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Cost of stroke in Sweden: An incidence estimate

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Objectives: To estimate the excess cost of stroke in Sweden and the potential costs that could be avoided by preventing first-ever strokes.

Methods: We adopted the incidence approach for estimating the present value of both direct and indirect costs. Data on mortality, stroke recurrence, and inpatient care were estimated from a national register of patient data with a four-year follow-up period. To estimate costs for social services, we used survey data on living conditions before stroke onset and at three and at twenty-four months. Costs for outpatient visits, rehabilitation, drugs, and production losses due to premature death and early retirement were estimated on the basis of both published and nonpublished sources. Lifetime costs were based on life tables adjusted for excess mortality of stroke, and costs in year 4 were extrapolated to subsequent years.

Results: The present value direct cost for an average stroke patient is SEK513,800 (US\$56,024 or Euro60,825). The corresponding indirect cost is SEK125,110 (US\$13,640 or Euro14,810). Almost 45 percent of the direct costs were attributable to social services. Women had higher costs than men, and costs for survivors increased with age due to social services.

Conclusions: With an incidence of 213 first-ever strokes per 100,000 individuals, the total excess direct and indirect cost of stroke would be SEK12.3 billion (approximately US\$1.3 billion or Euro1.5 billion). Hence, there are large potential cost offsets both in the health-care sector and in the social service sector if the incidence of first-ever stroke could be reduced.

Keywords: Stroke, Incidence cost, Cost of illness, Sweden

The prognosis for surviving stroke events has improved due to new technologies and rapid medical response with specialized staff (18;29;30). The Swedish National Quality Registry for Stroke Care (Riks-Stroke) has registered acute stroke patients at Swedish hospitals since 1995. Approximately 20,000 first-ever and recurrent stroke events have been recorded annually, which is estimated to be three quarters of all stroke events in Sweden, whereof 72 percent (19,200 patients) were first-ever strokes (213 per 100,000 individuals; 10).

Several studies have estimated that stroke care accounts for approximately 2 to 4 percent of total health-care expenditures in some European countries (8;12;16;20). A recent cost-of-illness study in Australia (7) estimated the total first-year cost of all first-ever strokes to be US\$395 million, or US\$13,500 per event (1997 values), in line with results from the United Kingdom (2;4). In Sweden, estimates of the excess direct cost per patient for first-ever strokes range between US\$8,100 (1994 prices) and US\$10,513 (1991 prices) over

the first twelve months, depending on included cost items (28;32). For subsequent years, the picture is less complete and estimates range from US\$5,406 (1983 prices) to US\$19,582 (1991 prices; 19;28). Indirect costs vary substantially between studies mainly because of differences in the mode of calculation. For example, it was estimated that indirect costs constituted 58 percent of total lifetime cost per person in the United States (27), 22 percent to 24 percent of the annual costs of stroke in the Netherlands and Sweden (8;28), and 6 percent of the first-year cost per patient in Australia (7).

As life expectancy has increased for stroke survivors and new treatment patterns may alter the prevailing cost structure, Swedish studies on stroke-related costs for subsequent years need revision. Updated information is useful, in particular for evaluating new technologies that prevent strokes. For these purposes, we estimate the excess direct and indirect discounted costs of stroke for surviving patients in Sweden over a four-year period. Lifetime present value costs are calculated on the basis of life tables adjusted for the excess mortality of stroke, and costs are extrapolated linearly from year 5.

METHODS

We use the incidence-based approach for this cost of illness study, using data on a cohort of first-ever stroke events. The definition of stroke is limited to ICD10-codes I61, I63, and I64. Information on patients' living conditions before the stroke event allows us to estimate the *excess cost* of stroke, that is, only costs directly related to the stroke are included. As many of these costs are incurred in the future, we calculate the lifetime present value cost (PVC_t), discounted to the time of the primary stroke t , which is expressed as:

$$PVC_t = \sum_{n=1}^W \left[\frac{P_{t,n+1} * AC_{t,n+1}}{(1+r)^n} \right],$$

where $P_{t,n+1}$ is the probability that a person of age t at stroke onset will survive to age $n+1$, $AC_{t,n+1}$ is the annual costs for a person surviving to age $n+1$, r is the discount rate (3 percent), and W the maximum lifetime (19).

Direct costs include both medical (hospitalizations, drugs, outpatient visits, rehabilitation) and nonmedical costs (nursing home, domestic aid). Indirect costs are estimated in accordance with the human capital approach and include production losses due to deaths and early retirement up to the age of sixty-five, the official retirement age in Sweden. Patients lost to follow-up are assigned the average values of the age-cohort. All statistical analysis are performed in SPSS for Windows, version 11.5.1 (SPSS, Inc.), and a two-sided p value ($<.05$) is considered significant.

Data

The Riks-Stroke register includes a questionnaire administered to patients in the acute phase with follow-up at three

months (1). From this register, we use patient-level data, including age, gender, living conditions and domestic aid needs, diagnosis, and admitting ward. In 1999, a two-year follow-up survey was performed on patients who suffered a stroke during the first six months of 1997 (22).

Patients' need for domestic aid is estimated by summing the help scores (in parentheses): a, mobility outdoors (1); b, mobility in- and outdoors (2); c, help with clothes (1); and d, help with toilet visits (1). The total assistance score thus ranges from zero (no assistance) to four (help outdoors, assistance in- and outdoors, with toilet visits, with clothing). Above a score of 4, the patient is supposed to be living in old people's homes.

We assume that patients living in service flats or old people's homes before the stroke continue to consume at least the same amount of social services in the future. Information on the consumption of social services from the follow-up at three months is extrapolated linearly to the two-year follow-up or until the patient dies. To estimate social service costs beyond year 2, we use the two-year follow-up data and assume a constant annual cost for subsequent years.

Patients included in the Riks-Stroke are then matched with data from National Hospital Discharge Register (Centre of Epidemiology, The National Board of Health and Welfare, Stockholm, Sweden), including date of death, subsequent strokes, and diagnosis-related group (DRG) weights for each admission for years 1997 to 2000. The acute stroke period is defined as the first twenty-eight days after admission. The DRG weight for "Specific cerebrovascular disorder, except transient ischemic attacks" (DRG 14) is 1.30. Admissions for causes other than stroke are excluded, as are admissions in the county of Skåne, as their DRG coding is not applicable. For the lifetime calculations, we use the average probability of death of year three and four to calculate the excess probability of death due to stroke, compared to the general population, in year five and onward.

The number of outpatient and rehabilitation visits, drug consumption after the acute phase, and production losses due to early retirement are taken from the literature. Specifically, the prescription pattern surveys among Swedish physicians performed biannually by Medical Index Sweden are used to estimate the drug consumption for patients with a stroke diagnosis. In the April to March 1998 survey, 2,289 doctors were surveyed (approximately 4 percent of all MDs in Sweden), of which 968 registered their prescriptions (15). The number of outpatient visits and rehabilitation are taken from a randomized controlled trial of rehabilitation at home after stroke performed in Stockholm, Sweden, between 1993 and 1996 (31). According to the authors, the 38 patients (mean age, seventy-two years, 55 percent men) in the routine rehabilitation (control) group made an average of 11.5 outpatient physician visits, 5.5 nurse visits, and twenty-four rehabilitation visits per year. In year 1, all patients are assumed to receive rehabilitation. In subsequent years, the number declines to roughly 50 percent, in

Table 1. Unit Costs, Year 2000 Prices

Cost item	Unit price
Cost per DRG weight (5)	34,800
Geriatric care, per day (25)	2,759
Outpatient visits (MD and nurse), per year (31;25)	10,208
Nursing home, per day (12)	1,215
Old people's home, per day (12)	694
Group-households, per day (12)	1,356
Service flat, per day (12)	518
Home services, score sum 1 (16 h/month) (9)	4,409
Home services, score sum 2 (36 h/month)(9)	8,495
Home services, score sum 3 (48 h/month)(9)	11,116
Home services, score sum 4 (76 h/month)(9)	17,105
Annual drug cost (14;13)	1,507
Average monthly production loss, men (22;23)	35,513
Average monthly production loss, women (22;23)	26,034
Rehabilitation cost per patient and year (31) ^a	15,879

^a The Swedish Federation of County Councils' index for wage and price changes are used as annual indices.

DRG, diagnosis-related groups; MD, medical doctor.

accordance with the two-year follow-up report from Riks-Stoke (22).

Production losses are calculated according to the human capital approach on the basis of premature deaths in productive ages (younger than sixty-five years) and early retirement due to stroke. According to the Swedish National Social Insurance Board, 577 men and 328 women received early retirement due to cerebrovascular diseases (including subarachnoidal bleedings), or approximately 6 and 3 percent of all male and female stroke cases in year 1997 (21). Production losses due to sick leaves are not included.

Costs

Costs for DRG weights are taken from the Centre for Patient Classification, which are calculated on a cost-per-patient basis. Approximately 18 to 23 percent of all inpatient stays in Sweden are included, and regional hospitals are over-represented in the sample (5). In those cases, patients are transferred to a geriatric clinic or nursing home, the length of stay is multiplied by the corresponding daily cost, see Table 1 (26). Unit costs for outpatient visits are taken from the same source, and unit prices for drugs are taken from pharmaceutical specialties in Sweden (FASS; 14;26).

Costs for home assistance are based on an unpublished study performed by a local community administration in Malmö, Sweden, in 1997 (9). We assume an assistance score of 1 to be equivalent to sixteen hours of assistance per month. The monthly cost includes overhead costs, fixed costs (e.g., alarm), and personnel costs, including supplementary pay for inconvenient working hours and traveling time. As no accommodation cost is attributed to patients living at home, we subtract 20 percent from the daily cost for institutional living to reflect personnel costs only (13;25). Average monthly salaries, including employment payroll taxes, are used to es-

timate production losses (23;24). The lower production loss for women reflects a higher part-time employment.

Results are presented both as the average cost per survivor in year 1 to 4, as well as the mortality-adjusted lifetime present value cost, where annual costs for year 5 and onward are assumed equal to costs in year 4. All costs are expressed in year 2000 prices.

RESULTS

The Riks-Stroke data contained 4,357 patients (2,187 men with mean age of seventy-two; women, mean age seventy-seven) who were admitted for their first-ever stroke during the first six months of 1997. Of these, 439 died during the initial twenty-eight days. Survival rates for age cohorts (younger than sixty-five, sixty-five to seventy-four, seventy-five to eighty-four, and older than eighty-five) varied between sexes, and the higher fraction of younger men in the sample biased the overall averages, see Table 2.

The total excess present value cost for stroke amounted to SEK292,000 for men and SEK320,000 for women surviving the first four years after the stroke. The main cost driver was social services costs, that is, home assistance and social services at institutional living, which amounted to 44 and 47 percent of the excess cost for men and women, respectively. In a lifetime, the mortality-adjusted average present value of direct costs per patient amounted to SEK484,000 for men and SEK544,000 for women. The corresponding figures for indirect costs were SEK164,000 and 87,000 for men and women, respectively (Table 3).

The Riks-Stroke survey was answered by 99, 80, and 53 percent of the patients at stroke onset and at three-month and twenty-four-month follow-ups, respectively. At the time of the stroke onset, 96 percent of the men and 91 percent of the women, were living at home, and of these, 30 and 54 percent of the men and women, respectively, lived alone ($p < .05$). Remaining patients lived in service flats or in old people's homes. Significant differences were also seen in the need for assistance in daily living (10 percent of men and 15 percent of women). Three months after the initial

Table 2. Survival after Initial Stroke Onset

	Age cohort (mean age)	N	1 year	2 years	3 years	4 years
Men	<65 (56)	469	0.934	0.913	0.887	0.866
	65-74 (70)	654	0.872	0.809	0.757	0.716
	75-84 (79)	814	0.738	0.624	0.523	0.445
	85+ (88)	250	0.520	0.388	0.260	0.188
	Total (72)	2,187	0.795	0.714	0.641	0.587
Women	<65 (54)	246	0.919	0.902	0.894	0.882
	65-74 (70)	483	0.876	0.830	0.774	0.710
	75-84 (80)	949	0.757	0.678	0.587	0.495
	85+ (88)	492	0.577	0.459	0.346	0.274
	Total (77)	2,170	0.761	0.688	0.609	0.537

Table 3. Excess Present Value (PV) Costs for Stroke Patients Surviving 4 Years, and Mortality Adjusted Lifetime Costs, $r = 3\%$, SEK, 2000 Prices^a

Year	Cost item	Men		Women		<i>p</i> value
		Mean	SD	Mean	SD	
–1	Social services	8,702	40,331	19,575	59,083	0.00
	Number of patients at stroke onset	2,187		2,170		
1	Index admission costs	70,388	59,910	69,990	58,661	0.37
	Re-stroke admission costs	8,709	35,006	8,310	32,776	0.43
	Outpatient costs	22,747	8,663	21,801	9,479	0.00
	Social services	48,844	130,177	63,241	134,479	0.00
	Survival following initial stroke onset	79.5%		76.1%		
	Excess PV costs for year 1 survivors	141,986		143,767		
2	Re-stroke admission costs	4,499	22,162	4,467	19,528	0.88
	Outpatient costs	17,901	3,635	18,015	3,567	0.26
	Social services	35,395	91,615	57,568	102,641	0.00
	Survival following initial stroke onset	71.4%		68.8%		
	Excess PV costs for year 2 survivors	49,092		60,474		
3	Re-stroke admission costs	3,279	16,565	3,921	20,838	0.06
	Outpatient costs	18,067	3,526	17,958	3,703	0.08
	Social services	39,882	90,255	59,141	101,793	0.00
	Survival following initial stroke onset	64.1%		60.9%		
	Excess PV costs for year 3 survivors	52,525		61,444		
4	Re-stroke admission costs	2,131	14,634	1,665	10,346	0.06
	Outpatient costs	18,914	3,147	18,489	3,768	0.00
	Social services	35,602	83,856	53,713	93,960	0.00
	Survival following initial stroke onset	58.7%		53.7%		
	Excess PV costs for year 4 survivors	47,945		54,291		
	Lifetime PV direct costs	484,105		543,710		
	Lifetime PV indirect costs	163,694		86,586		

^aNote: excess present value cost: total cost during the year less social services cost for the year preceding the stroke onset.

hospitalization, 79 and 71 percent of the male and female responders, respectively, lived at home. In the two-year follow-up questionnaire, the corresponding figures were 89 and 86 percent, respectively, whereof 25 and 48 percent, respectively, of the men and women lived alone ($p < .05$). A total of 30 and 47 percent of the men and women, respectively, were then in need for home assistance ($p < .05$). Social services costs during the year before the stroke onset were estimated to be SEK8,700 and 19,600 for men and women, respectively. The rather large drop in social services costs between year 1 and 2 was a result of the extrapolated living conditions from the three-month survey until the two-year follow-up, see Table 3.

The average length of hospital stay (LOS) during the initial stroke event (twenty-eight days) for all patients was twenty-two days (SD = 23). The average DRG-weight per patient was 1.65. During the first four-year period, 1,047 re-strokes were recorded (men, 533; women, 514), of which 534 occurred in the first year. Subsequent stroke patients had a longer LOS (mean, 26; SD, 27), indicating more complicated cases. The average cost for the initial admission amounts to SEK70,190, whereof SEK34,850 was attributable to the DRG14 code, and the rest a mix of extended stays at geriatric clinics, nursing homes, and other hospital wards within the first twenty-eight days (Table 3). The average annual cost for

a subsequent stroke diminished throughout the study period, in part due to discounting, but mainly because the incidence of subsequent strokes declined over time.

As outpatient visits, rehabilitation, and drugs were based on the literature, variation in resources was due only to deaths during the study period. Outpatient visit costs amounted to approximately SEK9,000 per annum, and drug costs were fairly stable around 3 percent, except for year 4 (8 percent) when more expensive drugs were prescribed. Rehabilitation costs accounted for 61 percent of total outpatient costs in the first year and 42 percent in the following years as rehabilitation was completed for some patients.

An average of twenty-seven and thirty-five working months for men and women, respectively, were lost due to premature deaths during the four-year period, which reflected the higher probability of death for women in the first year after stroke onset in this age cohort (younger than sixty-five years; 480 men, 252 women). Lifetime present value for indirect costs in this cohort amounted to SEK764,000 (men, fifty-six to sixty-five years) and SEK770,000 (women, fifty-four to sixty-five years).

Cohort analyses revealed that the average excess present value lifetime costs for health care and social services ranged from SEK251,991 among men eighty-five years of age and above (women, SEK358,293) to SEK780,671 for women

younger than sixty-five years of age (men, SEK613,456). The corresponding figures for the age cohorts sixty-five to seventy-four (seventy-five to eighty-four) years were SEK537,511 (437,957) and SEK678,493 (509,814) for men and women, respectively. Women had higher costs for social services than men in all age cohorts, and costs for four-year survivors increased with age, except for men eighty-five years old and older.

The difference in costs between sexes was attributable both to the longer life expectancy and higher annual costs for women, as they lived alone to a greater extent, limiting their ability to be fully independent at home. Hence, social services costs were the main cost driver, and its share increased with age. Despite higher mortality in the first year for women younger than sixty-five, female survivors had greater life expectancy, resulting in higher lifetime costs than for men.

DISCUSSION AND POLICY IMPLICATIONS

The average excess present value cost for health care and social services of stroke gives an indication of the costs that can be saved when a stroke is avoided. Our estimates include costs during a follow-up of four years, and costs incurred throughout the patient's remaining lifetime. The material has some limitations. First, the original data from Riks-Stroke are estimated to include three quarters of stroke events in Sweden, but is nevertheless considered representative for all stroke cases (10). In addition, we had to exclude patients treated in the region of Skåne (12 percent of the population in Sweden), although we have no reason to expect that their treatment or survival would differ systematically from the rest of Sweden.

Second, inpatient admissions costs, based on DRG weights may not reflect the true cost for patients or hospitals (3;17). For instance, the cost for different diagnosis grouped in the same DRG code can vary substantially due to different LOS, ranging from US\$13,490 to US\$8,140 for hemorrhagic and ischemic strokes, respectively, according to O'Brien (17). It is important, therefore, that the distribution of included diagnoses in the patient data is similar to that in the DRG calculations. However, according to the National Patient Registry, the DRG calculations have a high explanatory value on the basis of their goodness of fit (23). As we excluded admissions with a nonstroke primary diagnosis, we might underestimate the true inpatient cost slightly as some of these admissions could have been triggered (but not recorded) by the underlying stroke diagnosis.

Third, uncertainty regarding the costs for social services could be found both in the survey data and our extrapolation of the three-month status up to the twenty-four-months follow-up. If these services take time to organize and optimize for each patient, a three-month period might be too short. On the other hand, the twenty-four-months survey was in turn

assumed to be valid during the remaining study time, which may underestimate the true need, as individuals could require more resources when aging. Furthermore, patients living at home without home services but in need of assistance might have been assisted by a relative or friend that provided this service for free, although this service should be considered as a hidden societal cost. The higher fraction of women living alone could explain their higher average activities of daily living scores and institutional living.

Fourth, rehabilitation and outpatient visits were taken from a control group in a Swedish randomized controlled trial and may not be representative for all patients all over Sweden. Fifth, costs for drugs are lower than have been reported elsewhere (6;32), which can be a result of, for example, the survey-method or lacking coprescriptions due to other conditions. Sixth, indirect costs are certainly underestimated, as we have no patient data on sick leaves after the stroke.

Finally, all unit costs are assumed identical across Sweden and patients. It is not evident that, for example, social services costs in one local community are applicable to the rest of Sweden, or even the neighboring community. There are also several cost items that have not been included in this study, such as transportation services, assistive devices, housing adaptations, etc. The two latter items has been estimated to SEK4,327 to SEK5,714 (1996 year prices) for patients older than sixty-nine years surviving the first twelve months after acute stroke (11).

Comparing our results with others studies, Zethraeus and colleagues (32) estimated the excess direct cost of individuals with no history of stroke to SEK72,159 during the first year (1997 year prices, mean age younger than sixty-six years). Another study reported excess inpatient costs of SEK94,474 and 55,162 in year 1 and 2, respectively (1997 price level; 28). Outpatient and social services costs, on the other hand, were drastically lower than ours. Differences can be explained by patient characteristics, sample sizes, and geographic variations.

Compared with a 1983, the average three-year survival rate has increased by 22 percent (19). An extremely large improvement was found in patients older than eighty-four years (122 percent), but survival has increased only 4 percent for patients younger than sixty-five years. This development is reflected in inpatient and social services costs (for which we have patient-specific data) by the larger share of total costs for the eighty-five-year-old and older cohort in 1997 and 1998 compared with 1983 and 1984. Hence, even though the elderly have shorter life expectancies, their generally higher level of dependency affect the distribution of costs across age groups.

Calculating the excess cost of first-ever stroke patients gives an indication of the value of preventive measures. Such information is important in the assessment of new technologies affecting the incidence of stroke. Assuming 19,200 first-ever stroke cases in Sweden and identical patient

characteristics as in our data, this would result in an excess cost for health care and social services of SEK9.9 billion per year and a loss of production due to premature deaths and early retirement of SEK2.4 billion (year 2000 prices). As we have an aging population and costs increase with age, postponing the stroke onset, therefore, could free resources from younger cohorts for reallocation to the elderly.

REFERENCES

- Asplund K, Hulter Asberg K, Norrving B, Stegmayr B, Terent A. Riks-stroke: A Swedish national quality register for stroke care. *Cerebrovasc Dis*. 2003;15(Suppl 1):5-7.
- Beech R, Rudd A, Tilling K, Wolfe C. Economic consequences of early inpatient discharge to community-based rehabilitation for stroke in an inner-London teaching hospital. *Stroke*. 1999;30:729-735.
- Brouwer W, Rutten F, Koopmanschap M. Costing in economic evaluations. In: Drummond M, McGuire A, editors. *Economic evaluation in health care: Merging theory with practice*. Oxford: Oxford University Press; 2001:68-93.
- Caro J, Huybrechts K, (for the stroke economic analysis group). Stroke treatment economic model (STEM): Predicting long-term costs from functional status. *Stroke*. 1999;30:2574-2579.
- Centrum för Patientklassificering. Vårdkostnader och vårdtider 2000 för NordDRG. Socialstyrelsen, Stockholm, Sweden: 2002 [Center for Patient Classification, in Swedish].
- Claesson L, Gosman-Hedström G, Johannesson M, Fagerberg B, Blomstrand C. Resource utilization and costs of stroke unit care integrated in a care continuum: A 1-year controlled, prospective, randomized study in elderly patients. *Stroke*. 2000;31:2569-2577.
- Dewey H, Thrift A, Mihalopoulos C, et al. Cost of stroke in Australia from a societal perspective: Results from the North East Melbourne Stroke Incidence Study (NEMESIS). *Stroke*. 2001;32:2409-2416.
- Evers S, Engel G, Ament A. Cost of stroke in the Netherlands from a societal perspective. *Stroke*. 1997;28:1375-1381.
- Financial Department, Stadsdelsförvaltningen Västra Innerstaden, Malmö, Sweden, 1996. Unpublished.
- Glader E-L. *Stroke care in Sweden. Hospital care and patient follow-up based on Riks-Stroke, the National Quality Register for Stroke Care*. 2003, PhD dissertation. Department of Public Health and Clinical Medicine, Umeå University, Umeå, Sweden.
- Gosman-Hedstrom G, Claesson L, Blomstrand C, Fagerberg B, Lundgren-Lindquist B. Use and cost of assistive technology the first year after stroke. A randomized controlled trial. *Int J Technol Assess Health Care*. 2002;18:520-527.
- Kaste M, Fogelholm R, Rissanen A. Economic burden of stroke and the evaluation of new therapies. *Public Health*. 1998;112:103-112.
- Kungsholmens stadsdelsnämnd. Bilagor till verksamhetsberättelse med bokslutskommentarer 2000. Stockholm, Sweden [Kungsholmen municipality, Appendices to annual reports 2000, in Swedish].
- Linfo, FASS, Kungsbacka, Sweden: Elanders; 2000 [Pharmaceutical Specialities in Sweden, in Swedish].
- Medical Index Sweden, 1997 to 2000*. Läkemedelsstatistik AB, Stockholm.
- Meerding W, Bonneux L, Polder J, Koopmanschap M, van der Maas P. Demographic and epidemiological determinants of healthcare costs in Netherlands: Cost of illness study. *BMJ*. 1998;317:111-115.
- O'Brien J. Use of diagnosis related groups (DRG) in estimating costs. *ISPOR Connect*. 2003;9:5-7.
- Peltonen M, Stegmayr B, Asplund K. Time trends in long-term survival after stroke: The northern Sweden multinational monitoring of trends and determinants in cardiovascular disease (MONICA) study, 1985-1994. *Stroke*. 1998;29:1358-1365.
- Persson U, Silverberg R, Lindgren B, et al. Direct costs of stroke for a Swedish population. *Int J Technol Assess Health Care*. 1990;6:125-137.
- Porsdal V, Boysen G. Cost of illness studies of stroke. *Cerebrovasc Dis*. 1997;7:258-263.
- Riksförsäkringsverket. Nybeviljade förtidspensioner/sjukbidrag 1997. Statistikinformation Is-I 1998:008, 1998-04-20, Stockholm, Sweden: Swedish National Social Insurance Board. [In Swedish].
- Socialstyrelsen. Att drabbas av stroke—Hur ser situationen ut två år efter insjuknandet? Äldreuppdraget 2000:13, KopieCenter, Stockholm, Sweden: National Board of Health and Welfare. [In Swedish].
- Statistics Sweden. Arbetskraftsundersökningarna 2002 (AKU), AM0401, Örebro, Sweden: Publikationstjänsten; 2003. [Labour surveys 2002, in Swedish].
- Statistics Sweden. Lönesummor, arbetsgivaravgifter och preliminär A-skatt från skattedeklarationer (LAPS). AM0206, Örebro, Sweden: Publikationstjänsten; 2002 [Wages, employment pay-roll taxes and preliminary income-taxes from income-tax forms, in Swedish].
- Svensson M, Edebalk P-G, Persson U. Gruppboende för åldersdementa—vilken roll spelar utformning, lokalisering och vårdbehov, IHE Arbetsrapport 1995:3, Lund, Sweden. [In Swedish].
- Södra Regionvårdsnämnden Regionala Priser och Ersättningar 2000 för Södra Sjukvårdsregionen, 1999 [Southern regional health care board "Prices and Reimbursements for the Southern Health Care Region, 2000, in Swedish].
- Taylor T, Davis P, Torner J, et al. Lifetime cost of stroke in the United States. *Stroke*. 1996;27:1459-1466.
- Terént A, Marké LÅ, Asplund K, et al. Costs of stroke in Sweden: A national perspective. *Stroke*. 1994;25:2363-2369.
- Thorvaldsen P, Davidsen M, Brønnum-Hansen H, Schroll M, (for the Danish MONICA study group). Stable stroke occurrence despite incidence reduction in an aging population: Stroke trends in the danish monitoring trends and determinants in cardiovascular disease (MONICA) population. *Stroke*. 1999;30:2529-2534.
- Tuomilehto J, Rastenyte D, Sivenius J, et al. Ten-year trends in stroke incidence and mortality in the FINMONICA Stroke Study. *Stroke*. 1996;27:825-832.
- von Koch L, de Pedro-Cuesta J, Kostulas V, Almazán J, Widén-Holmqvist L. Randomized controlled trial of rehabilitation at home after stroke: One-year follow-up of patient outcome, resource use and cost. *Cerebrovasc Dis*. 2001;12:131-138.
- Zethraeus N, Molin T, Henriksson P, Jönsson B. Costs of coronary heart disease and stroke: The case of Sweden. *J Intern Med*. 1999;246:151-159.