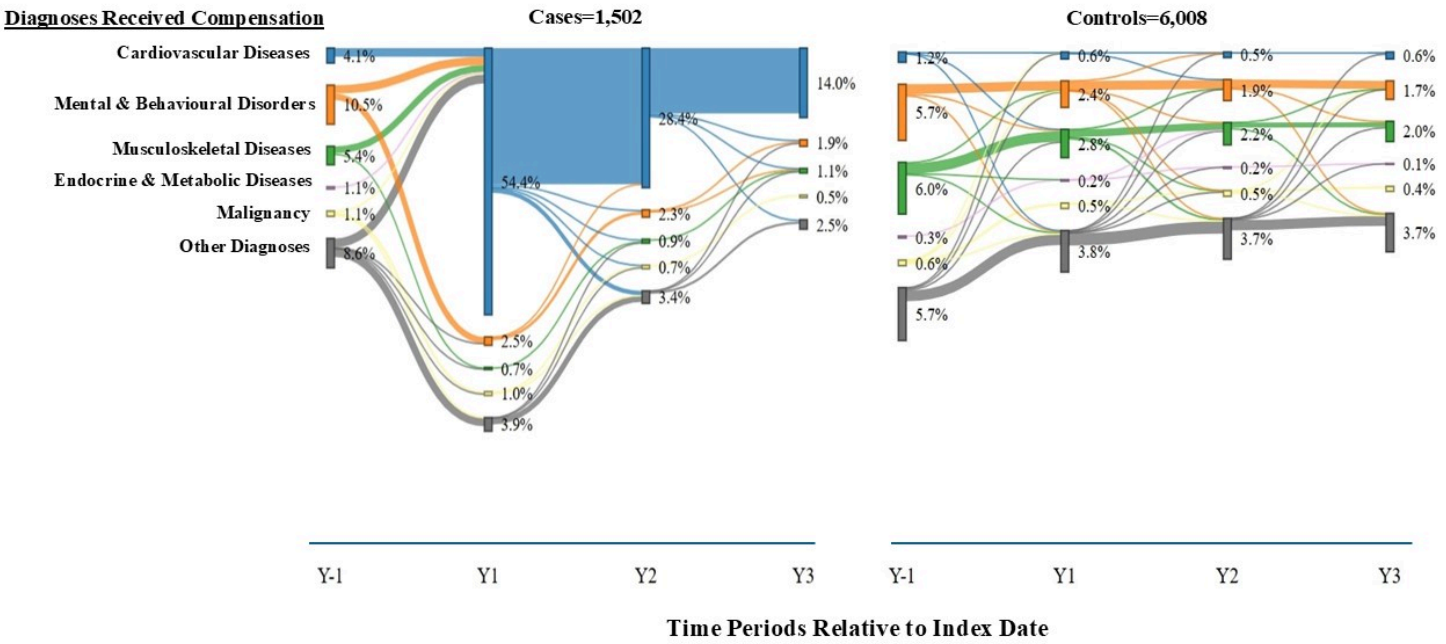


Figure 3

Sankey diagram illustrates year-by-year transitions across the diagnosis categories for which sick leave compensation was received among stroke cases and their matched controls in a 1:4 ratio. The bands (strata) represent the distribution of diagnosis categories at each time point (Y–1: pre-index period; Y1–Y3: years 1–3 of post-index period).

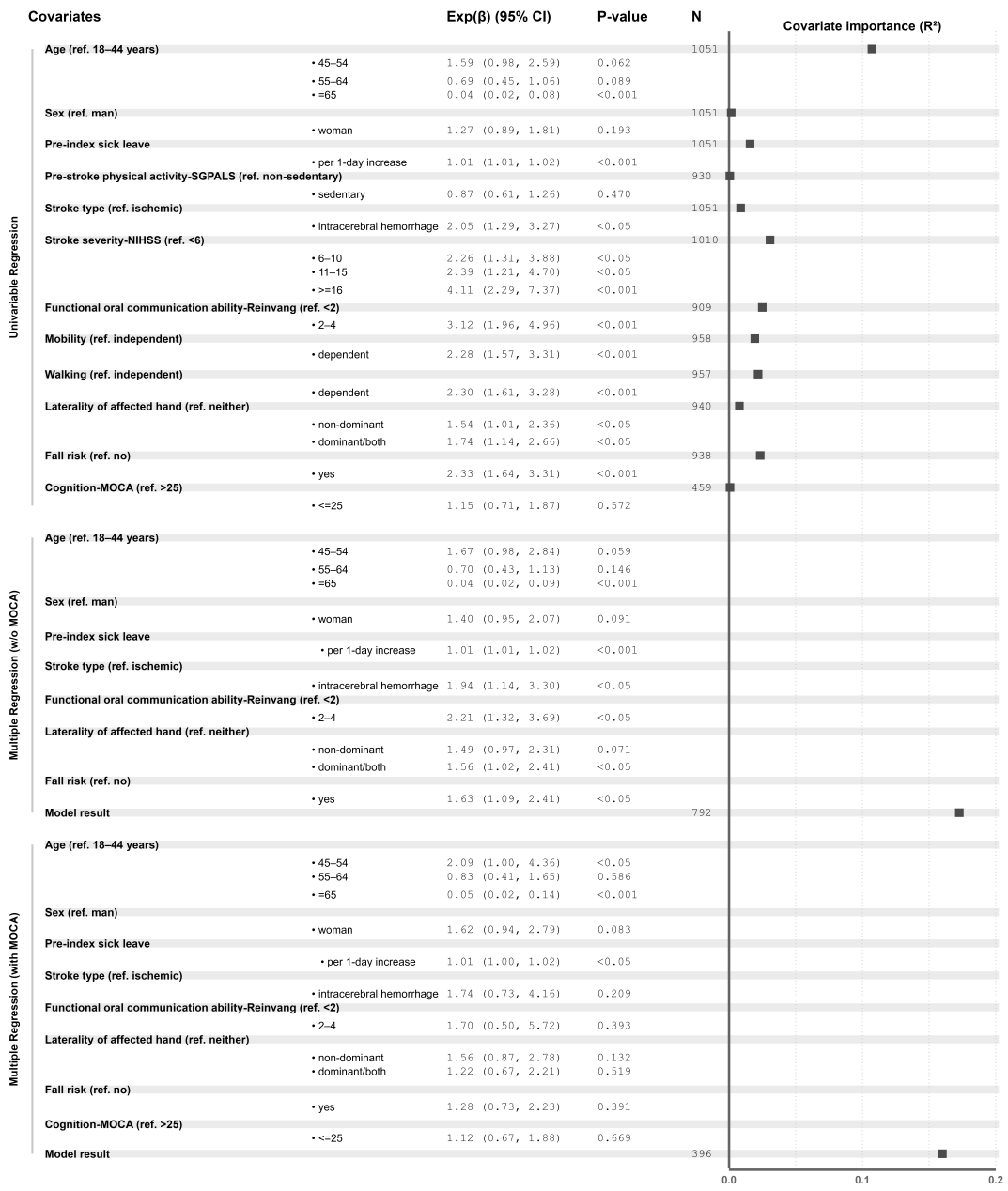


Figure 4

Results of univariable and multivariable linear regression analyses with a log-transformed outcome (the number of net sick leave days) within 3 years after stroke (n=1,051). The associations between each covariate and the outcome are presented as exponentiated regression coefficients (Exp(β)), 95% confidence intervals (CI), and p values, both before and after adjustment for other covariates. N indicates the number of cases contributing to each covariate and to each multivariable model. The right-hand panel illustrates the covariate importance (R^2) for each covariate and each multivariable model. Abbreviations and covariates definitions. SGPALS, Saltin–Grimby Physical Activity Level Scale (assessing pre-stroke physical activity); MoCA, Montreal Cognitive Assessment (assessing cognitive

function); Reinvang scale, functional oral communication ability; NIHSS, National Institutes of Health Stroke Scale (indicating stroke severity). The index date was defined as the date of the first-ever stroke; and the pre-index period is the year preceding that date. Sick leave pre-index denotes the number of net sick leave days ≤50% during the pre-index period. Timing of measurement: hand affected, MoCA, walking, mobility, risk of fall, Reinvang and NIHSS recorded at admission or within 24–48 h of hospitalization.