

Stroke in South Alabama: Incidence and Diagnostic Features — A Population Based Study

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SUMMARY This study has attempted to identify all persons from an area of southern Alabama who had a stroke in 1980 and were hospitalized. Data were gathered on disease onset, clinical course, laboratory results, history of risk factors, and outcome. The age-adjusted incidence rates for initial stroke were 109 per 100,000 for whites and 208 per 100,000 for blacks. Age-specific rates were higher in blacks than whites, and highest for black females.

The distribution of cases by type of stroke was: atherothrombotic (6%), embolic (26%), lacunar (13%), infarction of unspecified origin (40%), parenchymatous hemorrhage (8%), subarachnoid hemorrhage (6%), and unidentified type (1%). Blacks had higher incidence rates for hemorrhages, and black females had the highest incidence rate for lacunar stroke. The overall stroke incidence rates in this series were not significantly higher than those from prior population studies, suggesting that southern Alabama is not part of the so-called "Stroke Belt" area of the southeastern United States.

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ALTHOUGH STROKE INCIDENCE and mortality rates are reportedly higher in the southeastern regions of the United States, and higher among blacks than whites,¹⁻⁴ factors which influence these patterns of differential susceptibility to stroke are not well understood. In addition, little is known about differences between blacks and whites with respect to incidence and outcome by subtype of stroke, although clinical evidence suggests such differences may exist.⁵ The present study was designed to evaluate these factors.

Methods

As a part of the pilot Stroke Data Bank,⁶ clinical data were obtained on all persons aged 20 or older from three bi-racial communities in southern Alabama who had a stroke in 1980 and were hospitalized. Over 50% of the patients were personally examined by a study neurologist (CSK or JPM).

South Alabama Study Population

The study population (table 1) was drawn from the 103,358 persons (1980 Census) residing in three areas of south Alabama: the Three-Mile community of Mobile County, an urban area of 16 adjacent census tracts from the Mobile Standard Metropolitan Statistical Area (SMSA) with 53,362 residents, most of whom are black; the Daphne-Fairhope Bayshore communities of Baldwin County, a five tract area of the Mobile SMSA containing 27,345 persons, including many retired whites; and nearby Monroe County, a sparsely populated and rural area of 22,651 persons.

Case Ascertainment

Potential cases were identified through prospective screening of hospital admission and discharge diag-

noses and by direct referrals. Local Professional Standards Review Organization (PSRO) data indicated that over 95% of the hospitalizations of residents from the study population would be to twelve south Alabama hospitals. About forty percent of the eligible patients were admitted to the University of South Alabama Medical Center. Here, stroke patients are preferentially admitted to the Neurology service, under the direction of the study neurologists. Admission lists were also reviewed daily for stroke patients admitted to other services. A study neurologist personally examined and followed the course of each case of stroke through hospitalization and up to one year post-discharge. Weekly review of all hospital discharge diagnoses were conducted to ensure that no eligible patients were missed.

At the eleven other hospitals, preliminary information on all persons admitted with stroke or stroke-related symptomatology whose home address zip code overlapped the study areas was provided by persons in Admissions or Medical Records Departments who were contacted weekly or bi-weekly by study investigators. Patients satisfying study criteria were then culled from this group. Study neurologists examined all patients still hospitalized when notice of their admission was received in time. Discharge diagnoses were received monthly to assure coverage. Notification of stroke admissions was also solicited through study publicity, and this served to verify the completeness of the hospital surveillance. Finally, the coroner's office for south Alabama provided information on deaths attributed to cerebrovascular disease, and while no additional patients were identified by this source, it also served to verify the completeness of case ascertainment.

Diagnosis

The World Health Organization⁷ definition of stroke was used. Stroke was further classified into subtypes based on a schema developed for the NINCDS Pilot Stroke Data Bank.⁶ This schema attaches a degree of certainty to each diagnosis based on available clinical and laboratory findings, primarily CT scan and angio-

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TABLE 1 Age, Sex and Race Distribution of the South Alabama Study Population, 1980 US Census

Race	Sex	Age				Population aged 20+	Total population
		20-54	55-64	65-74	75 and Over		
White		16,741	3,967	2,940	1,835	25,483	39,954
	male	8,110	1,822	1,294	722	11,948	19,065
	female	8,631	2,145	1,646	1,113	13,535	20,529
Black		21,906	4,826	2,938	1,499	31,169	63,225
	male	9,474	2,298	1,266	622	13,660	29,949
	female	12,432	2,528	1,672	877	17,509	33,276
Total*		38,647	8,793	5,878	3,334	56,652	102,819

*539 persons, non-white and non-black, were excluded from the study population.

gram. Four types of infarction (atherothrombotic, lacunar, embolic, and of unspecified origin) and two types of hemorrhage (parenchymatous and subarachnoid) are recognized.

Risk Factors

As part of a detailed medical history interview, data on the following risk factors for stroke were collected: hypertension, diabetes, and coronary heart disease. History of hypertension was determined from the patient or family's report of diagnosis or treatment, or from previously recorded pressures of greater than 160 systolic or 95 diastolic. History of diabetes mellitus was determined by previous treatment or from records of a distinctly abnormal fasting blood sugar level and/or glucose tolerance test. History of coronary heart disease was considered positive if any of the following conditions were found: angina pectoris, coronary insufficiency, myocardial infarction, congestive heart failure or cardiac arrhythmia. History of these conditions was determined according to definitions provided by the Pilot Stroke Data Bank.⁶

Results

Between January 1, 1980 and December 31, 1980, 160 residents of the study area had a stroke and were hospitalized. Eighty-seven percent (139 cases) had their first stroke in 1980. Fifty-six percent (89 cases) were female and sixty-seven percent (107 cases) were black.

Annual Incidence

Based on the 139 first strokes, the crude incidence rate was 135 per 100,000 persons, 144 per 100,000 for blacks and 121 per 100,000 for whites. The incidence rates rose steeply with age. Among whites, the age specific incidence rates for males were always higher than those of females (table 2). Age-adjusted incidence rates were 159 per 100,000 persons, both races, 109 and 208 per 100,000, for whites and blacks, respectively (indirect method of adjustment, standard rates obtained from the National Survey of Stroke⁸). Black females had the highest age-adjusted incidence rate.

The 160 cases were classified as infarctions [atherothrombotic (6%), embolic (26%), lacunar (13%), and of unspecified origin (40%)], hemorrhages [parenchy-

matous (8%) and subarachnoid (6%)], and a small group of unidentified type (1%) (table 3).

Diagnostic Support

CT scans were part of the diagnostic examinations for 80% of the cases. CT scans were performed on all cases with hemorrhagic stroke, on 89% of the atherothrombotic infarction cases, and on 75% of the patients with infarctions of unspecified origin. Initial CT scans were normal in half of this latter group and in 63% of lacunar cases. Arteriographic studies were performed in 37% of the 160 cases, almost always after the CT scan had failed to clarify the stroke type. Other laboratory studies were either normal or non-contributory. Overall, 38% (61 cases) received one or more EEG studies, the frequency varying by diagnostic subtype from a low of 15% for infarctions of unspecified origin to a high of 60% for the lacunar infarct cases. Oculoplethysmography, static brain scans, dynamic brain scans, lumbar puncture and Doppler studies were performed infrequently, in 11%, 10%, 8%, 8%, and 7% of the patients, respectively.

The diagnosis of *atherothrombosis* was based entirely upon a positive angiogram, all 9 cases showing occlusion of a major artery. The 42 cases of *embolism* included cases with both cardiac and extracranial arterial source, and they were diagnosed by a variety of criteria (table 4). In a substantial number of cases diagnosed as embolism (12/42) the basis for the diagnosis was "Clinical Grounds." This implied the sudden onset of a focal deficit in the distribution of a branch of a cerebral artery, associated with laboratory data that were either non-diagnostic (7 cases) or not available (5 cases). This group of cases should be labelled as "probably" or "possibly" embolic in nature, since positive documentation of such etiology was not obtained. Included in this category were 4 cases with cardiac embolic source, as well as 3 others with an angiographically patent intracranial branch in whose distribution the clinical deficit occurred. The latter situation is considered compatible with embolism, as the unstable embolic material frequently undergoes early fragmentation and distal migration (with reopening of previously occluded branch), a phenomenon not known to occur in arterial occlusions of atherothrombotic nature.⁹ The diagnosis of *lacunes* was

TABLE 2 Number of Cases and Incidence* Rates for Stroke, South Alabama Study Population, 1980

White									
Age	Male number of strokes			Female number of strokes			Total number of strokes		
	All	First	Incidence rates	All	First	Incidence rates	All	First	Incidence rates
20-54	5	4	49	4	3	35	9	7	42
55-64	5	5	274	6	5	233	11	10	252
65-74	8	7	541	6	6	365	14	13	442
75+	11	10	1,385	8	8	719	19	18	981
All ages	29	26		24	22		53	48	
Crude rate			136			107			121
Age-adjusted rate†			139			88			109

Black									
Age	Male number of strokes			Female number of strokes			Total number of strokes		
	All	First	Incidence rates	All	First	Incidence rates	All	First	Incidence rates
20-54	7	3	32	9	8	64	16	11	50
55-64	14	13	566	19	18	712	33	31	642
65-74	16	14	1,106	19‡	16	957	35	30	1,021
75+	5‡	3	482	18	16	1,824	23	19	1,268
All ages	42	33		65	58		107	91	
Crude rate			110			174			144
Age-adjusted rate†			172			236			208

*Rate of initial strokes per 100,000 persons.

†Age-adjusted rates based on the NINCDS National Survey of Stroke,⁸ indirect method.

‡One case had unknown prior stroke history in each of these categories.

based on the highly characteristic clinical picture,¹⁰ and in only 4 cases by positive CT scan. The category of *infarction of unspecified origin* contained 64 patients, 13 of whom had no laboratory studies. Among the remaining 51 cases, 28 had abnormalities noted on

the CT scan or angiogram; however, the mechanism for the ischemia could not be determined from the radiologic abnormalities or the clinical details of the stroke onset, general and neurological examination, and associated medical illness. The same problem

TABLE 3 Overall Incidence Rates* for Stroke by Diagnostic Category, Race and Sex South Alabama Study Population, 1980

		Diagnosis					
		Total†	Athero- thrombotic infarction	Unspecified origin infarction	Embolic infarction	Lacunar infarction	Parenchy- matous hemorrhage
All cases		160(100)‡	9(6)	64(40)	42(26)	20(13)	13(8)
crude rate		282.4	15.9	113.0	74.1	35.3	22.9
White							
male	number	29(100)	0	9(31)	12(41)	5(17)	2(7)
	rate	242.7	0	75.3	100.4	41.8	16.7
female	number	24(100)	0	10(42)	6(25)	2(8)	1(4)
	rate	177.3	0	73.9	44.3	14.8	7.4
Black							
male	number	42(100)	5(12)	13(31)	15(36)	4(10)	5(12)
	rate	307.5	36.6	95.2	109.8	29.3	36.6
female	number	65(100)	4(6)	32(49)	9(14)	9(14)	5(8)
	rate	371.2	22.8	182.8	51.4	51.4	28.6

*All strokes per 100,000 persons aged 20 and over.

†Includes 139 initial stroke cases, 19 recurrent stroke cases, 2 cases with unknown CVD history. Three cases which had other stroke diagnoses are in the total but not listed by diagnosis.

‡Numbers in parentheses are the proportions of cases in each diagnostic category.

TABLE 4 Criteria for Diagnosis of Embolism

Method	Number of Cases
Autopsy	2
Angiography	15
alone	(5)
abnormal CT Scan	(10)
Abnormal CT scan*	13
alone†	(10)
normal angiogram‡	(3)
Clinical grounds§	12
normal CT scan	(4)
normal angiogram	(3)
no laboratory results	(5)
	42 cases

*Area of infarction (low attenuation) in distribution of subdivision (branch) of intracranial artery.

†Includes 8 cases with atrial fibrillation, and 2 cases of sudden focal stroke in a young adult.

‡Angiographically patent branch supplying area of CT-demonstrated infarct.

§Includes 4 cases with cardiac source.

arose in attempts to determine the mechanism of ischemia responsible for the 23 patients with negative angiograms or CT scans. Twenty-one of these 23 patients had only a single CT scan study, all performed within 3 days of onset.

Age, Sex, and Race

The average age of patients differed greatly among stroke subtypes and between race/sex groups. Considering the six major stroke subtypes, subarachnoid hemorrhage patients were youngest (average age 55 years) while patients with infarctions of unspecified origin were oldest (average 70 years). Black males and females were on the average, the same age or younger than their white counterparts for each subtype, except for parenchymatous hematoma, which occurred in only one white female (table 5).

The category subarachnoid hemorrhage was composed entirely of females. For other subtypes of stroke, sex differences were less extreme. Incidence of embolic infarctions in males was twice that observed for females, regardless of race. Blacks had higher incidences than whites for all stroke subtypes (table 3).

Risk Factors for Stroke

A history of hypertension was more frequent in blacks (74% compared with 41% of whites) as was diabetes mellitus (27% versus 18%). In every stroke subtype more blacks had history of hypertension than whites. Despite the close association observed between history of hypertension and diabetes (27 out of 98 hypertensives in this study were also diabetic), only one patient out of 21 with a diagnosis of hemorrhage was diabetic, despite 15 of the 21 being hypertensive.

Among the subtypes of infarction, regardless of race, lacunar infarct cases had the largest frequency of hypertension, while those with embolism had the least.

Information concerning a history of coronary heart

disease (angina pectoris, coronary insufficiency, myocardial infarction, congestive heart failure or cardiac arrhythmias) was available on 129 of the patients. Those with embolic infarction had the highest rate of previous heart disease (51%) while those with subarachnoid hemorrhage had the lowest (11%).

Follow-up

Data was available for most patients in this study up to June 1983, over two years beyond the end of the study period. Most deaths occurred within three months from onset of stroke. The majority of these deaths (89%) occurred in the hospital, the underlying cause attributed to stroke in 77%. Subarachnoid hemorrhage was fatal for six of nine cases within two weeks of onset. Five of 13 parenchymatous hemorrhage cases died, four in the first week. The case fatality rates among infarction patients were lower, ranging from 10% among lacunar infarction cases to a high of 33% among the cases with atherothrombotic infarction. Level of consciousness on first neurological examination was related to survival: 80% in coma died, compared with death in only 11% of those responsive, based on 90 patients tested.

Case fatality rates were determined for the first 30 days, 90 days, and one year. In the first 30 days, 35 patients died (22%). By 90 days, three more had died, yielding a three month fatality rate of 24%. Nine additional patients died by the end of the first year after their stroke, for a one year fatality rate of 29%.

Discussion

Incidence Rates

The data in the present study argue against the existence of a "Stroke Belt" in south Alabama, as the age specific incidence rates for whites are comparable to those from the National Stroke Survey⁸ and recent European reports.^{11, 12} They are lower than those for Rochester, Minnesota,¹³ except in the age group 45–54 years. They are lower than those of Evans County¹ for both races. South Alabama rates are comparable to the Mid-Missouri⁴ rates for whites, while for blacks, south Alabama rates are higher in the under 55 and 55 to 64 age intervals. South Alabama rates also approximate age specific rates for blacks in the Harlem study¹⁴ although the latter were higher in the under 45 age group. Information on racial differences in the United States is now over a decade old.^{1, 4, 14} Changes in methods of diagnosis since that time may be responsible for some of the differences noted, as might the decline in stroke incidence,¹⁵ which has probably occurred nationally. We believe it is unlikely that our figures of stroke incidence are artifactually low due to incomplete case ascertainment. As detailed in the "Methods" section, case ascertainment was conducted through a rigorous process of patient identification followed by all participating hospitals, and it is improbable that hospitalized cases were missed. However, no capturing mechanism existed for cases of stroke that may have not been admitted to a hospital or who were never seen by a physician, and this may have

TABLE 5 Average Age at Diagnosis by Race, Sex and Diagnostic Category, South Alabama Study Population, 1980

		Diagnosis						
	Total	Athero- thrombotic infarction	Unspecified origin infarction	Embolic infarction	Lacunar infarction	Parenchy- matous hemorrhage	Subarachnoid hemorrhage	Other
All cases	67(160)*	62(9)	70(64)	68(42)	64(20)	60(13)	55(9)	65(3)
White	69(53)	0	71(19)	70(18)	65 (7)	66 (3)	57(3)	65(3)
male	68(29)	0	65 (9)	70(12)	65 (5)	73 (2)	0	70(1)
female	70(24)	0	77(10)	72 (6)	64 (2)	53 (1)	57(3)	62(2)
Black	66(107)	62(9)	70(45)	67(24)	63(13)	59(10)	54(6)	0
male	64(42)	65(5)	65(13)	65(15)	64 (4)	58 (5)	0	0
female	67(65)	59(4)	72(32)	71 (9)	63 (9)	60 (5)	54(6)	0

*Number of cases is in parentheses.

accounted for missing cases of new stroke during the study period. The occasional instance of a stroke of such mild or transient character that allows for total care at home without the participation or knowledge of a health professional could have escaped detection by the methods used in this study. An estimation of the size of such sample of patients cannot be provided by the present study, and the conclusions achieved should thus apply to hospitalized cases of stroke.

Sex differences¹⁶ are evident in subarachnoid hemorrhage where females predominate, but not in cerebral hemorrhage. Cerebral infarctions occur more in men (1.45:1), based on European, Japanese and northern U.S. studies. Studies of blacks in the U.S. have generally reported no differences between the sexes in incidence for all types of strokes combined,^{1, 4, 14} but have either had too few cases or insufficient diagnostic information to report on differences by stroke subtype. Compared with black females, black males in the present study suffered over twice the rate of embolism, and experienced slightly more frequent parenchymatous hematoma and atherothrombotic infarction.

While the sex ratios for stroke among whites in southern regions of the U.S. has been reported to be as much as 3.55:1 for men,¹ the south Alabama study observed a sizeable although lower sex ratio of 1.58:1 (based on age-adjusted rates).

Risk Factors

The prevalence of hypertension in the U.S. is estimated to be about 30% for blacks and 20% for whites (age 18–74),¹⁷ figures which were exceeded for all stroke types with the possible exception of embolic infarction.

The association between diabetes mellitus and cerebral infarction has been noted in the Framingham study,¹⁸ but this relationship could not be ascertained satisfactorily in the present study due to small numbers.

Mortality Rates

Our 3-month mortality rate of 24% is lower than the 30% to 36% reported in prior studies from Western countries^{3, 14, 19} and the 53% (males) to 68.2% (females) rates found in Shibata, Japan.²⁰ The extremely

high mortality figures from the latter report are in part explained by the higher frequency of the poor prognostic group of hemorrhagic strokes (intracerebral and subarachnoid). A ratio of 2:1 for non-hemorrhagic: hemorrhagic stroke subtypes was found in the Japanese study, while those ratios are in the 6:1 to 5.5:1 range in most studies reported from Western countries.^{6, 11, 12, 14, 18, 19, 22} The differences in mortality rate between our study and others reported from Europe¹⁹ and the United States^{3, 14} are substantial and they are not explained by differences in the relative frequency of hemorrhagic and non-hemorrhagic subtypes. A low in-hospital mortality rate comparable to ours (19%) has been recently reported by Yatsu *et al*²¹ from analysis of 3,500 stroke cases from 3 communities in the United States. It is conceivable that the lower mortality figures found in their study and ours represent a new trend towards better vital prognosis for patients hospitalized with stroke, perhaps as a result of modern aggressive medical and surgical management of stroke patients.

Diagnosis Subtypes

The frequency of the two large categories of ischemic and hemorrhagic strokes is essentially identical to that reported in previous studies.^{6, 8, 22–24} However, within the broad category of ischemic strokes, the four subtypes recognized in this study include not only thrombosis and embolus, but also lacunar infarction and infarction of unspecified origin. The existence of a large category of infarctions of unspecified origin is not simply a lack of diagnostic inquiry, as 83% of patients in the study underwent CT scan or angiogram or both. Instead, the group reflects the difficulties encountered in attempting to distinguish four subtypes of stroke among a group of cases formerly labelled either thrombotic or embolic stroke. In most earlier studies,^{1, 4} a diagnosis of thrombosis or embolism was made largely on clinical criteria. In recent years, the category of infarction of unspecified origin has been created to account for those cases whose mechanism for ischemic damage is uncertain. The obvious reason for classification to this stroke subtype applies to the 26% of our cases without laboratory studies. In another 31%, the timing of the studies was not favorable to

demonstrate the lesions, either because the CT scan was performed on the day of onset of the stroke, or the angiogram was performed beyond the first few days, during which time most embolic occlusions cannot be documented angiographically.²² However, in the remaining 43%, although the studies were done in a timely fashion, they either failed to yield a diagnostic abnormality or the available clinical and laboratory data did not permit a reliable diagnosis of the stroke subtype. This last group confounds current efforts to make an accurate diagnosis of stroke subtypes and remains a major problem in clinical and epidemiologic research.

In this study, only those cases whose angiograms demonstrated large artery stenosis or occlusion were diagnosed as atherothrombosis, a requirement that yielded a low 6% of cases for this diagnosis. Other cases of ischemia were labelled as 'infarction of unspecified origin' on account of any of the following: angiograms showing no large artery stenosis or occlusion; angiographic abnormalities present in vascular territories not relevant to the clinical presentation; studies inconclusive or not performed at all. These findings suggest the category of thrombosis may have been over-used in the past as a convenient category for almost all cases of ischemia having no obvious cardiac source. In an effort to reconcile our data with the high frequency of atherothrombosis diagnosed in the past,^{1, 4, 13, 23} we reclassified our patients. First, the 21 cases of lacunar infarction were added, since earlier classifications of stroke lumped such cases under a category of thrombosis. Then the 64 cases of infarction of unspecified origin were arbitrarily reclassified using purely clinical criteria, which yielded another 38 cases for thrombosis, based simply on advanced age or the presence of diabetes mellitus. These two changes raised the total attributed to thrombosis due to atherosclerosis to 67. This recalculated frequency of 42% approaches the high rates for thrombosis which have been reported elsewhere. However, it must be emphasized that in only 8 of these 67 cases was the mechanism of large artery atherothrombotic disease documented. This finding has potential therapeutic implications as it suggests large artery atherothrombosis occurs at a far lower frequency than that inferred in earlier classifications.

There are no previous reports of the incidence of lacunar infarction. The frequency of lacunar infarction is difficult to compare as well, since it has been recognized heretofore only in one publication which reported hospital-based stroke registry data.²² In that study, largely on clinical criteria, 13% were labelled as lacunes, a figure comparable to the present study. The value of CT scanning in demonstrating the lesions has been recently documented.^{25, 26} but many forms of lacunes remain a clinical diagnosis only, due to their small size and inability to be visualized by current CT scanners. Future developments in scanning may improve the laboratory support for this diagnosis.

The high frequency of embolism (26%) is comparable only with the earlier findings of the Harvard Stroke

Registry,²² which used similar criteria for diagnosis of this stroke subtype. By contrast, using more traditional criteria, Wolf et al¹⁸ reported embolism in 15% of the strokes (41 of 168) from Framingham. Yet the proportion of ischemic strokes, of which embolism is a part, in Framingham (83%) was similar to that of South Alabama (86%). Although the higher frequency of embolism in south Alabama could be attributed simply to arbitrary differences in definitions and to geographic variation, we suspect it also reflects the impact of improvements in diagnostic techniques: 76% of our cases were diagnosed by combined radiographic and clinical criteria.

Subclassification of ischemic infarctions poses a major diagnostic challenge to the clinician, and tradition might encourage one to circumvent these difficulties, particularly for epidemiologic studies, by resorting to the simplistic thrombus/embolus dichotomy. However, spurred on by increasingly sophisticated and informative diagnostic methods, current trends in clinical research are aimed at refinement of diagnosis, leading to identification of subgroups of patients with similar stroke mechanisms to be selected for therapeutic or rehabilitative intervention and prevention studies. To adequately assess the possible benefits of such studies comparably classified epidemiologic reports are needed. We intend this to be one of the first such reports.

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Declining Incidence and Mortality of Stroke?

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SUMMARY The incidence and mortality from stroke in Espoo-Kauniainen, Finland, in 1972-73 were compared to the incidence and mortality from stroke in the same area 1978-80. The factors at the acute stage influencing case fatality were also analyzed. A declining trend in age-adjusted incidence of stroke was observed, though failing to reach statistical significance. The greatest decline was seen in the incidence of cerebral hemorrhage in men, with a statistically significant difference. The incidence of subarachnoid hemorrhage also decreased, and in women the decline was significant. There was no decrease at all of the incidence of cerebral infarction. The total mortality displayed no clear declining trend. However, the mortality from cerebral hemorrhage after three months from stroke had gone down from 72% to 59%. The most important factors responsible for increased case fatality were: lowered level of consciousness, cerebral hemorrhage and old age. The case fatality was also higher for women than for men. Previous heart diseases increased the mortality, but hypertension, diabetes, pure myocardial infarction and previous transient ischaemic attacks had no influence on mortality. The cause of decline in the incidence of cerebral hemorrhage might be improved care of hypertension: the decline in the incidence of subarachnoid hemorrhage however remains unclear.

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MANY REPORTS ARE FOUND in the literature on the declining incidence and mortality of stroke.¹⁻⁵ This has mostly been attributed to improved care of hypertension, which is the most important risk factor of stroke. In a recent report,⁶ about one fifth of the Finnish population had hypertension. Espoo and Kauniainen, two towns in South Finland were an object for a

stroke register from 1st January 1972 to 31st December 1973.⁷ The mean population during the study period was 113,000 (means of the January 1, 1972 and January 1, 1973 figures). The total incidence of stroke was 126.5 per 100,000 annually and if only new cases are included, 107.8 per 100,000 annually. The mortality after three months from stroke was 40%.

The purpose of the present study was twofold: firstly, to compare the incidence and mortality of stroke with those reported in the study of Aho.⁷ Therefore, a stroke register was kept in the same area during 1978-80. The second aim was to analyze the factors at the acute stage influencing the case fatality.

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