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Patterns of smoking cessation in the first 3 years after stroke: the South London Stroke Register

Sharon P. Ives, Peter U. Heuschmann, Charles D.A. Wolfe and Judith Redfern

Division of Health & Social Care Research, King's College London, London, UK

Background Stroke survivors are at high risk of recurrent strokes and other vascular events. Smoking is an established risk factor for stroke, with cessation recommended for secondary prevention. Little is known about patterns of smoking cessation after stroke.

Design A prospective cohort of patients was identified.

Methods Data were derived from the population-based South London Stroke Register. Self-reported smoking status was measured at the time of stroke, at 3 months, and at 1 and 3 years after stroke. Stroke survivors, who were smoking at the time of stroke and were alive 3 years later, were included. Logistic regression was used to examine associations between age, sex, ethnicity, socioeconomic status, risk factors, stroke subtype, disability, and probability of attempting and maintaining smoking cessation.

Results Complete smoking data were available for 363 survivors with strokes between 1995 and 2003. In all, 71% of the smokers had attempted to quit within 3 years; 30% had quit and maintained cessation at 1 and 3 years; 10% had quit immediately after stroke, but had subsequently relapsed (smoking again at 1 and 3 years); and 25% of the smokers had quit after 3 months. Black ethnicity [odds ratio (OR): 6.20; confidence interval (CI): 2.39–16.10] and more severe disability ($P = 0.035$) were predictors of attempts to quit. Older age (OR: 0.30; CI: 0.13–0.71) and black ethnicity (OR: 0.30; CI: 0.15–0.60) reduced the likelihood of smoking at 3 years. Among those attempting cessation, being older predicted maintenance (OR: 4.50; CI: 1.50–13.51).

Conclusion The majority of smokers had attempted to quit after stroke; however, a minority achieved sustained cessation in the longer term. Cessation patterns are complex, and interventions should be targeted at multiple time points. *Eur J Cardiovasc Prev Rehabil* 15:329–335 © 2008 The European Society of Cardiology

Introduction

Stroke survivors are at increased risk for recurrent stroke and further vascular events, including myocardial infarction [1]. The risk of stroke recurrence is highest immediately after the event and lowest at 3 years after stroke, rising gradually thereafter [1]. Smoking is a recognized risk factor for stroke, with cessation recommended for secondary prevention [2]. Stroke risk has been shown to decrease significantly 2 years after smoking cessation, equalling the risk for nonsmokers by 5 years after cessation [3].

Correspondence to Sharon P. Ives, MSc, Division of Health & Social Care Research, King's College London, 7th Floor, Capital House, 42 Weston Street, London, SE1 3QD, UK
Tel: + 44 207 848 6775; fax: + 44 207 848 6620; e-mail: sharon.ives@kcl.ac.uk
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Despite the importance of cessation, few studies have investigated smoking patterns after first stroke. Existing studies have included relatively small samples with short follow-up periods. Estimates of smoking cessation vary: one study found that 3 months after a subarachnoid haemorrhage (SAH), 37% of the smokers resumed smoking [4]; a study of 21 smokers attending stroke clinic appointments over a 2-year period found that none quit smoking [5]; and another study found that 6 months after stroke, one fifth of patients with a first stroke had quit [6]. Previous analysis of the South London Stroke Register (SLSR) suggested that 1 year after stroke, 41% of the smokers had quit [7].

Predictors of smoking resumption after a subarachnoid haemorrhage include the following: starting smoking at 16

years of age or younger; self-reported depression; and alcohol use [4]. Factors associated with smoking 6 months after stroke include male sex, absence of disability, living alone, and being a blue-collar worker [6]. Nonwhite ethnicity and institutionalization have also been found to be associated with quitting 3 months after stroke [7]. This study will investigate patterns of smoking cessation over a 3-year period after stroke, and will identify factors associated with quitting in the longer term, in a multiethnic population.

Methods

Participants

Data were derived from the SLSR, an ongoing population-based register of first-ever strokes among all age groups dating from January 1995. The WHO definition of stroke was used. The SLSR recorded hospitalized and nonhospitalized stroke cases within a defined multiethnic population of 271 817 in South London. The ethnic composition of the population was as follows: 63% white, 28% black (9% black Caribbean; 15% black African; and 4% black mixed), 5% Asian, and 4% other ethnic subgroups (as per the 2001 UK census). Overlapping sources of notification were used to ensure completeness of case ascertainment [8], including weekly telephone calls and visits to the wards of the seven hospitals serving the population; weekly screening of radiology records to identify stroke diagnoses; regular screening of death certificates/coroners' records for stroke; and primary care notifications received through general practitioners' surgeries. Case ascertainment has been reported as 88% complete [9]. Patients were interviewed in their homes by research fieldworkers, using a structured questionnaire with standardized measures, at the time of the index stroke, at 3 months, and at 1 year after stroke. Data were collected annually thereafter until death. The methods for the SLSR are complex and have been described in detail elsewhere [10].

Patients with first strokes registered between January 1995 and December 2003, who were smokers at the time of stroke and survived to 3 years, were included in the analysis. Patients without recorded smoking status at the 3-month, 1-year, and 3-year follow-ups were excluded.

Measures

Data were collected on patients' demographic characteristics at the time of stroke including age, sex, self-reported ethnicity, and socioeconomic status. Ethnicity was categorized into three groups: 'white', 'black' (black African, black Caribbean, and black other), and 'other' ethnic groups. Socioeconomic status was recorded using the Registrar General's classification of occupations [11], and was further categorized into nonmanual and manual occupations. Where participants were not working at the time of stroke or had retired, categorizations were based on their last known occupations. Data were collected on risk factors diagnosed prior to stroke, including atrial

fibrillation, diabetes, hypertension, and ischaemic heart disease. Hypertension was defined as general practice or hospital record, of high blood pressure (>140 mmHg systolic and/or > 90 mmHg diastolic) [12]. Ischaemic heart disease included diagnoses of myocardial infarction, heart attack, coronary thrombosis, or angina. Final diagnosis of stroke subtype was recorded as total anterior circulation infarct (TACI), partial anterior circulation infarct (PACI), posterior circulation infarct (POCI), lacunar infarct (LACI) [13], or haemorrhage combining primary intracerebral haemorrhage and subarachnoid haemorrhage – or as unclassified stroke. Disability was measured 7–10 days after stroke, using the Barthel Index. Scores were categorized as severe/moderate disability (0–14), mild disability (15–19), or independent (20) [14].

Measurement of smoking status

Smoking status was recorded at the time of stroke, and at 3 months, 1 year, and 3 years after stroke, using self-report [15]. Smokers were recorded as attempting to quit during the study period, if they reported not smoking at a follow-up interview (either at 3 months, or at 1, or 3 years). Relapse was used to describe smokers who reported having quit at a particular time point, but subsequently reported smoking again. The two key smoking cessation outcomes recorded were any reported quitting within the 3-year study period (defined as a quit attempt); and self-reported smoking status at 3 years after stroke. If patients reported not smoking at both 1 and 3 years, this was defined as maintenance.

Analysis

Univariate associations between sociodemographic variables, risk factors, stroke subtype, disability, and the two key smoking cessation outcomes (any reported quit attempt within the study period and smoking status at 3 years after stroke) were analysed using χ^2 tests. Multivariable logistic regression analysis, with variables entered simultaneously, was used to explore associations between age, sex, ethnicity, socioeconomic status, risk factors, stroke subtype, disability, and the two key smoking cessation outcomes. We also tested a model to investigate associations between these factors and maintenance of smoking cessation. Results were considered significant at $P < 0.05$. All analyses were performed using STATA (StataCorp, Texas, USA).

Ethics

Ethics approval was obtained from the research ethics committees at St Thomas' Hospital and King's College Hospital.

Results

During the study period, January 1995–December 2003, 980 patients reported smoking at the time of first stroke. Of these, 617 were excluded from further analysis (371 died

Table 1 Characteristics of the study population

	N (%)
Age (years)	
<55	69 (19.0)
55–64	90 (24.8)
65–74	132 (36.4)
75 +	72 (19.8)
Sex	
Male	229 (63.1)
Female	134 (37.0)
Ethnicity	
White	267 (74.2)
Black	67 (18.6)
Other	26 (7.2)
Socioeconomic status	
Nonmanual	90 (25.9)
Manual	258 (74.1)
Atrial fibrillation diagnosed prior to stroke	
No	324 (93.9)
Yes	21 (6.1)
Diabetes diagnosed prior to stroke	
No	297 (86.1)
Yes	48 (13.9)
Hypertension diagnosed prior to stroke	
No	120 (34.8)
Yes	225 (65.2)
Ischaemic heart disease diagnosed prior to stroke	
No	283 (82.0)
Yes	62 (18.0)
Stroke subtype	
TACI[a]	37 (10.3)
PACI[b]	93 (26.0)
POCI[c]	56 (15.6)
LACI[d]	100 (27.9)
Haemorrhagic	65 (18.2)
Unclassified	7 (2.0)
Barthel Index 7–10 days after stroke	
0–14, Severe/moderate disability	156 (50.8)
15–19, Mild disability	63 (20.5)
20 Independent	88 (28.7)

[a]Total anterior circulation infarct. [b]Partial anterior circulation infarct. [c]Posterior circulation infarct. [d]Lacunar infarct.

within the 3-year follow-up period and 246 did not have recorded smoking status at one or more follow-up). Complete data on smoking patterns were available for 363 smokers.

Characteristics of the study population are presented in Table 1. The population were younger [16] and less disabled [17] than stroke survivors in general: 159 (44%) individuals were aged < 65 years; 152 (42%) were independent in activities of daily living at 3 months.

Patterns of smoking cessation
Smoking patterns were mapped up to 3 years after stroke (see Fig. 1). A total of 258 (71%) smokers reported quitting smoking, at least one time point, within the first 3 years after stroke. Of these, 169 (66%) reported quitting at 3 months. A further 89 (25%), who had not quit at 3 months, subsequently quit at either 1 or 3 years. Thirty-six (10%) of those who reported not smoking at 3 months subsequently reported smoking again at both 1 and 3 years. In all, 105 (29%) did not give up within the 3-year study period. Sixty-two (17%) smokers quit immediately after stroke, and reported continued abstinence at all subsequent follow-ups.

Predicting cessation
Ethnicity and disability were significantly associated with quit attempts, that is, patients reported having quit at atleast one time point during the first 3 years after stroke (Table 2). Nonwhite ethnic groups were more likely to attempt quitting than white smokers. This included black

Fig. 1
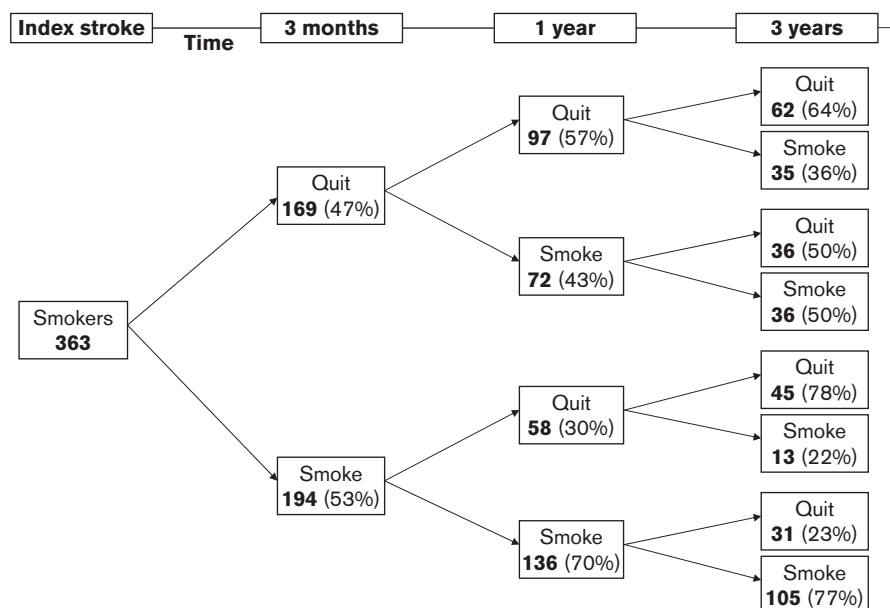
Patterns of smoking cessation 3 years after stroke.

Table 2　Factors associated with any reported quit attempt within the first 3 years after stroke

| | Total | Univariate analysis | | Multivariable analysis | | |
| | | No. reporting quitting at any time point within the first 3 years after stroke | | | | |
		N (%)	P	OR	CI (95%)	P
Age (years)	363					
<55	69	40 (58.0)	0.017	1.00		0.094
55–64	90	66 (73.3)		2.38	0.98–5.73	
65–74	132	93 (70.5)		1.36	0.63–2.92	
75 +	72	59 (81.9)		2.65	1.03–6.81	
Sex	363					
Male	229	159 (69.4)	0.367	1.00		0.498
Female	134	99 (73.9)		1.23	0.67–2.27	
Ethnicity	360					
White	267	178 (66.7)	0.010	1.00		<0.001
Black	67	57 (85.1)		6.20	2.39–16.10	
Other	26	20 (76.9)		5.27	1.07–26.09	
Socioeconomic status	348					
Nonmanual	90	63 (70.0)	0.978	1.00		0.784
Manual	258	181 (70.2)		0.91	0.48–1.74	
Atrial fibrillation	345					
No	324	226 (69.8)	0.276	1.00		0.708
Yes	21	17 (81.0)		1.26	0.37–4.28	
Diabetes	345					
No	297	205 (69.0)	0.258	1.00		0.836
Yes	48	37 (77.1)		0.90	0.35–2.35	
Hypertension	345					
No	120	79 (65.8)	0.201	1.00		0.580
Yes	225	163 (72.4)		1.19	0.65–2.17	
Ischaemic heart disease	345					
No	283	201 (71.0)	0.608	1.00		0.343
Yes	62	42 (67.7)		1.41	0.69–2.87	
Stroke subtype	358					
TACI[a]	37	26 (70.3)	0.732	1.00		0.187
PACI[b]	93	68 (73.1)		2.24	0.79–6.33	
POCI[c]	56	43 (76.8)		3.61	1.14–11.42	
LACI[d]	100	67 (67.0)		1.47	0.53–4.06	
Haemorrhagic	65	48 (73.9)		2.11	0.73–6.16	
Unclassified	7	4 (57.1)		0.86	0.10–7.43	
Barthel Index 7–10 days after stroke	307					
Severe/moderate disability	156	122 (78.2)	0.004	1.00		0.035
Mild disability	63	39 (61.9)		0.41	0.19–0.86	
Independent	88	53 (60.2)		0.48	0.23–0.99	

[a]Total anterior circulation infarct. [b]Partial anterior circulation infarct. [c]Posterior circulation infarct. [d]Lacunar infarct. CI, confidence interval; OR, odds ratio.

stroke survivors [Odds ratio, OR: 6.20; confidence interval (CI): 2.39–16.10], of whom 57 (85%) reported having quit smoking at atleast one time point during the 3-year period, compared with 178 (67%) white smokers. In the 'other' ethnic group (OR: 5.27; CI: 1.07–26.09), 20 (77%) reported quitting at atleast one time point during the study period. Patients with mild disability 7–10 days after stroke (OR: 0.41; CI: 0.19–0.86) or those who were independent (OR: 0.48; CI: 0.23–0.99) were less likely to report having quit in the first 3 years after stroke, compared with those who had severe/moderate disability. Age was also associated with attempts to quit within the study period, although this was not statistically significant at the 5% level. The oldest subgroup, aged 75 years and older, were more likely to report having quit at least one time point during the first 3 years after stroke (OR: 2.65; CI: 1.03–6.81).

Age and ethnicity also predicted smoking status at 3 years (Table 3). Older stroke survivors (75 years or older) (OR:

0.30; CI: 0.13–0.71) and black (OR: 0.30; CI: 0.15–0.60) or 'other' ethnic groups (OR: 0.29; CI: 0.09–0.96) were less likely to be smoking at 3 years after stroke.

The only independent predictor of maintenance was older age (data not shown), with patients aged 75 years and older more likely to report not smoking at 1 and 3 years after stroke (OR: 4.50; CI: 1.50–13.51).

Discussion
The majority of smokers in the sample reported quitting at atleast one time point during the first 3 years after stroke, but only a minority maintained cessation in the longer term. The pattern of smoking cessation was complex, with new reported quit attempts and subsequent relapses at different time points after stroke. Of those who did not quit early (by 3 months), the majority were still smoking at 3 years.

Table 3 Factors associated with quitting smoking at 3-year follow-up

| | | Univariate analysis | | Multivariable analysis | | |
| | | No. quit at 3 years' follow-up | | | | |
	Total	N (%)	P	OR	CI (95%)	P
Age (years)	363					
<55	69	26 (37.7)	0.014	1.00		0.024
55–64	90	42 (46.7)		0.57	0.26–1.27	
65–74	132	60 (45.5)		0.76	0.37–1.57	
75+	72	46 (63.9)		0.30	0.13–0.71	
Sex	363					
Male	229	104 (45.4)	0.209	1.00		0.569
Female	134	70 (52.2)		0.86	0.50–1.46	
Ethnicity	360					
White	267	115 (43.1)	0.010	1.00		0.001
Black	67	41 (61.2)		0.30	0.15–0.60	
Other	26	16 (61.5)		0.29	0.09–0.96	
Socioeconomic status	348					
Nonmanual	90	42 (46.7)	0.919	1.00		0.812
Manual	258	122 (47.3)		0.93	0.52–1.68	
Atrial fibrillation	345					
No	324	151 (46.6)	0.928	1.00		0.743
Yes	21	10 (47.6)		1.18	0.43–3.24	
Diabetes	345					
No	297	133 (44.8)	0.081	1.00		0.222
Yes	48	28 (58.3)		0.61	0.28–1.35	
Hypertension	345					
No	120	57 (47.5)	0.760	1.00		0.507
Yes	225	103(45.8)		1.21	0.69–2.12	
Ischaemic heart disease	345					
No	283	138 (48.8)	0.095	1.00		0.610
Yes	62	23 (37.1)		1.19	0.62–2.28	
Stroke subtype	358					
TACI[a]	37	17 (46.0)	0.996	1.00		0.761
PACI[b]	93	44 (47.3)		0.61	0.24–1.57	
POCI[c]	56	27 (48.2)		0.64	0.23–1.78	
LACI[d]	100	48 (48.0)		0.70	0.28–1.77	
Haemorrhagic	65	33 (50.8)		0.51	0.19–1.33	
Unclassified	7	3 (42.9)		1.32	0.16–10.80	
Barthel Index 7–10 days after stroke	307					
Severe/moderate disability	156	76 (48.7)	0.402	1.00		0.870
Mild disability	63	26 (41.3)		1.12	0.57–2.20	
Independent	88	36 (40.9)		0.93	0.48–1.78	

[a]Total anterior circulation infarct. [b]Partial anterior circulation infarct. [c]Posterior circulation infarct. [d]Lacunar infarct. CI, confidence interval; OR, odds ratio.

The fact that most smokers attempting to quit did so within the first 3 months might be related to the stroke event itself. Other authors have discussed the potential of 'teachable moments', where health events, such as the diagnosis of chronic disease or hospitalization, motivate individuals to adopt risk factor modifications such as smoking cessation [18]. The concept of teachable moments might be particularly important in the case of stroke, where risk of recurrence is highest in the period immediately following the index event [1].

In this sample, ethnicity and disability (measured 7–10 days after stroke) were significantly associated with any reported attempt to quit smoking within the first 3 years of stroke. Specifically, black and 'other' stroke survivors were more likely than white stroke survivors to report quit attempts. Nonwhite stroke survivors were also less likely to be smoking at 3 years after stroke. The relationship between black ethnicity and the increased probability of attempting to quit smoking might be complex. Recent analysis of the SLSR identified a survival advantage for black stroke patients and more active management of modifiable risk factors before stroke (specifically through medication use) was found among black Africans and black Caribbeans [19]. There is little detail about differences in stroke secondary prevention between ethnic groups. A study of diabetics aged 35 years or older found that black and Hispanic people more frequently engaged in preventive care practices than whites. Compared with white diabetic patients, black diabetic patients were more likely to attempt smoking cessation [20]. The association between black ethnicity and smoking cessation might reflect cultural differences in smoking behaviour or other factors not examined here.

Participants in the oldest age group, 75 years or older, were more likely than younger stroke survivors to report quit attempts during the study period and to report not smoking at 3 years. They were also more likely to

maintain smoking cessation (report not smoking at both 1 and 3 years after stroke). These findings might reflect reduced access to cigarettes because of a greater likelihood of impaired mobility or of living in institutionalized settings. They might also be related to an increased likelihood of comorbidities, although in this sample, the presence of atrial fibrillation, diabetes, hypertension, or ischaemic heart disease did not predict quit attempts, smoking status at 3 years, or maintenance of smoking cessation after stroke. We did not, however, explore the presence of smoking-related diseases, such as chronic obstructive pulmonary disease, which could potentially influence smoking behaviour.

A study comparing diseased smokers (with diabetes, hypertension, or ischaemic heart disease) with disease-free smoking controls found that desire to quit was significantly greater amongst diseased smokers. Following a subsequent stop-smoking intervention, however, the number quitting at the 18-month follow-up was low [21]. In our sample, the majority made attempts to quit, but only a minority maintained cessation in the longer term.

Patients with mild or no disability 7–10 days after stroke were significantly less likely to report quitting at atleast one time point in the first 3 years after stroke. Disability at 7–10 days after stroke was, however, not associated with smoking status at 3 years. The stroke event and the resulting disability might be associated with early cessation attempts because of the perceived severity of the condition or because of physical/cognitive disabilities, which reduce access to cigarettes and impair the physical act of smoking. Three years after stroke, the initial level of disability might no longer be an important factor for smoking cessation.

The results add to previous findings in which short-term predictors of smoking cessation had been identified. Our results have public health implications for smoking cessation interventions. Typically most stroke survivors have at least one contact with health services in the first 3 months after stroke [22], the period during which most risk factor-modification advice is likely to be given. In the years following stroke, contact with stroke-specialist services declines and responsibilities for secondary prevention are passed on to generalists in primary care. Consequently, support and advice for smoking cessation might be less frequent. Our results demonstrate a need for targeted cessation interventions, both early after stroke and later.

The study has strengths and limitations. We relied upon self-report to record smoking status. Other studies have also used this measure [5–7]. Whilst there are recognized biochemical validation techniques, such as cotinine or carbon monoxide testing, self-report has been found to be valid for use in most studies, particularly observational studies such as this, which do not focus on groups such as students, who are known to give unreliable self-reports [15]. Estimates of smoking cessation in patients with coronary heart disease have, however, shown discrepancies between self-report and serum-cotinine measures. Although an association was found between self-reported smoking and secondary cardiovascular disease events, the association became stronger when cotinine-validated smoking status was used [23]. The authors suggest that relying on self-report alone might result in the underestimation of the benefit of smoking cessation [24]. In the present study, the majority of patients did not report sustained cessation. It is, however, conceivable that cotinine validation of smoking status could potentially change the absolute numbers of smokers, if not the pattern of smoking behaviour. This study recorded smoking status at the time of stroke and at three subsequent follow-up points. The availability of data at multiple time points is one of the strengths of this study, although there was no information about smoking behaviour between these time points. We therefore demonstrate patterns of cessation at distinct points over a 3-year period rather than present a complete picture of smoking behaviour throughout this period. The initial sample of first strokes registered was large, but because we aimed to investigate longer term smoking patients, a large proportion were non-smokers, died within the study period or did not complete follow up, the size of the study population was limited. Therefore, some selection bias cannot be ruled out. Another limitation of the size of our study population is that survival analysis of the impact of smoking cessation was not possible.

Summary
This study has demonstrated complexities in patterns of smoking cessation after stroke.

Around half of smokers continued smoking after stroke, but went on to quit in subsequent years. This suggests that smokers who do not quit early after stroke might still benefit from cessation interventions. Of those who do quit early after stroke, just under half relapse, and are smoking again at 1 year. Early cessation does not necessarily result in continued abstinence. More research is needed to understand the potential of interventions to support smoking cessation after stroke and to prevent relapse.

Acknowledgements

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