



**UNIVERSITY OF LEEDS**

This is a repository copy of *Incidence of first stroke and ethnic differences in stroke pattern in Bradford, UK: Bradford Stroke Study*.

White Rose Research Online URL for this paper:  
<http://eprints.whiterose.ac.uk/125205/>

Version: Accepted Version

---

**Article:**

Ramadan, H, Patterson, C, Maguire, S et al. (4 more authors) (2018) Incidence of first stroke and ethnic differences in stroke pattern in Bradford, UK: Bradford Stroke Study. *International Journal of Stroke*, 13 (4). 1747493017743052. pp. 374-378. ISSN 1747-4930

<https://doi.org/10.1177/1747493017743052>

---

© 2017 World Stroke Organization. This is an author produced version of a paper published in *International Journal of Stroke*. Uploaded in accordance with the publisher's self-archiving policy.

**Reuse**

Items deposited in White Rose Research Online are protected by copyright, with all rights reserved unless indicated otherwise. They may be downloaded and/or printed for private study, or other acts as permitted by national copyright laws. The publisher or other rights holders may allow further reproduction and re-use of the full text version. This is indicated by the licence information on the White Rose Research Online record for the item.

**Takedown**

If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing [eprints@whiterose.ac.uk](mailto:eprints@whiterose.ac.uk) including the URL of the record and the reason for the withdrawal request.



[eprints@whiterose.ac.uk](mailto:eprints@whiterose.ac.uk)  
<https://eprints.whiterose.ac.uk/>

# Incidence of First Stroke and Ethnic Differences in Stroke pattern in Bradford, UK: Bradford Stroke Study

Hawraman Ramadan FRCP<sup>1</sup>, Chris Patterson FRCP<sup>1</sup>, Stuart Maguire MRCP<sup>1</sup>, Ian Melvin DipHE<sup>1</sup>,  
Kirti Kain MD<sup>2</sup>, Elizabeth Teale PhD<sup>3</sup>, Anne Forster PhD<sup>3</sup>

<sup>1</sup>Neurology department, Bradford Teaching Hospitals NHS Foundation Trust, Bradford, United Kingdom. <sup>2</sup>Division of Cardiovascular & Diabetes Research, University of Leeds, Leeds, United Kingdom. <sup>3</sup>Academic Unit of Elderly Care and Rehabilitation, University of Leeds, Leeds, United Kingdom

## Corresponding author:

Dr Hawraman Ramadan  
Consultant Neurologist and Stroke Physician  
Room 93,  
C Floor-Field House  
Bradford Royal Infirmary  
Duckworth Lane  
Bradford BD9 6RJ  
UK

[Hawraman@doctors.org.uk](mailto:Hawraman@doctors.org.uk)

Tel: 00441274382323

Fax: 00441274382893

**Keywords:** Stroke, ethnicity, epidemiology

## Word count

Abstract 248

Total, including title page and two tables: 2,655 words

## Tables:

- **Table 1:** Pathological 1st ever stroke incidence (per 100,000) by ethnicity and mid-decade age bands group in Bradford residents , UK in 2013-2014
- **Table 2:** Risk factors among White and Pakistani patients with 1st-ever stroke in Bradford residents, UK in 2013-2014

**Background:** Information on ethnic disparities in stroke between White and Pakistani population in Europe is scarce. Bradford District has the largest proportion of Pakistani people in England; this provides a unique opportunity to study the difference in stroke between the two major ethnic groups.

**Aim:** To determine the first-ever-stroke incidence and examine the disparities in stroke patterns between Whites and Pakistanis in Bradford.

**Methods:** Prospective 12-months study consisting of 273,327 adults ( $\geq 18$  years) residents. Stroke cases were identified by multiple overlapping approaches.

**Results:** In the study period, 541 first-ever-strokes were recorded. The Crude incidence rate was 198 per 100,000 person-years. Age adjusted-standardized rate to the WHO world population of first-ever-stroke is 155 and 101 per 100,000 person-years in Pakistanis and Whites respectively. 438 patients (81%) were whites, 83 (15.3%) were Pakistanis, 11 (2%) were Indian and Bangladeshis, and 9 (1.7%) were of other ethnic origin. Pakistanis were significantly younger and had more obesity ( $p=0.049$ ), and diabetes mellitus ( $p<0.001$ ). They were less likely to suffer from atrial fibrillation ( $p<0.001$ ), be ex- or current smokers ( $p<0.001$ ), and drink alcohol above the recommended level ( $p=0.007$ ) compared with Whites. In comparison with Whites, higher rates of age-adjusted stroke (1.5-fold), lacunar infarction (3-fold) and ischemic infarction due to large artery disease (2-fold) were found in the Pakistanis.

**Conclusions:** The incidence of first-ever-stroke is higher in the Pakistanis compared with the Whites in Bradford, UK. Aetiology and vascular risk factors vary between the ethnic groups. This information should be considered when investigating stroke aetiology, and when planning prevention and care provision to improve outcomes after stroke.

## **Introduction**

The burden of stroke is better documented in developed than in developing countries<sup>1-2</sup>. The ethnic disparity in stroke incidence and cardiovascular risk factors among North American Whites, Blacks and Hispanics has been studied extensively<sup>3-4</sup>. In New Zealand; there are data on incidence of stroke subtypes within the large multi-ethnic population between New Zealanders/Europeans, Maori/Pacific and Asian/other people<sup>5</sup>. However, in Europe there are no published data on the ethnic differences in stroke between Whites and Pakistanis.

According to the 2011 UK census (released in 2013), Bradford District has the largest proportion of Pakistanis (mostly of Kashmiri-origin) in the UK (20.4%)<sup>6</sup>. The purpose of this study was to determine the incidence of first-ever-new stroke in the adult population and examine the disparities in the stroke patterns between Whites and Pakistanis in Bradford, UK from May 1<sup>st</sup> 2013 to April 30<sup>th</sup> 2014. The identification of risk factors and predictors for stroke in Pakistanis is essential to allow the implementation of population appropriate therapeutic and preventive strategies based on their risk profile and not results of trials conducted non-south Asians.

## **Methods**

Bradford Teaching Hospitals NHS Foundation Trust (BTHFT) provides hyper-acute stroke care for 273,327 adults ( $\geq 18$  years) residents in Bradford, UK. White, Indian, Pakistani or Bangladeshi was defined as a person with one or more grandparents originally born in Europe, India, Pakistan or Bangladesh respectively. Ethnicity was self-identified by use of the 2011 UK census definitions. The Research Ethics Committees advised that ethical approval was not required. Six percent (22,930) and 1.5% (5,802) of residents are aged  $\geq 75$  and  $\geq 85$  respectively. Whites constituted 65% (178,578) and 80% (18,476) of  $\geq 18$  and  $\geq 75$  years age group population respectively, Pakistani ethnic 21% (57,590) and 8% (1,684), Indian and Bangladeshi together 5% (13,958) and 0.18% (514), and people of other ethnic

groups 8.4% (23,201) and 0.2% (572). Eighty percent of residents in the study area were born in UK, 4% born in the rest of Europe and 14% in Asia.

### **Case Ascertainment**

Patients admitted with suspected new stroke were identified through daily examination of multiple overlapping information sources (stroke unit, emergency department records, radiology results, coding, bereavement departments, out-patient clinics and the community stroke-neurology rehabilitation team) to ascertain all cases of new strokes based on recommended criteria for ideal stroke incidence studies<sup>7</sup>. Surveillance of admissions continued for a further two months after 30<sup>th</sup> April 2014 to ensure the registration of all patients whose stroke occurred on or before 30<sup>th</sup> April 2014. The local health authority recommends referral of all suspected new stroke cases to BTHFT. Therefore, we anticipated that all those patients with new minor stroke presenting to their family doctor rather than the emergency department would be referred into our stroke service. All suspected new stroke patients were assessed as soon as possible after the event by a stroke consultant. Ischemic stroke (IS) subtype was assigned by TOAST criteria<sup>8</sup>.

### **Results**

There were 916 suspected stroke presentations during the 12-month period study period. Of these, 664(72.5%) were confirmed stroke and 252(27.5%) were stroke-mimics. Of 541 patients presenting with first-ever-stroke, 438(81%) were Whites, 83(15.3%) Pakistanis, 11(2%) Indian and Bangladeshis, and 9(1.7%) were of other ethnic origin. Pakistanis were significantly younger, with a mean age of 64 years (95%CI, 60.7-67.3) compared with 72.5 years (95%CI, 71.1-73.9) for Whites. There were no significant differences in sex in the Whites and Pakistanis. Seventy-nine percent of 541 cases were admitted and examined within 24 hours of symptom onset. Stroke pathology was determined by neuroimaging in 99% of patients. IS occurred in 438(81%), primary intracerebral haemorrhage (pICH) 72 (13%), SAH in 26(5%), and stroke type was undetermined (SUT) in 1% because they were

too ill and agitated, with comorbidities like advanced dementia and prior decision about palliative approach in their hospital care therefore “no scan or invasive intervention” decision were made. The mean age at presentation for both IS and pICH in men and women were 67(95%CI, 66.05-67.95) and 76(95%CI, 75.5-77.5) respectively. Among 83 Pakistanis with first-ever-stroke, 11(13%) were born in the UK, 53(64%) were immigrants to the UK before 1990 and the remaining 19(23%) came to the UK between 1990 and 2004. Forty-one(49%), 29(35%) and 5(6%) patients were from Kashmir, Punjab Province and Karachi areas of Pakistan respectively. The place of origin was not determined in remaining 8(10%) of patients.

The crude incidence of overall first-ever-stroke per 100,000 person-years of observation for  $\geq 18$  years was 198; 160 for IS, 26 for ICH, 10 for SAH, and 1 for undetermined. The crude incidence rate varied from 22 per 100,000 person-years in 18-44 years of age to 1896 in  $\geq 85$  years of age. Stroke rates were higher in men in most age groups.

The incidence of first-ever-stroke was 166 per 100,000 per person-years when age-adjusted to the World Health Organization (WHO) world population. The first-ever-stroke per 100,000 by ethnicity and age for different stroke types is displayed in table 1. Stroke incidence was 1.57 fold higher in men and 47% of strokes occurred in patient  $\geq 75$  years old (7.7% of the population). The incidence rate ratios for Pakistanis to Whites were 1.65 for IS and 1.46 for pICH. The mean age of IS was 65 (95%CI, 61.6-68.4) in Pakistanis and 73 (95%CI, 71.5-74.5) in Whites. For pICH, the mean age difference widens further to 10 years gap between Whites (73 years) and Pakistanis (63 years) patients. In the 18-44 age groups; the proportion of stroke in Pakistanis and Whites were 13.2% and 4.4% respectively.

Of 438 IS cases; ECGs were performed in 97%, CT brain in 92%, Carotid Duplex Ultrasound in 52%, MRI brain in 40%, 24-72 hour ECG in 40%, Echo in 17%, MRA in 13% and CT Angiogram in 4%. Pathological classification for IS; 31 (7%) were large artery atherosclerosis; 121 (28%) cardioembolism, 70 (16%) lacunar; 10 (2%) other determined causes; and 204 (47%) undetermined. Age adjusted incidence per 100,000 person-years of large artery atherosclerosis stroke was similar for both ethnic groups, however, the lacunar

were 38 and 12 and ischaemic stroke of undetermined aetiology were 62 and 37 per 100,000 person-years in Pakistanis and Whites respectively.

Pakistanis were more likely to be obese (34%; body-mass index  $\geq 30$  kg/m<sup>2</sup>;  $p=0.049$ ), and to have a history of diabetes mellitus (DM) (51%;  $p<0.001$ ) than the Whites. The proportion of DM among Pakistanis was 2.5 fold higher than Whites. Whites however, were more likely to have atrial fibrillation (AF) (29%;  $p<0.001$ ), be ex- or current smokers (29-33%;  $p<0.001$ ), and to drink alcohol above the recommended level (13%;  $p=0.007$ ). AF was three times more prevalent in Whites (Table 2). No patients were lost to follow up. The overall 30 day case fatality in 541 patients was 18% (97 cases). Unadjusted fatality in pICH was similar between Whites and Pakistanis (45% versus 41%), however, fatality from IS was significantly lower in Pakistanis (4%) than Whites (13%;  $p<0.001$ ).

## **Discussion**

This is the first-ever study directly comparing the pattern of acute stroke disease between White and UK Pakistanis originating from a defined geographical area of Pakistan. During the 12 month study period we believe the vast majority of new strokes in our catchment area have been identified through multiple overlapping sources. The age-adjusted incidence rate of first-ever-stroke standardised to the WHO world population in Bradford is higher than Adelaide<sup>9</sup> and Dublin<sup>10</sup> but less than Auckland<sup>11</sup>. The proportion of stroke of undetermined type (1%) is lower compared with other studies due to short time gap between symptoms onset and brain imaging as a result of recent stroke service reorganisation in UK in general and improved public awareness of stroke symptoms through “FAST act” campaign which leads to earlier presentation to hospital. The proportional frequency distribution of stroke type and pathophysiological aetiology of IS in this study is in line with results of other population-based studies. Twenty-nine percent of patients with first-ever IS had AF which is comparable with other studies<sup>10,12</sup>. Pakistanis had high levels of obesity and a history of DM but decreased prevalence of AF, smoking and drinking alcohol than the Whites’. The study

show no difference in the proportion of both IS and pICH in both Whites and Pakistanis in Bradford. The mean age of stroke in Pakistanis was a decade younger compared with Whites and the proportion of stroke among 18-44 year age in Pakistanis is more than three folds higher than Whites. The incidence of large artery atherosclerosis stroke was similar in both ethnic groups, however, the lacunar infarction was three times (possibly due to increased DM) and ischaemic stroke undetermined aetiology was nearly two folds greater in Pakistanis than in Whites. In our area most Pakistani meals followed the traditional food whereas White people eat more variable diet with no difference in overall vegetable consumption in both ethnic groups<sup>13</sup>. There is no published data on genetic background of stroke in Pakistani population. The higher incidence of stroke in this group is likely to be to combination of higher burden of DM (including undiagnosed DM) and hypertension, lack of awareness of their comorbidities, personal healthcare and possibly regular medical check-ups or compliance with medications<sup>14</sup>. The reasons for lower unadjusted 30 day fatality from IS in Pakistani are not clear; the possible explanations might be the younger age of stroke, less AF and more lacunar infarctions in this ethnic group. These ethnic differences have considerable public health clinical implications and should be taken into consideration on choice of stroke prevention strategies and planning stroke care provision in order to reduce stroke burden in Pakistanis.

### **Limitations**

Our study has several limitations: given the smaller proportion of Pakistani residents as compared to whites, that stroke incidence may be over- or under- represented. The difference in the risk factors between both ethnic groups may be due to chance and a formal statistical test by the Bonferroni correction is not applicable in this exploratory epidemiological study. The proportion of lacunar and large artery strokes is likely underestimated by low utilization of MRI and vascular imaging.



**Conflict of interest:** None declared

## References

1. Pongvarin N. Stroke in the developing world. *The Lancet*. 1998 Oct;352:S19–S22.
2. Hashmi M, Khan M, Wasay M. Growing burden of stroke in Pakistan: a review of progress and limitations. *Int J Stroke*. 2013 Oct;8(7):575-81
3. Kittner SJ, White LR, Losonczy KG, Wolf PA, Hebel JR. Black-white differences in stroke incidence in a national sample. The contribution of hypertension and diabetes mellitus. *Jama J. Am. Med. Assoc.* 1990 Sep 12;264(10):1267–70.
4. Sacco RL, Kargman DE, Zamanillo MC. Race-ethnic differences in stroke risk factors among hospitalized patients with cerebral infarction: the Northern Manhattan Stroke Study. *Neurology*. 1995 Apr;45(4):659–63.
5. Feigin V, Carter K, Hackett M et al. Ethnic disparities in incidence of stroke subtypes: Auckland Regional Community Stroke Study, 2002-2003. *Lancet Neurol*. 2006 Feb;5(2):130–9.
6. White E. 2011 Census: Key Statistics for England and Wales, March 2011 [Internet]. Office for National Statistics. <http://ons.gov.uk/ons/rel/census/2011-census/key-statistics-for-local-authorities-in-england-and-wales/stb-2011-census-key-statistics-for-england-and-wales.html>. Accessed January 2, 2013.
7. Sudlow CLM, Warlow CP. Comparing Stroke Incidence Worldwide What Makes Studies Comparable?. *Stroke*. 1996 Mar 1;27(3):550–8.
8. Adams HP, Bendixen BH, Kappelle LJ, Biller J, Love BB, Gordon DL, et al. Classification of subtype of acute ischemic stroke. Definitions for use in a multicenter clinical trial. TOAST. Trial of Org 10172 in Acute Stroke Treatment. *Stroke*. 1993 Jan 1;24(1):35–41.
9. Leyden M, Kleinig J, Newbury J et al. Adelaide stroke incidence study: declining stroke rates but many preventable cardioembolic strokes. *Stroke*. 2013 May; 44(5):1226-31.
10. Kelly J, Crispino G, Sheehan O et al. Incidence, event rates, and early outcome of stroke in Dublin, Ireland: the North Dublin population stroke study. *Stroke*. 2012 Aug;43 (8):2042-7.
11. Feigin V, Carter K, Hackett M et al. Ethnic disparities in incidence of stroke subtypes: Auckland Regional Community Stroke Study, 2002-2003. *Lancet Neurol*. 2006 Feb;5(2):130–9.
12. Hilmarsson A, Kjartansson O, Olafsson E. Incidence of first stroke: a population study in Iceland. *Stroke*. 2013 Jun; 44(6):1714-6

13. Smith Z, Knight T, Sahota P, Kernohan E, Baker M. Dietary patterns in Asian and Caucasian men in Bradford: differences and implications for nutrition education. *Journal of Human Nutrition and Dietetics*.1993 Aug;6, 323-333

14. Nomani A, Nabi S, Badshah M, Ahmed S. Review of acute ischaemic stroke in Pakistan: progress in management and future perspectives. *Stroke and Vascular Neurology*. 2017;2:30-39

**Table 1. Pathological 1st ever stroke incidence (per 100,000) by ethnicity and mid-decade age bands group in Bradford residents , UK in 2013-2014**

	Total population	All stroke types		IS		pICH		SAH		SUT	
		No.	Incidence rate	No.	Incidence rate	No.	Incidence rate	No.	Incidence rate	No.	Incidence rate
White											
18-44 years	79,899	19	24	13	16	3	8	3	8	0	
45-54 years	33,128	32	97	27	82	2	6	3	9	0	
55-64 years	28,426	59	208	45	158	8	28	6	21	0	
65-74 years	18,649	108	579	87	467	14	75	7	38	0	
75-84 years	13,082	117	894	88	673	21	161	3	23	4	
≥ 85 years	5,394	103	1909	91	1687	10	185	2	37	0	
All ages	178,578	438	254	351	197	58	32	24	13	4	2.2
Standerised*			101		80		15		9		
Pakistani											
18-44 years	43,113	11	26	8	19	3	7	0		0	
45-54 years	6,266	8	128	6	96	1	16	1	16	0	
55-64 years	4,379	22	503	21	480	1	23	0		0	
65-74 years	2,148	15	698	12	559	3	140	0		0	
75-84 years	1,458	20	1372	17	1166	3	206	0		0	
≥ 85 years	226	7	3097	6	2655	1	442	0		0	
All ages	57,590	83	144	70	121	12	21	1	1.7	0	
Standerised*			155		132		22		1.8		

\*Age-adjusted rate standardised to the WHO world population. IS, ischemic stroke; pICH, primary intracerebral haemorrhage; SAH, subarachnoid haemorrhage; SUT, Stroke of Undetermined Type.

**Table 2. Risk factors among White and Pakistani patients with 1st-ever stroke in Bradford residents, UK in 2013-2014**

Medical history	White (N= 438 )	Pakistani (N= 83 )	P-value
IHD	103 (24%)	17 (20%)	0.54
Hypertension	301 (69%)	58 (70%)	0.80
Hyperlipidaemia	354 (81%)	73 (88%)	0.17
AF	125 (29%)	8 (10%)	<0.001
CCF	47 (11%)	10 (12%)	0.70
Obesity	103 (26%)	28 (34%)	0.049
PAD	30 (7%)	6 (7%)	0.90
DM	92 (21%)	42 (51%)	<0.001
current smoker	146 (33%)	16 (19%)	<0.001
ex-smoker	126 (29%)	9 (11%)	<0.001
TIA	42 (10%)	7 (8%)	0.70
FH of stroke	66 (15%)	12 (14%)	0.80
Alcohol	57 (13%)	1 (1.2%)	0.007

IHD, ischemic heart disease; AF, atrial fibrillation; CCF, congestive cardiac failure; PAD, peripheral arterial disease; DM, diabetes mellitus; TIA, transient ischemic attack; FH, family history.