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ORIGINAL RESEARCH

Follow-Up in Primary Care After Ischemic Stroke – Insights From the Nor-COAST Study

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Background: There is limited information on follow-up routines for adequate poststroke care after discharge from hospital.

Purpose: This study aimed to assess the likelihood of general practitioner (GP) follow-up within 18 months after an ischemic stroke and to identify clinical factors influencing follow-up frequency.

Patients and Methods: Home-dwelling patients admitted to St. Olavs University Hospital with ischemic stroke between 2015 and 2017 were included. Follow-up was assessed by linkage to administrative health data, tracking GP visits over the 18-month period post discharge.

Results: In total, 278 of the 302 patients included (92%) had at least one consultation, with a mean time to first consultation of 64 days (SD 96). Of these 278 patients, the cumulative probability of a consultation within 30, 90, 365, and 540 days was 56%, 81%, 96%, and 100%, respectively. The mean number of consultations during the 18-month follow-up was 6.2 (SD 6.7). Factors associated with a lower probability of consultation within the first 90 days included use of home care services (HR 0.56, 95% CI 0.41–0.77), disability (HR 0.70, 95% CI 0.61–0.79), frailty (HR 0.82, 95% CI 0.72–0.94), and cognitive impairment (HR 0.85, 95% CI 0.75–0.97). Additionally, older age (coefficient −0.09 per year, 95% CI −0.16 to −0.02), use of home care services (coefficient −2.34, 95% CI −4.52 to −0.15), and cognitive impairment (coefficient −0.77, 95% CI −1.46 to −0.09) were associated with fewer consultations.

Conclusion: Most patients had at least one GP consultation within 18 months poststroke. However, vulnerable patients with advanced age, frailty, disability, and cognitive impairment may be at risk of suboptimal follow-up after ischemic stroke.

Keywords: ischemic stroke, general practice, primary care, cardiovascular prevention, secondary prevention

Introduction

Significant efforts have been made to improve acute stroke care and rehabilitation, leading to a growing number of stroke survivors requiring optimal secondary prevention.[1] Despite well-established guidelines, studies continue to report suboptimal risk factor control and low adherence to secondary preventive medications, which increase the risk of recurrent stroke and other cardiovascular events.[2–7]

Several factors may contribute to poor adherence and inadequate risk factor management, including patient-related barriers (eg, socioeconomic status, disability, cognitive decline), physician-related factors (eg, complex drug regimens, time constraints), and health care system factors (eg, follow-up routines in primary care, coordination between hospital

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and primary care).[8] While secondary prevention strategies emphasize regular monitoring and medication adherence, the implementation of structured follow-up in clinical practice remains inconsistent.

General practitioners (GPs) play a crucial role in the long-term management of stroke patients. Beyond the recommended 3-month follow-up at hospital outpatient clinics, no standardized poststroke follow-up program exists in Norway.[9] This raises concerns about whether stroke patients receive adequate long-term monitoring and risk factor management.[10] Given the heterogeneity of stroke survivors – including variations in comorbidities, disability levels, and risk factor burdens – there is a critical need to better understand how follow-up care is delivered. However, limited evidence exists on how frequently stroke patients are seen in primary care, what factors influence follow-up timing and whether certain patient groups are at risk of inadequate monitoring. Identifying these gaps is essential for optimizing secondary prevention strategies. To address this, we aim to assess the frequency of GP follow-up within an 18-month period poststroke and identify key clinical factors influencing both the time to first contact and the frequency of follow-up visits.

Materials and Methods

Study Population

This study is part of the Nor-COAST (Norwegian Cognitive Impairment after Stroke) study, a Norwegian multicenter observational cohort study that consecutively included patients with acute stroke at five Norwegian stroke units between May 2015 and March 2017.[11] For the current substudy, we included patients with ischemic stroke treated at St. Olavs University Hospital in central Norway (n=356). We excluded patients who died within the first 3 months poststroke (n=19) and patients residing in long-term care facilities at the 3-month follow-up (n=34). One patient was lost to follow-up due to emigration, leaving 302 home-dwelling patients eligible for analysis, Figure 1.

These patients were assessed at the outpatient clinic at 3 and 18 months poststroke through cognitive and physical clinical examinations, interviews, self-report questionnaires, and blood samples. We assessed patients unable to attend the outpatient clinic via telephone interview or through proxy information. The study was approved by the Regional Committee for Medical and Health Research Ethics in North Norway (REC number 2017/1462). All participants gave their written informed consent before inclusion or proxy consent was obtained if they could not provide it themselves. The study was conducted in accordance with the Declaration of Helsinki.

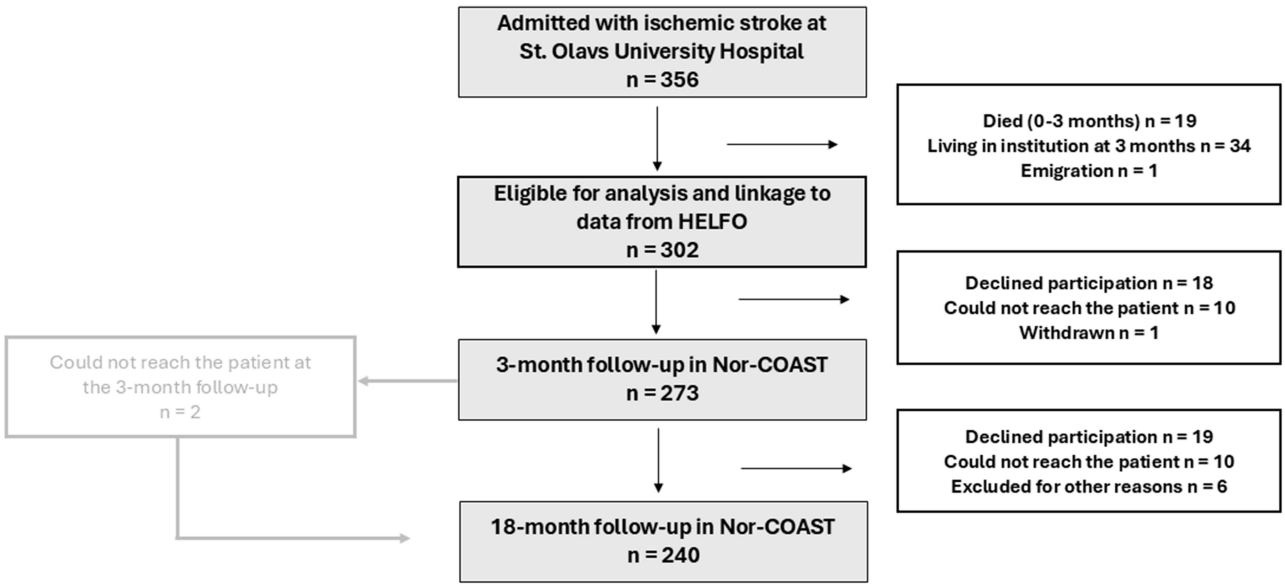

Figure 1 Flow chart of inclusion and exclusion of patients in current analysis.
Abbreviation: HELFO, the Norwegian Health Economics Administration.

Outcome Assessments

Assessment of Follow-Up in General Practice

In Norway, all residents are assigned a specific GP to consult according to the regular general practitioner scheme. GPs have a list of patients for whom they hold a special responsibility. Contacts with the GPs' office from the discharge date to 18 months post discharge were identified through linkage to the Norwegian Health Economics Administration (HELFO). HELFO, a subdivision of the Directorate of Health, administers payments from the National Insurance scheme to health care providers, ensuring accessible and equitable health services.[12] This includes services from general practice offices, reimbursed through codes registered in the Norwegian Control and Payment of Health Reimbursement (KUHR) database. For this study, we defined contacts with diagnostic codes related to cardiovascular diseases, according to the International Classification of Primary Care (ICPC) code system, as relevant.[13] This classification was intended to capture follow-up appointments where secondary prevention was a primary or secondary focus. Contacts without a cardiovascular diagnostic code were excluded. A complete list of relevant diagnostic codes is provided in Supplementary Table S1.

We retrieved contact dates and reimbursement codes. A consultation with a GP was defined as a "face-to-face contact", based on the reimbursement codes 2ad (consultation with a doctor, day rate) and/or 11ad (home visit, day rate), according to the Norwegian Medical Association's "Normal Tariff for General Practice 2016–2017". Simple contacts were recorded separately, such as telephone calls, electronic communication, sick leave registrations, and electronic prescriptions. Follow-up information on the date of death was obtained from the Norwegian Causes of Death Registry.

Factors Influencing Follow-Up Frequency and Time to First Contact

Potential factors influencing the degree of follow-up were chosen a priori, based on results from previously published studies.[5,14,15] We analyzed age and years of education as continuous variables, sex with males as reference. Home care at admission or the 3-month follow-up was obtained through the self-report questionnaire and analyzed as a categorical variable (yes/no). Disability was measured by the Modified Rankin Scale at discharge and analyzed as a continuous variable, with scores ranging from 0 (no symptoms) to 5 (severe disability).[16] Frailty was assessed using the modified 5-item Fried criteria,[17] with a score from 0 (robust) to 5 (frail) based on slow gait speed, reduced grip strength, self-reported fatigue, low physical activity, and unintentional weight loss, all assessed during the index stay. Cognitive function was assessed using the Global Deterioration Scale (GDS),[18] through interviews with caregivers conducted by study nurses during the hospital stay. GDS is a global measure of cognitive function and ability to perform daily life activities, with scores ranging from 1 (normal cognitive function) to 7 (severe dementia). Psychological distress was measured using the Hospital Anxiety and Depression Scale (HADS)[19] at 3 months and analyzed as a continuous variable (score 0–42). For factors potentially influencing time to first contact, medication changes during hospital stay were defined as a new prescription of a secondary preventive drug (adding a drug with the following Anatomical Therapeutic Chemical Classification System codes (ATC): antithrombotic drugs (B01A), antihypertensive drugs (C02A, C02C, C02D, C03A, C07, C08, C09) or lipid-lowering drugs (C10)) and analyzed as categorical variable (yes/no).

Assessment of Vascular Treatment Targets and Medication Adherence

Blood pressure (BP) at follow-up was measured three times by the same physician with one-minute intervals, and the mean of the second and third measurements was used in the analysis. BP control was defined as BP < 140/90 mmHg according to the recommendations in Norwegian guidelines at the time of the survey.[9] Non-fasting serum concentrations of low-density lipoprotein cholesterol (LDL-C) were measured, and LDL-C control was defined as < 2.0 mmol/L.[9] We defined persistence as medication continuation from hospital discharge to 18 months poststroke. Self-reported medication adherence was measured by the 4-item Morisky Medication Adherence Scale (MMAS-4),[20–22] where a score of 4 corresponds to high adherence, 2–3 to medium adherence, and 0–1 to low adherence.

Statistical Analysis

We report means with standard deviations (SD) and proportions as appropriate for baseline characteristics. We use descriptive statistics to describe the proportion of patients with a follow-up appointment by the GP within 1, 3, 6, 12, and

18 months poststroke. We used a Cox regression model with the probability of a consultation within the first 90 days as the outcome variable. The following covariates were included in the model, one at a time: age, sex, education, home care services, disability, frailty, cognitive impairment, psychological distress, and medication changes during hospital stay. We did unadjusted analyses and analyses adjusted for age, sex, and education. In a linear regression model with number of consultations between discharge and 18 months as the dependent variable, the following covariates were included in the model, one at a time: age, sex, education, home care services, disability, frailty, cognitive function, and psychological distress. Due to non-normality of residuals, we used bootstrapping with bias-corrected and accelerated (BCa) adjustment, using B=2000 bootstrap samples. We did unadjusted analyses and analyses adjusted for age, sex, and education. We used single imputation with predictive mean matching for missing risk factor levels at 3 and 18 months. We report estimates with 95% confidence intervals (CI) where relevant. Two-sided p-values <0.05 were considered as statistically significant. However, due to multiple comparisons, p-values between 0.01 and 0.05 should be interpreted cautiously. Data analysis was performed using Stata version 16 (StataCorp 2015. College Station, Texas, USA).

Subgroup Analyses

In a preplanned subgroup analysis, we excluded patients using warfarin, as they are regularly monitored through International Normalized Ratio measurements. We also analyzed associations between the number of contacts and covariates separately for patients with and without home-care services.

To explore the association between cognitive function and poststroke follow-up, we conducted a subgroup analysis excluding patients with prestroke cognitive impairment (GDS > 3). Additionally, we examined the association between cognitive function at follow-up, and both follow-up frequency and the probability of having a consultation within the first 90 days.

Results

Baseline Characteristics

Baseline characteristics are shown in Table 1. The mean (SD) age was 73.8 (10.5) years (range 37 to 96), and 42% were female. Most patients had mild strokes (mean National Institutes of Health Stroke Scale score of 4.0 (SD 4.4)) and 57% had an independent functional status at discharge.

Table 1 Clinical Characteristics at the Index Stroke Event

Prestroke Demographic and Clinical Characteristics		Prestroke Vascular Risk Factors		Poststroke Clinical Characteristics	
Age (years)	73.8 (10.5)	Atrial fibrillation[d]	70 (23%)	NIHSS[j] admission	4.0 (4.4)
Sex, female	127 (42%)	Diabetes mellitus[e]	59 (20%)	NIHSS discharge	2.1 (2.5)
Education (years)	11.4 (3.6)	Hypertension[f]	177 (59%)	Independent functional status[a] at discharge	171 (57%)
Living alone	113 (37%)	Hypercholesterolemia[g]	148 (49%)	Number of medications at discharge	5.6 (2.5)
Independent functional status[a]	260 (86%)	Previous stroke / TIA[h]	86 (28%)	Antihypertensive drugs[k]	233 (77%)
Charlson Comorbidity Index	4.2 (1.9)	Ischemic heart disease[h]	67 (22%)	Lipid-lowering drugs[k]	255 (84%)
Cognitive impairment[b]	55 (18%)	Peripheral artery disease[h]	30 (10%)	Antiplatelet drugs[k]	246 (81%)
Frail[c]	37 (12%)	Estimated GRF[i] (mL/min/1.73 m^2)	76.6 (18.1)	Anticoagulation[k]	81 (27%)
Home care	41 (14%)	Current tobacco smoking	67 (22%)	Warfarin or heparin[k]	39 (13%)
		BMI	26.1 (3.9)	DOAC[k]	42 (14%)
				Antidiabetic drugs[k]	40 (13%)

Notes: Values are n / N (%) or mean (standard deviation (SD). [a]Defined as Modified Rankin Scale ≤2. [b]Defined as score ≥ 3 on Global Deterioration Scale. [c]Frailty measured by 5-item Fried criteria. [d]Atrial fibrillation was defined by self-report or documented on electrocardiogram or telemetry during admission. [e]Prestroke diabetes mellitus was defined as self-reported diabetes or HbA1c ≥ 48 mmol/mol or prescribed antidiabetic drugs at admission. [f]Hypertension was defined as use of antihypertensive drugs at admission. [g]Hypercholesterolemia was defined by use of lipid lowering drugs at admission. [h]Prevalence of previous cerebrovascular disease and coronary heart disease was retrieved from hospital medical records. [i]CKD-EPI equation based on gender, age and the serum creatinine concentration at admission. [j]Stroke severity according to National Institutes of Health Stroke Scale (NIHSS). [k]At discharge or started <3 months after discharge.

Abbreviations: TIA, Transient ischemic attack; BMI, Body Mass Index; GFR, Glomerular Filtration Rate; DOAC, Direct Oral Anticoagulant.

Follow-Up by GPs From Discharge to 18 Months After Stroke

In total, 4% (n=12) died between 3 and 18 months. Median time from discharge to death for these patients was 351 days (interquartile range (IQR) 209 to 411). In total, 96% (n=289) had contact with their GP, either through consultations or simple contacts, in the period from discharge to the 18-month follow-up, leaving 4% (n=13) with no contact.

Furthermore, 92% (n=278) had at least one consultation. Mean time from discharge until first consultation with the GP was 64 days (SD 96), range 1 to 531 days. The cumulative probability of a consultation within 30, 90, 180, 365 and 540 days for patients who had a consultation (n=278) were 56% (n=155), 81% (n=225), 90% (n=251), 96% (n=267) and 100% (n=278), respectively.

The number of consultations per patient ranged from 0 to 50, with an average of 6.2 (SD 6.7). Of patients having a GP consultation, 11% (n=32) had only one consultation, whereas 14% (n=43) had two consultations, 7% (n=22) had three consultations, and 9% (n=27) had four consultations. In total, 51% (n=154) had five or more consultations.

At the 3- and 18-month follow-up, 26% (n=72) and 24% (n=58) had home care services, respectively. In total, 57% had attended some form of rehabilitation service within the first 3 months (details in Supplementary Table S2).

Patient Characteristics and the Likelihood of Follow-Up Within 90 Days Post-Stroke

Table 2 shows results from the Cox regression analysis, reporting hazard ratios (HRs) for clinical factors associated with the probability of a consultation within 90 days poststroke. In unadjusted analyses, use of home care services (HR 0.56, 95% CI 0.41 to 0.77), disability (HR 0.70, 95% CI 0.61 to 0.79), frailty (HR 0.82, 95% CI 0.72 to 0.94) and cognitive impairment (HR 0.85, 95% CI 0.75 to 0.97) were associated with lower probability of having a consultation the first 90 days postdischarge. Analyses adjusted for age, sex, and education showed effect estimates in line with the unadjusted analyses. However, the association between cognitive impairment and consultation the first 90 days was no longer significant after adjustment (HR 0.88, 95% CI 0.77 to 1.01, p=0.076).

Supplementary Table S3 shows patient characteristics and risk factor levels at 3 months for patients stratified by time to first consultation. In total, 57% of patients having a consultation the first month had reached the LDL-C target at 3 months, while 42% of patients with no GP consultation had reached the target. Mean systolic blood pressure for patients with contact the first month was 143 mmHg (SD 18), while the level for patients with first contact after 365 days was 148 mmHg (SD 15). A larger proportion of patients with late first contact with a GP tended to have both inpatient and outpatient rehabilitation between 0 and 3 months than those with early contact in descriptive analyses.

Table 2 Cox Regression Model with Consultation with the General Practitioner Within the First 90 Days Post-Discharge as Outcome Variable (n = 302)

		Unadjusted Analysis		Adjusted Analysis[g]	
	n	HR (95% CI)	p-value	HR (95% CI)	p-value
Age, years	302	0.99 (0.98 to 1.00)	0.091	0.99 (0.98 to 1.0)	0.076
Sex, female	302	1.01 (0.78 to 1.31)	0.942	1.08 (0.82 to 1.42)	0.578
Education, years	302	1.03 (1.00 to 1.07)	0.093	1.02 (0.98 to 1.07)	0.242
Home Care services[a]	302	0.56 (0.41 to 0.77)	<0.001	0.57 (0.41 to 0.80)	0.001
Disability[b]	300	0.70 (0.61 to 0.79)	< 0.001	0.70 (0.62 to 0.80)	<0.001
Frailty[c]	302	0.82 (0.72 to 0.94)	0.004	0.84 (0.73 to 0.96)	0.011
Cognitive impairment[d]	297	0.85 (0.75 to 0.97)	0.015	0.88 (0.77 to 1.01)	0.076
Psychological distress[e]	236	0.98 (0.96 to 1.00)	0.165	0.98 (0.96 to 1.01)	0.129
Medication changes during admission[f]	302	1.15 (0.86 to 1.55)	0.352	1.10 (0.81 to 1.48)	0.540

Notes: [a]Home care services at baseline or 3 months follow-up. [b]Measured by Modified Rankin Scale with 0 as reference corresponding to no disability. [c]Measured by 5-item Fried Frailty Criteria with 0 as reference corresponding to robust, and 5 to frail. [d]Measured by Global deterioration scale with 1 as reference corresponding to normal cognitive function and 7 to severe dementia. [e]Hospital Anxiety and Depression Scale (HADS) 0–42, with 0 as reference with increasing scores indicating increasing burden. [f]Added secondary preventive medications during hospital stay. [g]Adjusted for age, sex and education.
Abbreviation: HR, Hazard ratio.

Associations Between Patient Characteristics and Number of Consultations with the GP

Table 3 shows results from the linear regression reporting coefficients for clinical factors associated with increasing number of consultations with the GP in the follow-up period. Older age (coefficient −0.09 per year (95% CI −0.16 to −0.02), use of home care services (coefficient −2.34 (95% CI −4.52 to −0.15) and cognitive impairment (coefficient −0.77 per point increase on GDS (95% CI −1.46 to −0.09) were associated with fewer consultations with the GP in unadjusted analyses. The associations between number of consultations and home care services and cognitive impairment were not significant in adjusted analyses.

For patients with no consultation with the GP, persistence to secondary preventive drugs prescribed at discharge was as follows: 85% for antihypertensives, 79% for lipid-lowering drugs, and 89% for antithrombotic drugs (Table 4). The corresponding numbers for patients with ≥5 consultations, were 93%, 88% and 98%, respectively. In total, 74% of patients with ≥5 consultations reported high medication adherence compared to 67% of those with no consultation. Supplemental clinical characteristics for patients stratified by number of consultations are shown in Supplementary Table S4. In total, 96% of patients with no GP consultation had a Nor-COAST study follow-up appointment at 3 or 18 months.

Table 3 Linear Regression with Number of Consultations with the General Practitioner Within 18 Months Poststroke as Dependent Variable (n = 302)

	n	Unadjusted Analysis		Adjusted Analysis[g]	
		Coefficient (95% CI)	p-value	Coefficient (95% CI)	p-value
Age, years	302	−0.09 (−0.16 to −0.02)	0.015	−0.09 (−0.16 to −0.02)	0.018
Sex, female	302	−0.81 (−2.32 to 0.72)	0.296	−0.49 (−2.0 to 1.02)	0.535
Education, years	302	0.18 (−0.19 to 0.39)	0.075	0.09 (−0.13 to 0.31)	0.424
Home Care services[a]	302	−2.34 (−4.53 to −0.15)	0.036	−1.58 (−3.89 to 0.71)	0.176
Disability[b]	300	−0.42 (−1.13 to 0.29)	0.249	−0.14 (1–0.89 to 0.61)	0.709
Frailty[c]	302	−0.48 (−1.18 to 0.22)	0.181	−0.17 (−0.91 to 0.57)	0.643
Cognitive impairment[d]	297	−0.77 (−1.46 to −0.09)	0.027	−0.50 (−1.25 to 0.25)	0.191
Psychological distress[e]	236	−0.09 (−0.23 to 0.05)	0.206	−0.08 (−0.22 to 0.07)	0.296

Notes: [a]Home care services at baseline or 3 months follow-up. [b]Measured by Modified Rankin Scale with 0 as reference corresponding to no disability. [c]Measured by 5-item Fried Frailty Criteria with 0 as reference corresponding to robust, and 5 to frail. [d]Measured by Global deterioration scale with 1 as reference corresponding to normal cognitive function and 7 to severe dementia. [e]Hospital Anxiety and Depression Scale (HADS) 0–42, with 0 as reference with increasing scores indicating increasing burden. [g]Adjusted for age, sex and education.

Table 4 Vascular Risk Factor Levels and Medication Adherence at 18 Months Stratified by Consultation Frequency with the General Practitioner in the Period (n=302)

	No Consultation (n= 24)	One Consultation (n= 32)	1–4 Consultations (n=92)	≥5 Consultations (n=154)
Persistent to antihypertensive drugs[a]	11 (85%)	11 (85%)	51 (96%)	93 (93%)
Persistent to lipid-lowering drugs[a]	11 (79%)	19 (95%)	56 (92%)	98 (88%)
Persistent to antithrombotic agents[a]	16 (89%)	22 (100%)	73 (99%)	120 (98%)
Smoking	4 (17%)	1 (3%)	15 (16%)	20 (13%)
Mean LDL-C	2.0 (0.6)	2.0 (0.7)	2.3 (0.8)	2.2 (0.8)
LDL-C < 2.0 mmol/L	12 (50%)	19 (59%)	40 (44%)	74 (48%)
Mean systolic blood pressure	142 (16)	144 (17)	145 (20)	142 (19)
Blood pressure < 140/90 mmHg	11 (46%)	13 (41%)	34 (37%)	67 (44%)
High self-reported medication adherence[b]	16 (67%)	24 (75%)	66 (72%)	114 (74%)

Notes: [a]For patients with available information on medications in use at 18 months follow-up (n=237), corresponding n for 0, 1, 1–4 and ≥5 consultations were 18, 22, 74 and 122. Persistence defined as continuation of medications prescribed at discharge at 18 months. [b]Measured by the Morisky Medication Adherence Scale (0 to 4 points) where 4 corresponds to high adherence, ©MMAS, www.adherence.cc.[20]

Abbreviations: LDL-C, Low density lipoprotein cholesterol; CAD, coronary artery disease; PAD, peripheral artery disease.

Subgroup Analyses

Subgroup analyses excluding patients using warfarin (n=39) showed results largely consistent with results in Tables 2 and 3 (data not shown). Subgroup analyses for patients with and without home care services at admission or 3 months showed effect estimates consistent with those in Table 3. However, none of the associations were significant (data not shown).

In subgroup analyses excluding patients with prestroke cognitive impairment, there was no significant association between cognitive function assessed at the 3- and 18-month follow-up and number of consultations (Supplementary Table S5). However, there was a lower probability of consultation with the GP within the first 90 days for patients with cognitive impairment measured at 18 months in unadjusted analyses (HR 0.87, 95% CI 0.77 to 0.99, p=0.043), but not when adjusting for age, sex and education (Supplementary Table S6).

Discussion

Main Findings

Our study showed that most patients had at least one GP visit within 18 months post-stroke, with an average of 6.2 consultations. However, 20% did not see their GP within the first 3 months, and 8% had no GP visit during the 18-month period. Factors associated with a lower probability of early consultation (within 90 days) included use of home care services, disability, frailty, and cognitive impairment. Older age, use of home care services, and cognitive impairment were also linked to fewer overall consultations.

Comparison with Other Studies

The frequency of consultations within 18 months post-stroke is significantly higher than that of the average Norwegian citizen,[23] and comparable to contact frequencies after stroke in other countries.[24] While 8% of patients had no recorded consultations, it is possible that these individuals had contact with their GP, but non-cardiovascular ICPC codes were used. Previous studies indicate that most consultations for stroke patients address topics unrelated to stroke.[25] Notably, one-fifth of participants did not have a GP consultation within the first 90 days, consistent with findings from a Swedish registry study.[14]

The use of home care services is associated with a lower probability of early GP contact and fewer overall consultations in other studies as well.[26] In our study, 28% of patients received home care services, which may substitute for GP care by providing monitoring and support at home, thereby reducing the need for regular GP visits. Similarly, disability is linked to a lower probability of early contact, in line with findings from Sweden.[14] The same study found that vulnerable patients, particularly those of advanced age or with severe strokes, had lower probability of follow-up within the first 90 days.[14] However, disability is also associated with a higher likelihood of utilizing rehabilitation services both in municipal and specialist healthcare settings, potentially reducing the need for GP contact. Conversely, stroke survivors with more severe health issues, such as frailty, disability, and cognitive impairment, may face barriers to accessing regular GP care and instead opt for more accessible alternatives, such as home care services.

Frailty was associated with lower probability of early contact, possibly due to mobility challenges or the need for more complex care and support, which may be better managed through home care services or caregivers. In line with other studies, we found that advanced age was associated with fewer consultations with the GP, which may be partly explained by the same factors as frailty.[14] We found no significant association between sex and probability of contact within the first 90 days or consultation frequency, which contrasts with previous studies that have shown female sex to be associated both with lower consultation frequency,[27] and conversely, with higher consultation frequency.[14,28] Stroke patients face an increased risk of post-stroke cognitive impairment, which may contribute to reduced contact with GPs, as shown in our study and others.[29] This aligns with findings from studies on coronary artery disease patients, which highlight similar patterns of follow-up behavior.[30]

Whereas medication changes during the hospital stay and explicit recommendations in the discharge summary about follow-up appointments have been associated with early contact with the GP in previous studies,[30] we found no significant association. Stroke patients in Norway also have a guideline-recommended 3-month control in specialist health care, which might postpone early contact with the GP. Previous studies have shown that more frequent physician

contact is associated with better risk factor control and improved medication adherence.[31–33] However, the bidirectional relationship between contact frequency and risk factor control complicates interpretation, as GP visits may influence risk factor control, while poor control may also lead to increased contact.

Strengths and Limitations

Strengths of our study include the integration of both administrative health data and clinical follow-up data, covering an up-to-date period that reflects current clinical practice. The study also has a relatively long follow-up period compared to other studies.[14,25] However, several limitations should be noted. Firstly, we included only visits with cardiovascular ICPC codes. Although the validity of ICPC codes has been established,[13] this may lead to an underestimation of the total number of consultations. Our consultation rate is lower than reported in a previous Norwegian that assessed GP medical records for 51 stroke patients.[25] However, stroke was not the primary focus of most consultations in that study, and visits for conditions unrelated to secondary prevention may also influence our consultation count. We lack information on follow-up recommendations provided in discharge summaries,[30] and there is no detailed data on follow-up within specialist healthcare services, such as outpatient clinics or hospital readmissions, which may affect GP follow-up frequency. Additionally, data on long-term rehabilitation services and municipal follow-up programs are absent, as is detailed information about the frequency and content of home care services. Missing data for vascular risk factors at 3 and 18 months is another limitation. While the clinical characteristics of the Nor-COAST study population align with those in the Norwegian Stroke Registry,[34] conclusions drawn from this single-center study may not be generalizable to other populations. Finally, assessing the complex associations between factors influencing follow-up patterns remains a challenge.

Clinical Implications

The findings of this study have several clinical implications for the management and follow-up of stroke patients. The study highlights variability in GP consultation rates, particularly among vulnerable groups, underscoring the need for care coordination between hospitals, GPs, home care and rehabilitation services to ensure comprehensive follow-up.[35] Research shows that medication adherence often improves around healthcare appointments, a phenomenon known as white-coat adherence,[31–33] suggesting that regular GP contact can enhance risk factor control and medication adjustments. Adherence is a dynamic phenomenon and long-term follow-up is essential.[33] Additionally, consistent GP follow-up is linked to lower hospital readmission and mortality rates.[36,37]

However, it remains unanswered whether follow-up in the current study aligns with clinical guidelines or meets individual patient needs. Stroke is a complex and heterogeneous condition, often accompanied by multiple comorbidities,[38,39] which can complicate adherence to secondary prevention guidelines. Factors such as family support, alternative primary health services, and rehabilitation programs may reduce GP visit frequency without compromising the quality of care.

Access to regular and optimal GP follow-up can be particularly challenging for vulnerable groups, such as older adults or individuals with disabilities, potentially increasing their risk of inadequate follow-up and adverse cardiovascular outcomes. However, these patients often rely on home care services. Identifying high-risk individuals and providing coordinated, multidisciplinary follow-up, including home care, could significantly improve outcomes for these populations,[1] while reducing the demand for GP visits.

Conclusion

Most patients had at least one consultation with the GP within 18 months poststroke, however, a significant proportion had infrequent visits. Vulnerable patients with advanced age, frailty, disability and cognitive impairment may be at risk of suboptimal follow-up after ischemic stroke. Identifying these high-risk individuals at discharge and providing coordinated, multidisciplinary follow-up, including home care, could improve care and outcomes for these populations.

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Disclosure

The authors report no conflicts of interest in this work.

References

1. Lambert CM, Olulana O, Bailey-Davis L, Abedi V, Zand R. "Lessons learned" preventing recurrent ischemic strokes through secondary prevention programs: a systematic review. *J Clin Med*. 2021;10(18):4209. doi:10.3390/jcm10184209
2. Brewer L, Mellon L, Hall P, et al. Secondary prevention after ischaemic stroke: the ASPIRE-S study. *BMC Neurol*. 2015;15(1):216. doi:10.1186/s12883-015-0466-2
3. Hopstock LA, Morseth B, Cook S, et al. Treatment target achievement after myocardial infarction and ischaemic stroke: cardiovascular risk factors, medication use, and lifestyle: the tromsø study 2015-16. *Eur J Prev Cardiol*. 2021. doi:10.1093/eurjpc/zwab050
4. Heuschmann PU, Kircher J, Nowe T, et al. Control of main risk factors after ischaemic stroke across Europe: data from the stroke-specific module of the EUROASPIRE III survey. *Eur J Prev Cardiol*. 2015;22(10):1354–1362. doi:10.1177/2047487314546825
5. Gynnild MN, Aakerøy R, Spigset O, et al. Vascular risk factor control and adherence to secondary preventive medication after ischaemic stroke. *J Intern Med*. 2020;289(3):355–368. doi:10.1111/joim.13161
6. Sverre E, Peersen K, Husebye E, et al. Unfavourable risk factor control after coronary events in routine clinical practice. *BMC Cardiovasc Disord*. 2017;17(1):40. doi:10.1186/s12872-016-0387-z
7. Doogue R, McCann D, Fitzgerald N, Murphy AW, Glynn LG, Hayes P. Blood pressure control in patients with a previous stroke/transient ischaemic attack in primary care in Ireland: a cross sectional study. *BMC Fam Pract*. 2020;21(1):139. doi:10.1186/s12875-020-01211-z
8. World Health Organization. Adherence to long-term therapies - evidence for action. 2003 https://iris.who.int/handle/10665/42682.
9. National guideline for treatment and rehabilitation in stroke. The Norwegian Directorate of Health. Available from: https://www.helsedirektoratet.no/retningslinjer/hjerneslag. Accessed April 9, 2025.
10. Tapela N, Collister J, Clifton L, Turnbull I, Rahimi K, Hunter DJ. Prevalence and determinants of hypertension control among almost 100 000 treated adults in the UK. *Open Heart*. 2021;8(1):e001461. doi:10.1136/openhrt-2020-001461
11. Thingstad P, Askim T, Beyer MK, et al. The Norwegian cognitive impairment after stroke study (Nor-COAST): study protocol of a multicentre, prospective cohort study. *BMC Neurol*. 2018;18(1):193. doi:10.1186/s12883-018-1198-x
12. The Norwegian Healths Economics Administration. About helfo. Available from: https://www.helfo.no/om-helfo/om-helfo/about-helfo. Accessed April 9, 2025.
13. Sporaland GL, Mouland G, Bratland B, Rygh E, Reiso H. General practitioners' use of ICPC diagnoses and their correspondence with patient record notes. *Tidsskr Nor Laegeforen*. 2019;139(15) doi:10.4045/tidsskr.18.0440
14. Ullberg T, Zia E, Petersson J, Norrving B. Doctor's follow-up after stroke in the south of Sweden: an observational study from the Swedish stroke register (Riksstroke). *Eur Stroke J*. 2016;1(2):114–121. doi:10.1177/2396987316650597
15. Redfern J, McKevitt C, Rudd AG, Wolfe CDA. Health care follow-up after stroke: opportunities for secondary prevention. *Fam Pract*. 2002;19(4):378–382. doi:10.1093/fampra/19.4.378
16. Wolfe CDA, Taub NA, Woodrow EJ, Burney PGJ. Assessment of scales of disability and handicap for stroke patients. *Stroke*. 1991;22(10):1242–1244. doi:10.1161/01.STR.22.10.1242
17. Wæhler IS, Saltvedt I, Lydersen S, et al. Association between in-hospital frailty and health-related quality of life after stroke: the Nor-COAST study. *BMC Neurol*. 2021;21(1):100. doi:10.1186/s12883-021-02128-5
18. Reisberg B, Ferris SH, de Leon MJ, Crook T. The global deterioration scale for assessment of primary degenerative dementia. *Am J Psychiatry*. 1982;139(9):1136–1139. doi:10.1176/ajp.139.9.1136
19. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatr Scand*. 1983;67(6):361–370. doi:10.1111/j.1600-0447.1983.tb09716.x
20. Morisky DE, DiMatteo MR. Improving the measurement of self-reported medication nonadherence: response to authors. *J Clin Epidemiol*. 2011;64(3):255–257. doi:10.1016/j.jclinepi.2010.09.002
21. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care*. 1986;24(1):67–74. doi:10.1097/00005650-198601000-00007
22. Morisky DE, Malotte CK, Choi P, et al. A patient education program to improve adherence rates with antituberculosis drug regimens. *Health Educ Q*. 1990;17(3):253–267. doi:10.1177/109019819001700303
23. Statistics Norway (SSB). Consultations at a general practitioner (GP) or in emergency primary health care during the year, by age groups and by gender. Available from: https://www.ssb.no/en/helse/helsetjenester/statistikk/allmennlegetjenesten. Accessed April 9, 2025.
24. Obembe AO, Simpson LA, Sakakibara BM, Eng JJ. Healthcare utilization after stroke in Canada- a population based study. *BMC Health Serv Res*. 2019;19(1):192. doi:10.1186/s12913-019-4020-6
25. Pedersen RA, Petursson H, Hetlevik I. Stroke follow-up in primary care: a prospective cohort study on guideline adherence. *BMC Fam Pract*. 2018;19(1):179. doi:10.1186/s12875-018-0872-9

26. Forder J, Gousia K, Saloniki EC. The impact of long-term care on primary care doctor consultations for people over 75 years. *Eur J Health Econ*. 2019;20(3):375–387. doi:10.1007/s10198-018-0999-6
27. Baudier L, Senn N, Wild P, Cohidon C. Consultation frequency and general practitioners' and practices' characteristics. *BMC Primary Care*. 2023;24(1):39. doi:10.1186/s12875-023-01996-9
28. Ballering AV, Olde Hartman TC, Verheij R, Rosmalen JGM. Sex and gender differences in primary care help-seeking for common somatic symptoms: a longitudinal study. *Scand J Prim Health Care*. 2023;41(2):132–139. doi:10.1080/02813432.2023.2191653
29. Munthe-Kaas R, Aam S, Ihle-Hansen H, et al. Impact of different methods defining post-stroke neurocognitive disorder: the nor-COAST study. *Alzheimers & Dementia: Transl Res & Clin Interventions*. 2020;6(1):e12000.
30. Huang LYI, Fogarty SJ, Act N, Wang WYS. Rates and predictors of general practitioner (GP) follow-up postdischarge from a tertiary hospital cardiology unit: a retrospective cohort study. *BMJ Open*. 2019;9(10):e031627–e031627. doi:10.1136/bmjopen-2019-031627
31. Burnier M, Wuerzner G, Struijker-Boudier H, Urquhart J. Measuring, analyzing, and managing drug adherence in resistant hypertension. *Hypertension*. 2013;62(2):218–225. doi:10.1161/HYPERTENSIONAHA.113.00687
32. Cramer JA, Scheyer RD, Mattson RH. Compliance declines between clinic visits. *Arch Intern Med*. 1990;150(7):1509–1510. doi:10.1001/archinte.1990.00390190143023
33. Osterberg L, Blaschke T. Adherence to medication. *N Engl J Med*. 2005;353(5):487–497. doi:10.1056/NEJMra050100
34. Kuvås KR, Saltvedt I, Aam S, Thingstad P, Ellekjær H, Askim T. The risk of selection bias in a clinical multi-center cohort study. results from the Norwegian cognitive impairment after stroke (Nor-COAST) study. *Clin Epidemiol*. 2020;12:1327–1336. doi:10.2147/clep.S276631
35. Kjær LA, Tøien M, Førsund LH. Exploring nurse practitioners' collaboration with general practitioners in Norwegian homecare services: a qualitative study. *Scand J Prim Health Care*. 1–10. doi:10.1080/02813432.2024.2381064
36. Sandvik H, Hetlevik Ø, Blinkenberg J, Hunskaar S. Continuity in general practice as predictor of mortality, acute hospitalisation, and use of out-of-hours care: a registry-based observational study in Norway. *Br J Gen Pract*. 2022;72(715):e84. doi:10.3399/BJGP.2021.0340
37. Pereira Gray DJ, Sidaway-Lee K, White E, Thorne A, Evans PH. Continuity of care with doctors—a matter of life and death? A systematic review of continuity of care and mortality. *BMJ Open*. 2018;8(6):e021161. doi:10.1136/bmjopen-2017-021161
38. Pedersen RA, Petursson H, Hetlevik I. Stroke follow-up in primary care: a Norwegian modelling study on the implications of multimorbidity for guideline adherence. *BMC Fam Pract*. 2019;20(1):138. doi:10.1186/s12875-019-1021-9
39. Gallacher KI, Jani BD, Hanlon P, Nicholl BI, Mair FS. Multimorbidity in stroke. *Stroke*. 2019;50(7):1919–1926. doi:10.1161/STROKEAHA.118.020376

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