

# DEMOGRAPHIC ANALYSIS OF INCIDENT STROKE HOSPITALISATIONS IN SCOTLAND

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## ABSTRACT

In UK there is a perpetual surge in stroke incidence from 1996 to 2006 and it is responsible for around 53000 deaths every year. Stroke is a chronic disease with complex multifactorial etiology and incidence variability. Thus, the present study is looking to unveil the demographic trends in incident stroke hospitalizations in Scotland.

The data set comprising of 157, 639 incident hospitalizations was collected from NHS and ISD division of Scottish Morbidity Records (SMR). Chi-square goodness of fit test was used to analyze the dataset on SPSS version 15.0. The frequency of incident stroke hospitalizations increased with age in both sexes (women more than men) with an increase in the number of stroke incidences in young age-group with a three-fold increase in ICH stroke sub-type. Women constitute a greater proportion of those who had an incident stroke than men with stroke incidence increased in the <55 years age groups. Incidence of ICH and IS rose with NS declined and SAH remained constant.

**KEYWORDS:** Stroke, Stroke incidence, Demography, Gender, age, Stroke sub-type.

## INTRODUCTION

Stroke is defined as “abrupt impairment of brain functions by a variety of pathological changes involving intracranial or extracranial blood vessels” (1). Prognosis following stroke is poor, 25% to 30% deaths occur in the initial three weeks and 30% to 66% in the first year following stroke incidence (2). There are approximately 111,000 stroke incidents in UK every year (3). Scotland experienced a decline of 21.2% between 1999/00 and 2008/09 for stroke incidence rate (4).

The presence of stroke in those aged over 75 years in U.K. has increased from 9% to 13% (men) and 8% to 11% (women) over the period from 1994 to 2006 (3). This has a lot to do with the continuous rise in aging population due to demographic transition. According to Scotland Health Survey 2008, till date 2.5% men and 2.8% women are affected by stroke in Scotland (5).

In U.K. stroke is responsible for around 53000 deaths every year (6). Though there has been remarkable decline in this age – standardized stroke portability rates since 1968, a lot of variability is still present within U.K. The rates are highest in Scotland followed by North England, Ireland, Wales and South England (5).

It is known fact that strokes, like many other chronic

diseases has a complex multifactorial aetiology. Genetics family history, age, sex, ethnicity and race are all non modifiable risk factors. But other risk factors as smoking, drinking, physical activity and diet can be modified to reduce the risk of stroke significantly.

The aim of present study is to study any interrelationship between age and gender and incident stroke hospitalizations in Scotland (1986 – 2006) and suggest measures to reduce them.

## METHODS

Stroke data related to all incident hospitalization for stroke in Scotland is collected between 1986 and 2005. The data set comprise of a sample size 157, 639 incident hospitalization. Following sources were kind enough to provide information about personal details (age, sex) of patient's details year – wise.

1. National Health Service (NHS)
2. Information Service Division (ISD)
3. Scottish Morbidity Records (SMR)

SPSS (Statistical Package for Social Sciences, 15.0 versions for Windows) was used for statistical analysis.

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hospitalization was performed by creating five age groups, <55, 55–64, 65–74, 75–85 and >85 years. For both males and females separately, frequency of all incident strokes were analyzed to appreciate a gender disparity throughout all age groups. The frequency of all incident strokes was analyzed year – wise (1986 – 2005) to observe a trend in incident stroke amongst all age groups (combined for males and females). Incidents strokes were split into its subtypes (ischemic stroke, intracerebral haemorrhage, subarachnoid hemorrhage and non- specific) and analyzed year – wise (1986 – 2005) again for frequency in order to appreciate a change in the pattern of different stroke subtypes with time (combined from males and females).

To look for variations in all incident strokes throughout different months of the year, Chi-square goodness of fit test was used.

Ethical approval was granted from Faculty of Medicine Ethics Committee for Non-Clinical Research involving human subjects, University of Glasgow (Project No-Fm00609). The retrospective data were approved by Privacy Advisory Committee (PAC).

## RESULTS

A dataset of 157,639 incident hospitalizations for stroke was analysed; (men: 44.9%, mean age: 69.2 years, & S.D: 13.07, women: 55.1%, mean age: 74.1 years, SD: 13.33). Overall women have higher frequency of stroke hospitalization and higher mean age than men.

Table 1 show that the frequency of incident stroke hospitalizations increased with age in both sexes. In the youngest age group (<55 years) the percentage of stroke is slightly higher in males (12.7% vs 8.8%) but this figure more than doubled in females in the most elderly age group. When the age groups are compared, in males the distribution is almost equal (65-74: 30.6% & 75-84: 29.7%) but in females this percentage has almost increased to one and a half folds (23.1% vs 36.7%); signifying (75-84) years age group posed high risk for incident stroke in females.

Sex of patient	Age group (Years) n(%)				
	< 55	55 to 64	65 to 74	75 to 84	≥85
Males	8992 (12.7)	12,743 (18.0)	21,638 (30.6)	20,985 (29.7)	6368 (9.0)
Females	7645 (8.8)	9006 (10.4)	20,107 (23.1)	31,880 (36.7)	18,275 (21.0)
Total	16,637 (10.6)	21,749 (13.8)	41,745 (26.5)	52,865 (33.5)	24,643 (15.6)

**Table 1: Baseline Characteristics Of Stroke Hospitalizations (1986-2005)**

Table 2 demonstrates the trend of incident stroke hospitalizations in Scotland from 1986-2005 across different age groups. In males and females, the number of cases in the younger age group (<55 years) has increased from 1,461 (9.4%) in 1986/1987 to 1,753 (12.4%) in 2004/2005. Similar rise of 12.9% to 17.3% was observed in most elderly age group (≥85 years) during the same period. On the contrary, a slight decline was observed in age groups 65-74 years & 75-84 year with 28% and 35.6% in 1985/1986 to 23.8% and 32.2% in 2004/2005 respectively. But the burden of incident strokes in those aged 55-64 years remained fairly constant throughout the twenty years.

Year of Adm	Age Group n(%)				
	< 55	55 to 64	65 to 74	75 to 84	≥85
1986/1987	1461 (9.4)	2173 (14.1)	4329 (28.0)	5500 (35.6)	2001 (12.9)
1988/1989	1442 (9.4)	2015 (13.1)	4175 (27.2)	5662 (36.8)	2079 (13.5)
1990/1991	1448 (9.3)	2115 (13.5)	4178 (26.7)	5674 (36.3)	2211 (14.1)
1992/1993	1645 (9.7)	2285 (13.4)	4592 (26.9)	5909 (34.7)	2611 (15.3)
1994/1995	1757 (10.4)	2285 (13.5)	4702 (27.8)	5497 (32.6)	2645 (15.7)
1996/1997	1725 (10.9)	2145 (13.5)	4284 (27)	5119 (32.3)	2571 (16.2)
1998/1999	1814 (11.1)	2322 (14.2)	4303 (26.2)	5238 (32)	2717 (16.6)
2000/2001	1804 (11.4)	2291 (14.4)	4026 (25.3)	5006 (31.5)	2756 (17.4)
2002/2003	1788 (12.0)	2097 (14.0)	3775 (25.3)	4688 (31.4)	2592 (17.3)
2004/2005	1753 (12.4)	2021 (14.2)	3381 (23.8)	4572 (32.2)	2460 (17.3)

**Table 2: Age & Yearly Trend Of First Stroke Hospitalizations In Scotland (1986-2005)**

Year of Adm	Stroke sub type n (%)			
	SAH	ICH	IS	NS
1986/1987	955 (6.2)	680 (4.4)	1785 (11.5)	12,044 (77.9)
1988/1989	915 (6.0)	710 (4.6)	1797 (11.7)	11,951 (77.7)
1990/1991	923 (5.9)	706 (4.5)	2021 (12.9)	11,976 (75.5)
1992/1993	998 (5.9)	1028 (6.0)	2678 (15.7)	12,338 (72.4)
1994/1995	1059 (6.3)	1191 (7.1)	3805 (22.5)	10,831 (64.1)
1996/1997	1098 (6.9)	1458 (9.2)	4909 (31.0)	8379 (52.9)
1998/1999	1143 (7.0)	1670 (10.2)	6064 (37.0)	7517 (45.9)
2000/2001	1074 (6.8)	1779 (11.2)	6632 (41.8)	6398 (36.7)
2002/2003	1015 (6.8)	1566 (10.5)	6880 (46.1)	5479 (36.7)
2004/2005	933 (6.6)	1612 (11.4)	6927 (48.8)	4715 (33.2)

**Table 3: Stroke Subtype & Yearly Trend Of Incident Stroke Hospitalizations In Scotland (1986-2005)**

Table 3 demonstrates the trend of incident stroke hospitalizations in Scotland from 1986-2005 across the different stroke types. Overall, the absolute number & % of subarachnoid hemorrhage (SAH) remained fairly consistent throughout the 20 year period. For intra cerebral hemorrhage (ICH), a consistent increase of almost three fold was observed

during the same period with a low frequency of 680 (4.4%) in 1986/87 and 710 (4.6%) in 1988/1989 to a relatively high number 1,566 (10.5%) and 1,612 (11.4%) in 2002/2003 and 2004/2005 respectively. An acceleration of more than four times over the study period was found for ischemic stroke (IS) hospitalizations. With 1,785 (11.5%) in 1986/1987 and 2,021 (12.9%) in 1990/1991, this figure increased to 6,880 (46.1%) and 6,927 (48.8%) in 2002/2003 and 2004/2005 respectively. With improvements in diagnostic accuracy, a stable decline occurred in the percentage of non-specific strokes (77.9% in 1986/1987 to 33.2% in 2004/2005).

Year of Adm	Age Group n (%)				
	< 55	55 to 64	65 to 74	75 to 84	≥85
SAH	5092 (50.4)	2225 (22.0)	1759 (17.4)	848 (8.4)	189 (1.9)
ICH	2283 (18.4)	2287 (18.4)	3352 (27.0)	3315 (26.7)	1163 (9.4)
IS	4690 (10.8)	7036 (16.2)	12,588 (28.9)	13,573 (31.2)	5611 (12.9)
Non-Specific	4572 (5.0)	10,201 (11.1)	24,046 (26.2)	35,129 (38.3)	17,680 (19.3)

**Table 4: Stroke Subtype & Yearly Trend Of Incident Stroke Hospitalizations In Scotland (1986-2005)**

Table 4 shows the distribution of stroke sub-types amongst the different age groups. Subarachnoid hemorrhage (SAH) was responsible for 5,092 (50.4%) hemorrhagic strokes in the youngest age group of less than 55 years and its frequency decreased subsequently with an increase in age evident from a low percentage (189, 1.9%) in the most elderly age group (≥85 years). Intra cerebral hemorrhage (ICH), ischemic stroke (IS) and non specific stroke type showed an amplification trend (increase in percentage with increase in age) across all age groups (up to 84 years) followed by a sharp decline in the elderly age group (≥85 years).

## DISCUSSION

The demographic analyses of data show the proportion of women of those experiencing an incident stroke in Scotland, 1986 – 2005 is higher than men (55.1% vs 44.9%). According to global statistics in 2000, there were 32,000 excess stroke deaths in women and this figures is expected to rise up to 68,000 by 2050 [7]. This is due to the fact that the blood vessels of females are more sensitive to weather parameters than men due to predominance of a estrogen hormone which stimulates production of adrenergic alpha 2C-receptors [8]. This actually makes the vasculature

more reactive and thus making women more sensitive to weather [8]. Despite the fact that no appreciable difference is visible in the severity of disease in context of gender, increased depression and lack of social support is more appreciable amongst women [7]. To some extent less awareness about cerebrovascular as compared to cardiovascular disease in women [7] is also responsible for higher stroke incidence. Mean age for incident stroke hospitalizations was also higher for women than men in our results (74.2 years vs 69.2 years). The only explanation for the aforementioned observation seemed to be reported higher life expectancy in women than men [9].

From 1986 – 2005, a comparison of incident stroke hospitalizations across various age groups in Scotland reveals that slight risk in the strike frequency is <55 years and >85 years age groups. During the same period an increase was also observed in the proportion of aging populations which is thought to be responsible for greater prevalence in >85 years age groups. But age stratified statistics described above actually marks the actual picture of stroke incidence. In fact the stroke incidence rates in Scotland fell from 215/100,000 in 1999 – 2000 to 166/100,000 in 2008 – 2009, along with a decline hospital admissions during the same period (225.2/100,000 to 217.3/100,000) [10]. This decline is attributed to an improvement in emergency services, risk factor prevention policies and health promotion strategies.

When stroke sub-types were quantified from incident stroke hospitalization (1980 – 2005), SAH percentage remained fairly consistent throughout the twenty years period. However a continuous increase was observed in IS and ICH cases whereas non-specific type declined dramatically during the same period. This pattern may be due to ameliorations in diagnostic accuracy. As the choice of investigations has shifted from neurological examination [11,12] to CT scan [13,14] and cerebral angiography [15], more cases now a days are diagnosed correctly.

Some of the suggestions to prevent stroke keeping in mind the aforesaid argument include protection from cold weather, decrease alcohol consumption, maintaining blood pressure within the safe range during winter season constitutes some of the precautionary measures. Protection from heat along with adequate hydration during summer season decreases risk of IS. It is worth identifying risk factors in context of seasonality among young individuals as they are more prone for SAH than their old counterparts. Most of the time they experience these hemorrhages without any prior



warning signs unlike IS where a TIA episode usually precedes stroke.

## CONCLUSION

The demographic analysis of incident stroke hospitalizations in Scotland (1986 - 2005) shows that women constitute a greater proportion of those who had an incident stroke (55.1%, 74.2 years) than men (44.9%, 69.2 years). Stroke incidence increased in the <55 years (9.4% to 12.4%) and ≥84 years (12.9% to 17.3%) age groups. During the same period incidence of ICH (4.4% to 11.4%), IS (11.5 to 48.8%) rose; however, NS (77.9 to 33.3) declined and SAH (6.2% to 6.6%) remained constant.

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