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Original Paper

Stroke Types in Rural and Urban Northern Portugal: Incidence and 7-Year Survival in a Community-Based Study

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Key Words
Stroke · Incidence · Survival · Prognosis · Rural/urban Portugal

Abstract
Background/Aim: Differences in stroke incidence and mortality between regions could stem from differences in the incidence of particular stroke types and long-term prognosis. The aim of this study was to investigate whether different risk profiles and stroke types underlie the difference in stroke incidence and patient long-term survival in rural and urban populations. ***Methods:*** All suspected first-ever-in-a-lifetime strokes occurring between October 1998 and September 2000 in 37,290 residents of rural municipalities and in 86,023 individuals living in the city of Porto were entered into a population-based registry. Standard definitions of stroke types and overlapping comprehensive sources of information were used for patient identification. Patients were examined by neurologists at 3 months, 1 year and 7 years after the index event. ***Results:*** From a total of 688 patients included (226 in rural and 462 in urban areas), 76.2% had an ischaemic stroke (IS; 75.3 vs. 77.9%), 16.1% a primary intracerebral haemorrhage (PICH; 16.3 vs. 14.6%) and 3.3% a subarachnoid haemorrhage (SAH; 2.7 vs. 3.7%); in 4.4% (4.9 vs. 4.1%), the stroke type could not be determined. The annual incidence rate per 1,000 was 2.13 (95% CI, 1.95–2.31), 0.45 (95% CI, 0.37–0.53), 0.09 (95% CI, 0.06–0.14) and 0.12 (95% CI, 0.08–0.17), respectively. The age-specific rural/urban incidence rate ratios for IS in the youngest group (<55 years) was 0.27 (95% CI, 0.11–0.69), increasing to 1.47 (95% CI, 1.07–2.01) for those aged 65–74 years and to 1.87 (95% CI, 1.39–2.52) for those between 75 and 84 years. Rural compared to urban patients with an IS were predominantly men, had a prevalence ratio (PR) of 1.28 (95% CI, 1.05–1.56), were 65 years or older (PR = 1.18; 95% CI, 1.08–1.30) and had

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in general a lower prevalence of risk factors. There was no evidence of rural/urban differences in 28-day case fatality for the stroke types, although IS tended to be less fatal among urban patients (10.3 vs. 13.1%), whereas PICH (33.3 vs. 24.2%) and SAH (35.3 vs. 16.7%) were less fatal among rural patients. Independently of rural/urban residence, predictors of poor survival after the acute phase (28 days) were age >65 years (HR = 3.57; 95% CI, 2.6–4.9), diabetes (HR = 1.5; 95% CI, 1.2–1.9), ischaemic heart disease (HR = 1.8; 95% CI, 1.3–2.6), atrial fibrillation (HR = 1.5; 95% CI, 1.1–2.0) and smoking habits (HR = 1.6; 95% CI, 1.1–2.3). ***Conclusions:*** The age pattern of IS incidence marks the difference between rural and urban populations; the youngest urban and the oldest rural residents were at a higher risk. Although patients from rural areas were older, the relatively lower prevalence of simultaneously occurring risk and prognostic factors among them as well as the similar management of rural and urban patients may justify why rurality is not associated with long-term survival.

Introduction

Despite the continuous decrease in mortality rates from stroke in Portugal in the last two decades [1], disparities still remain in standardized rates among rural (77.1/100,000) and urban (71.8/100,000) areas in northern Portugal [2]. We have shown that this excess mortality in rural areas could be partially explained by a higher incidence of stroke and not by short-term case fatality, i.e., 30.1% in rural areas compared to 27.9% in the city of Porto in the first year following the first-ever-in-a-lifetime stroke (FELS) [3]. Rather than being a single pathological entity, stroke is a disease that includes distinct types having different incidence rates, risk profiles, management guidelines and outcomes that may lead to different disease burdens in different regions. Comparing the incidence of different stroke types as well as the risk profiles and long-term survival of patients with these stroke types in rural and urban populations may add important knowledge about their aetiology, prevention and prognosis. In order to accurately assess the incidence of different stroke types, studies investigating stroke incidences must meet ideal criteria [4, 5], such as the use of diagnostic brain imaging for the majority (ideally for all) of the patients [6]. In accordance to these criteria, a community-based prospective stroke registry was set up in northern Portugal [3]. The aim of this article is to present data on stroke types regarding incidence, risk profile and long-term survival for understanding the patterns of stroke in rural and urban populations.

Population and Methods

The ACINrpc was a community-based study of the incidence and outcome of FELS and transient neurological focal symptoms and signs. The overall design of the project has been described in detail elsewhere [3]. In brief, the study population comprised 123,112 individuals registered and identified by a unique health service at five health centres on September 30, 1999 (mid-study period): 37,089 in rural areas and 80,023 in the city of Porto. This population was not significantly different from the corresponding geographic population [3]. Case ascertainment lasted from October 1, 1998, to September 30, 2000, and included both 'hot- and cold-pursuit data collection' using a variety of overlapping sources of information.

A study neurologist examined all suspected cases as soon as possible, and a CT was performed after the event. Medical records from hospitals and/or general practitioners (GP) were checked for details of any previous event and vascular risk factors (VRF). The principal investigator reviewed the information of each patient and classified the type of stroke;

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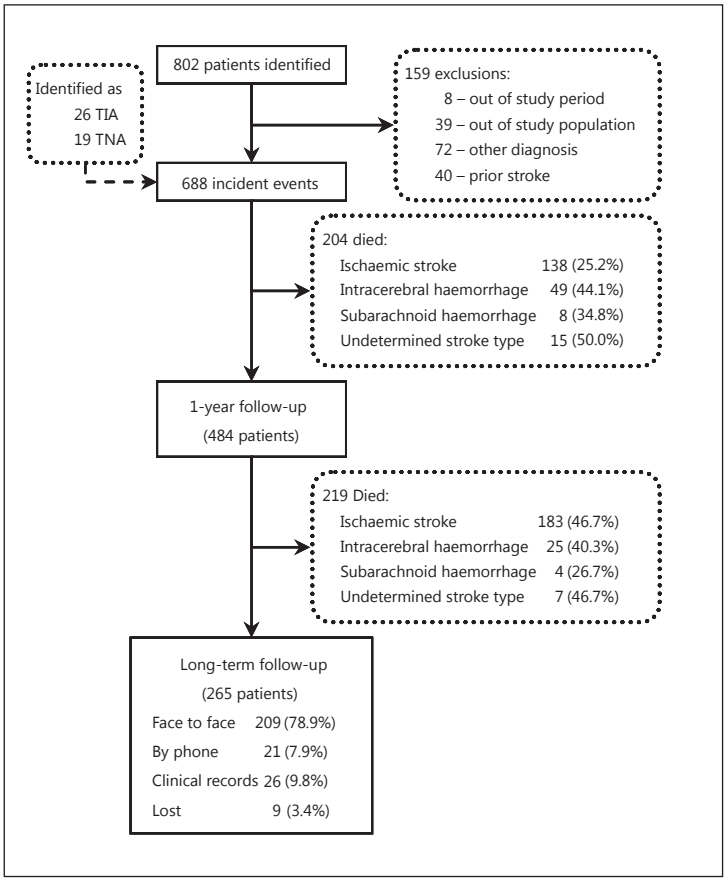

Fig. 1. Ascertainment and inclusion of FELS in northern Portugal and details of the 7-year follow-up.

whenever appropriate, the classification was established after consensus between the neurologist who first examined the patient and the principal investigator.

All patients were followed up by neurologists at 3 months, 1 year and 7 years after the index event. The long-term follow-up began in September 2005, and every attempt was made to include all patients alive at the 1-year follow-up (fig. 1). The process began by updating the telephone contacts of the patients using health centre/hospital administrative files and all available information on patient medical records. This was followed by a first contact by phone made 15 days before the end of the 7-year period, and, when this failed, two letters were sent explaining the study purpose and suggesting a date for a consultation. Patients who collaborated but were not willing to complete the consultation were contacted by phone, and for those unable to come to the hospital, home visits were scheduled. For patients known to be deceased based on previous information, a family member/caregiver had to give information about the date and circumstances of death; otherwise, a search was done in the computer files held at the Northern Regional Health Administration. In case of death, information about date and circumstances of death was confirmed by manual inspection of written monthly reports at each health centre since current legislation forbids the use of death certificates for research purposes. This information was linked to existing clinical records for assigning the underlying cause of death, determined by a study neurologist. If no contact or information could be obtained, the patient was considered lost to follow-up.

Stroke was defined according to the World Health Organization [7], and stroke types were classified according to Sudlow and Warlow [5] as ischaemic stroke (IS), primary intra-

cerebral haemorrhage (PICH) and subarachnoid haemorrhage (SAH). If no brain CT scan was performed within 30 days and no autopsy, lumbar puncture or angiography (in case of suspected SAH) results were available, stroke was classified as undetermined. For VRF, the following definitions were used: for hypertension, a history of high blood pressure (BP) or an anti-hypertensive treatment or systolic BP >160 mm Hg and/or diastolic BP >95 mm Hg on at least two different measures; for diabetes, a previous diagnosis/treatment of diabetes mellitus with oral anti-diabetic/insulin or fasting glycaemia >126 mg/dl, postprandial glycaemia ≥200 mg/dl and/or a glucose tolerance test with values of glycaemia ≥200 mg/dl at the second hour; for hypercholesterolaemia, a previous diagnosis/treatment of hypercholesterolaemia or a serum total cholesterol level after 12 h of fasting ≥240 mg/dl; and for cardiac disease, a previous diagnosis of angina, myocardial infarction (MI) or atrial fibrillation by EKG confirmation, a previous diagnosis of a transient ischaemic attack (TIA), and smoking, categorized as never smoked, smoked regularly but not in the preceding 12 months (ex-smoker) and current smoker.

The Ethics Committee of the Hospital de Santo António, where the study coordination centre was located, approved the study. Informed consent was obtained from each participant, or from the next of kin when appropriate, before any clinical assessment. Since medical records are part of the National Health Service institutions, for follow-up purposes clinical files were used whenever the patient could not be contacted.

Statistical Analysis

The distribution of patient characteristics at baseline according to stroke type is described. The crude incidence rates age-standardized to the Portuguese [8] and European populations [9] are reported, and the 95% confidence intervals (CI) were calculated by the Poisson distribution. The rural/urban ratios of VRF prevalence, stroke incidence and case fatality were calculated based on cross-tabulation and were used to compare rural and urban patients. The Kaplan-Meier estimates for the cumulative risk of death for stroke types over a period of 7 years after the index event were calculated in rural and urban patients. After checking the assumption of proportional hazards with the Schoenfeld's test, the rural/urban hazard ratios (HR) were calculated using a Cox model including the baseline risk profiles. Since this assumption failed when considering the time from the index event until death over the 7-year follow-up, this model was restricted to patients surviving the acute phase (28 days).

Results

Of the 688 FELS (226 in rural and 462 in urban areas), 76.2% were IS (75.3 in rural vs. 77.9% in urban), 16.1% were PICH (16.3 vs. 14.6%), 3.3% SAH (2.7 vs. 3.7%) and 4.4% of undetermined stroke type (4.9 vs. 4.1%). More cases in rural compared to urban areas were ascertained by 'hot-pursuit' and sooner after the event. Nearly 56% of the patients were admitted to the hospital, with a similar proportion for IS in both rural and urban areas but a lower proportion of PICH in the rural area (69.7 vs. 96.2%). Overall, a CT scan was performed in 96.9% of the patients (not done in 12 urban and 9 rural patients) and in 70.3% within 24 h following the event.

Vascular Risk Profiles and Incidence

Although patients were mostly women (58.7%), men predominated in rural areas (48.2 vs. 37.9%) either with an IS or PICH; patients from rural areas were older than patients from urban areas, especially those with an IS (table 1). Hypertension was the most prevalent VRF (60.9%), whereas a previous TIA was seldom registered (8.6%). In general, the prevalence of

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Table 1. Ascertainment and patient characteristics (in %) by stroke type in urban and rural areas

	Urban				Rural				Ratio rural:urban			
	IS (n = 348)	PICH (n = 78)	SAH (n = 17)	All (n = 462)	IS (n = 176)	PICH (n = 33)	SAH (n = 6)	All (n = 226)	IS		PICH	
									ratio	95% CI	ratio	95% CI
First source of information												
'Hot pursuit'	76.4	56.4	23.5	69.5	97.2	97.0	83.3	94.7	1.27	1.19–1.35	1.72	1.40–2.11
Health centre	5.5	–	–	5.6	47.2	60.6	16.7	48.7				
Hospital	71.0	56.4	23.5	63.9	50.0	36.4	66.7	46.0				
Patient assessment												
Emergency services	93.7	97.4	100.0	92.0	93.8	97.0	100.0	91.2	1.00	0.95–1.05	1.00	0.93–1.07
<3 h	36.8	50.0	52.9	39.5	48.8	71.9	66.7	52.9	1.33	1.08–1.63	1.45	1.07–1.97
In-patient admission	50.3	96.2	100.0	57.8	50.6	69.7	100.0	52.2	1.01	0.84–1.20	0.72	0.58–0.91
Time between onset and CT scan <24 h	67.2	83.3	70.6	69.1	67.0	66.7	50.0	65.9	1.00	0.88–1.13	0.80	0.62–1.04
Patient characteristics												
Male gender	38.2	37.5	29.4	37.9	48.9	51.5	–	48.2	1.28	1.05–1.56	1.39	0.89–2.15
Mean age ± SD, years	71.0±13.1	67.2±14.6	59.9±19.0	70.3±13.9	73.6±9.4	67.5±12.3	58.8±19.7	72.5±10.9				
>65 years	71.0	55.1	52.9	68.2	84.1	60.6	50.0	80.1	1.18	1.08–1.30	1.10	0.78–1.54
Hypertension	62.9	69.2	52.9	62.3	58.0	69.7	–	58.0	0.92	0.79–1.07	1.01	0.77–1.32
Hypercholesterolaemia	41.4	28.2	17.6	37.9	28.4	9.1	16.7	24.8	0.69	0.53–0.90	0.32	0.10–1.00
Diabetes	29.6	24.4	11.8	27.1	21.6	9.1	–	18.6	0.73	0.53–1.01	0.37	0.12–1.18
Atrial fibrillation	17.2	3.8	–	13.9	17.0	–	–	13.3	0.99	0.66–1.47	–	
MI/angina	11.5	10.3	5.9	10.6	5.7	3.0	–	5.3	0.49	0.25–0.96	0.30	0.04–2.27
TIA	12.4	2.6	–	9.7	7.4	–	–	6.2	0.60	0.33–1.08	–	
Smoking habits												
Current smoker	17.2	12.8	23.5	16.9	8.0	6.1	–	8.0	0.46	0.27–0.80	0.47	0.11–2.04
Ex-smoker	9.2	5.1	–	7.8	5.7	12.1	–	6.2	0.60	0.30–1.19	2.36	0.63–8.89

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Table 2. Age-specific annual incidence per 1,000 for stroke types in urban and rural northern Portugal (1998–2000)

Age group (in years)	Person-years	IS			PICH			SAH			Undetermined		
		n	rate	95% CI	n	rate	95% CI	n	rate	95% CI	n	rate	95% CI
Urban													
00–34	68,706	2	0.03	0.00–0.11	2	0.03	0.00–0.11	1	0.01	0.00–0.08	0	0.00	0.00–0.05
35–44	24,806	15	0.60	0.34–1.00	4	0.16	0.04–0.41	3	0.12	0.02–0.35	0	0.00	0.00–0.15
45–54	23,500	24	1.02	0.65–1.52	9	0.38	0.18–0.73	3	0.13	0.03–0.37	2	0.09	0.01–0.31
55–64	19,584	48	2.45	1.81–3.25	17	0.87	0.51–1.39	1	0.05	0.00–0.28	0	0.00	0.00–0.19
65–74	19,544	102	5.22	4.21–6.23	20	1.02	0.63–1.58	6	0.31	0.11–0.67	5	0.26	0.08–0.60
75–84	11,812	108	9.14	7.42–10.9	14	1.19	0.65–1.99	1	0.08	0.00–0.47	6	0.51	0.19–1.11
≥85	4,094	49	11.97	8.85–15.8	12	2.93	1.51–5.12	2	0.49	0.06–1.76	6	1.47	0.54–3.19
All	172,046	348	2.02	1.81–2.24	78	0.45	0.36–0.57	17	0.10	0.06–0.16	19	0.11	0.07–0.17
ASRP			1.63	1.44–1.82		0.38	0.29–0.48		0.09	0.05–0.14		0.08	0.04–0.14
ASRE			1.26	1.10–1.44		0.32	0.24–0.42		0.08	0.04–0.13		0.06	0.03–0.11
Rural													
00–34	33,690	1	0.03	0.00–0.17	0	0.00	0.00–0.11	1	0.03	0.00–0.17	0	0.00	0.00–0.11
35–44	9,972	2	0.20	0.02–0.72	0	0.00	0.00–0.37	1	0.10	0.00–0.56	1	0.10	0.00–0.56
45–54	8,360	2	0.24	0.03–0.86	7	0.84	0.34–1.72	0	0.00	0.00–0.44	0	0.00	0.00–0.44
55–64	8,386	19	2.27	1.36–3.54	6	0.72	0.26–1.56	1	0.12	0.00–0.66	0	0.00	0.00–0.44
65–74	8,350	64	7.66	5.90–9.79	10	1.20	0.57–2.20	2	0.24	0.03–0.86	3	0.36	0.07–1.05
75–84	4,152	71	17.10	13.4–21.6	8	1.93	0.83–3.80	1	0.24	0.01–1.34	4	0.96	0.26–2.47
≥85	1,268	17	13.41	7.81–21.5	2	1.58	0.19–5.69	0	0.00	0.00–2.91	3	2.37	0.49–6.92
All	74,178	176	2.37	2.02–2.72	33	0.44	0.31–0.62	6	0.08	0.03–0.18	11	0.15	0.07–0.27
ASRP			2.12	1.79–2.45		0.42	0.28–0.59		0.08	0.03–0.18		0.13	0.06–0.25
ASRE			1.51	1.23–1.79		0.35	0.23–0.51		0.07	0.02–0.16		0.09	0.04–0.19
All													
00–34	102,396	3	0.03	0.01–0.09	2	0.02	0.00–0.07	2	0.02	0.00–0.07	0	0.00	0.00–0.04
35–44	34,778	17	0.49	0.28–0.78	4	0.12	0.03–0.29	4	0.12	0.03–0.29	1	0.03	0.00–0.16
45–54	31,860	26	0.82	0.53–1.20	16	0.50	0.29–0.82	3	0.09	0.02–0.28	2	0.06	0.01–0.23
55–64	27,970	67	2.40	1.86–3.04	23	0.82	0.52–1.23	2	0.07	0.01–0.26	0	0.00	0.00–0.13
65–74	27,894	166	5.95	5.05–6.86	30	1.08	0.73–1.54	8	0.29	0.12–0.56	8	0.29	0.12–0.56
75–84	15,964	179	11.21	9.57–12.9	22	1.38	0.86–2.09	2	0.13	0.02–0.45	10	0.63	0.30–1.15
≥85	5,362	66	12.31	9.52–15.7	14	2.61	1.43–4.38	2	0.37	0.04–1.35	9	1.68	0.77–3.19
All	246,224	524	2.13	1.95–2.31	111	0.45	0.37–0.53	23	0.09	0.06–0.14	30	0.12	0.08–0.17
ASRP			1.76	1.60–1.93		0.39	0.32–0.48		0.08	0.05–0.13		0.10	0.06–0.15
ASRE			1.33	1.19–1.48		0.33	0.26–0.41		0.07	0.04–0.12		0.07	0.04–0.11
Incidence rate ratios rural/urban													
00–54			0.27	0.11–0.69		1.05	0.43–2.57		0.64	0.13–3.09		1.12	0.10–12.4
55–64			0.92	0.54–1.57		0.82	0.33–2.09		2.34	0.15–37.3		–	
65–74			1.47	1.08–2.01		1.17	0.55–2.50		0.78	0.16–3.86		1.40	0.34–5.88
75–84			1.87	1.39–2.52		1.63	0.68–3.87		2.84	0.18–45.5		1.90	0.54–6.72
≥85			1.12	0.65–1.94		0.54	0.12–2.40		–			1.61	0.40–6.45
All			1.19	0.95–1.50		1.10	0.69–1.75		0.89	0.32–2.50		1.62	0.62–4.27

ASRP = Age-standardized rate for the Portuguese population, 1999; ASRE = age-standardized rate for the European population.

VRF was lower in rural compared to urban patients, namely cardiac disease (IS and ICH), hypercholesterolaemia and smoking habits (IS).

The crude overall annual incidence rate per 1,000 population was 2.13 (95% CI, 1.95–2.31) for IS, 0.45 (95% CI, 0.37–0.53) for PICH, 0.09 (95% CI, 0.06–0.14) for SAH and 0.12 (95% CI, 0.08–0.17) for strokes of undetermined type; adjusted for the European population, these rates were 1.33 (95% CI, 1.19–1.48), 0.33 (95% CI, 0.25–0.41), 0.07 (95% CI, 0.04–0.12) and 0.07 (95% CI, 0.04–0.11), respectively (table 2). The ratio of rates indicates that the incidence of IS in the youngest group (<55 years) was lower in rural compared to urban populations, particularly in men (0.12; 95% CI, 0.02–0.91). The opposite trend was found among those aged 65–84 years (2.19; 95% CI, 1.37–3.49 in men and 1.65; 95% CI, 1.12–2.45 in women; results not shown). For the remaining stroke types, there was no evidence of differences in the age pattern of incidence rates between the rural and urban environment.

Short- and Long-Term Survival

Of the 688 FELS patients, 204 (29.7%) died during the first year; the 7-year follow-up details for the 484 survivors are described in figure 1. Nine patients were lost after the 1-year follow-up (1.1–2.4 years), mostly because they had changed residence or went abroad (7 IS, 1 PICH and 1 SAH). Among the 209 (78.9%) patients examined by the neurologist, 21 (10%) were visited at their homes. The follow-up time ranged from 7 to 8.6 years.

By day 28, 59 (11.3%), 34 (30.6%), 7 (30.4%) and 11 (36.7%) patients had died after the first IS, PICH, SAH and undetermined stroke, respectively. There was no evidence of rural/urban differences in 28-day case fatality for the different stroke types, although IS tended to be less fatal among urban patients (10.3 vs. 13.1%), whereas PICH (33.3 vs. 24.2%) and SAH (35.3 vs. 16.7%) were less fatal among rural patients, corresponding to rural/urban ratios of 1.26 (95% CI, 0.77–2.06), 0.73 (95% CI, 0.37–1.44) and 0.47 (95% CI, 0.07–3.16), respectively. The cumulative risk of death at 7 years followed the same pattern: IS was less fatal in urban patients (57.4 vs. 61.5%), and PICH (67.4 vs. 64.6%) or SAH (61.2 vs. 33.3%) were less fatal in rural patients. The proportional mortality from stroke (first or recurrent stroke) was 74.8% (83/111) at 28 days, 48.0% (98/204) during the first year and 30.3% (128/423) at the end of follow-up after 7 years. Figure 2 shows the risk of death at 28 days and by year for ischaemic and haemorrhage stroke (PICH and SAH), indicating a relatively constant yearly risk after 3 years in patients with an IS. Table 3 shows the independent baseline predictors of long-term survival after the acute phase. Besides age, diabetes (HR = 1.48; 95% CI, 1.15–1.92), MI/angina (HR = 1.80; 95% CI, 1.25–2.58), atrial fibrillation (HR = 1.47; 95% CI, 1.07–2.00) and being a current smoker (HR = 1.60; 95% CI, 1.13–2.28) increased the risk of death, whereas hypercholesterolaemia was a protective factor (HR = 0.45; 95% CI, 0.34–0.59). Stroke type and rural/urban residence were not associated with survival after the acute phase.

Discussion

This is the first study to present a comprehensive picture of the burden of stroke among rural and urban populations, looking at the incidence of stroke types as well as at vascular risk profiles and long-term survival of patients. A high proportion of patients were ascertained by 'hot-pursuit'; almost all underwent a CT soon after the initial symptoms, thus improving the reliability of the results for the incidence of stroke types [5]. Differences in procedural aspects mostly stem from the organization of the National Health Service; health centre services are more readily available than hospital services for rural populations, and in the city this is mainly a question of choice since there are no barriers of distance. Almost all

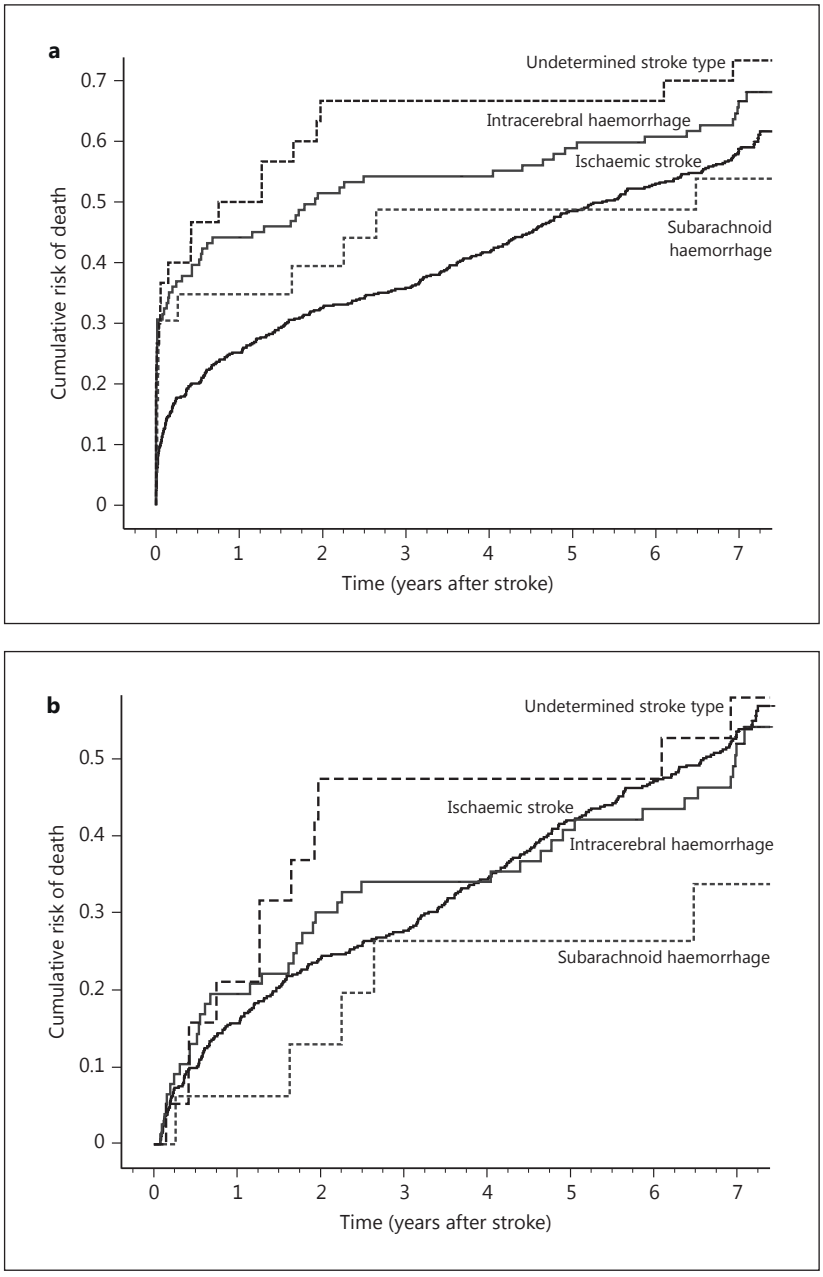

Fig. 2. Kaplan-Meier estimates of the cumulative death risk for all patients (**a**) and the cumulative death risk in 28-day stroke survivors by stroke type (**b**). N = Cumulative number of patients.

Stroke type	0–28 days	29 days to 1 year	1–2 years	2–3 years	3–4 years	4–5 years	5–6 years	6–7 years
Ischemic								
At risk, n	524	465	392	351	331	301	266	242
Death, n (N)	59 (59)	73 (132)	38 (170)	17 (187)	30 (217)	35 (252)	23 (275)	28 (303)
Risk, %	11.3	15.7	9.8	4.9	9.1	11.6	8.7	11.6
95% CI	8.8–14.3	12.7–19.3	7.2–13.1	3.1–7.7	6.4–12.6	8.5–15.7	5.9–12.7	8.1–16.2
Hemorrhagic								
At risk, n	134	93	77	66	61	61	56	54
Death, n (N)	41 (41)	16 (57)	9 (66)	5 (71)	0 (71)	5 (76)	2 (78)	7 (85)
Risk, %	30.6	17.2	12.0	7.6	0.0	8.2	3.6	13.0
95% CI	23.4–38.9	10.9–26.1	6.4–21.3	3.3–16.5	0.0–5.9	3.6–17.8	1.0–12.1	6.4–24.4

Table 3. HR for the association between factors at presentation and death among 28-day survivors

	Univariate		Multivariate	
	HR	95% CI	HR	95% CI
Sociodemographics				
Rural versus urban	1.18	0.93–1.49	1.00	0.79–1.29
Men versus women	1.00	0.80–1.26	0.94	0.71–1.24
Age >65 versus ≤65 years	3.58	2.62–4.90***	3.57	2.58–4.95***
Risk factors (yes vs. no)				
Hypertension	0.81	0.64–1.02	0.86	0.68–1.09
Diabetes	1.21	0.94–1.56	1.48	1.15–1.92**
Atrial fibrillation	2.01	1.49–2.72***	1.47	1.07–2.00*
MI/angina	1.58	1.11–2.23**	1.80	1.25–2.58**
TIA	0.92	0.61–1.37	0.99	0.66–1.47
Hypercholesterolaemia	0.46	0.36–0.60***	0.45	0.34–0.59***
Smoking habits				
Ex-smoker	0.65	0.42–1.02	0.80	0.49–1.31
Current smoker	1.07	0.80–1.43	1.60	1.13–2.28**
Diagnosis (vs. IS)				
PICH	0.96	0.69–1.34	1.12	0.79–1.58
SAH	0.52	0.21–1.25	0.63	0.26–1.75
Undetermined stroke type	1.15	0.63–2.10	1.28	0.69–2.36

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

patients (91–92%) were seen at an 'emergency service'; however, in rural areas it was mostly at the health centre (open 24 h) and this is why these patients are more often observed within 3 h after the stroke. Nevertheless, in case of a PICH, there were fewer hospital admissions of rural compared with urban patients, though they remained in-patients in the health centre. Overall, the health services provided were similar for rural and urban patients, and based on previous studies we know that individuals living in rural areas are more prone to attend the family doctor at the health centre in case of most stroke warning signs than individuals living in urban areas [10].

There was a higher incidence of both IS and PICH in rural than urban areas. Nevertheless, the comparison of standardized rates obscured the differences in the incidence age pattern in the two populations, particularly in IS. On average, the first IS happened almost 3 years earlier in life among the urban population, leading to a higher IS incidence in the youngest group (<55 years), especially in men, whereas for those aged 75–84 years living in rural areas, the average risk is almost twice as high than in the city. Although patients living in rural areas were older, they had, in general, less traditional VRF than patients living in urban areas, in particular cardiac disease and hypercholesterolaemia in patients with IS. The reduced information and awareness of VRF [10] in rural areas and the consequent lack of monitoring probably led to an under-reporting and/or under-diagnosis, mainly by GPs, since by description of ascertainment, health centre services are 'more accessible' in rural areas. On the other hand, our results go in the same direction than those from a Dutch study [11], in which self-reported health problems pointed to a better health in rural areas, although this could not be confirmed by the information available on GP records.

Figure 3 shows the joint distribution of IS and PICH incidence across community-based studies with standardized rates (European population) or if data were available for calculation [12–34]. The IS incidence ranged from 57/100,000 in Menorca [29] to 255/100,000 in

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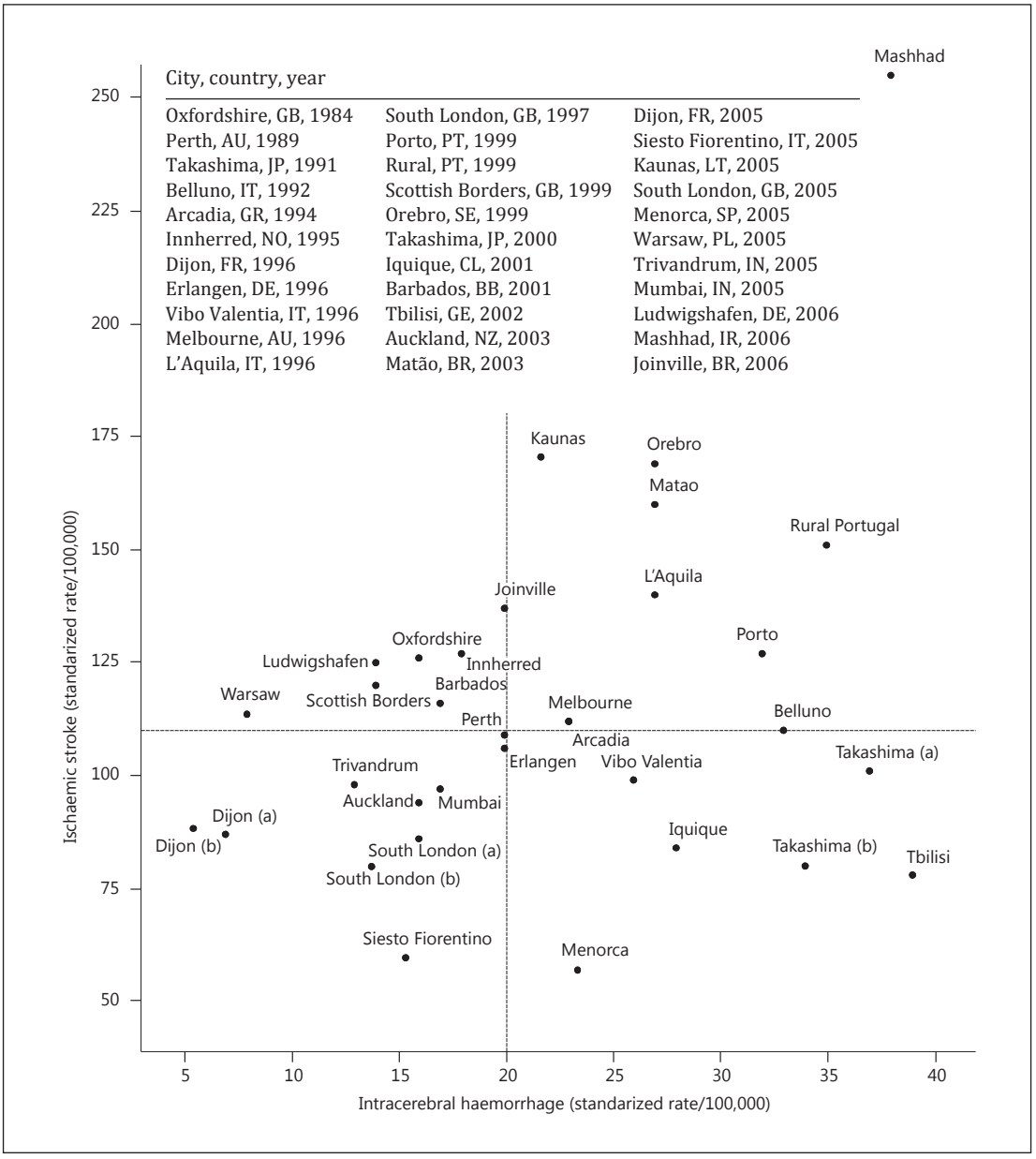

Fig. 3. Joint distribution of standardized IS and intracerebral haemorrhage incidence in community-based studies. The lines represent the median values.

Mashhad [33], and the incidence of PICH ranged from 6/100,000 in Dijon [29] to 39/100,000 in Tbilisi [26]. Both Portuguese urban and rural populations are in the upper-right quadrant, indicating a relatively high incidence of both IS and PICH, with the first being only higher in Mashhad, Kaunas, Orebro and Matão [23, 28, 29, 33] and the latter in Mashhad, Tbilisi and Takashima [14, 26, 33]. Apart from Japan, studies in Greece [16], Italy [15, 19, 21] and Georgia [26] also reported a relatively high incidence of PICH, probably linked to the high prevalence of hypertension and excess of salt in the Mediterranean diet, similar to the Japanese diet with a high consumption of salted fish [35]. The standardized incidence of SAH in this group of studies ranged from 1 to 16/100,000 (median = 6/100,000), and the values in Portugal are

close to the median. The comparison of the incidence of stroke types may be biased since the incidence of undetermined strokes could be as high as 59/100,000 (Trivandrum [30]), resulting from the low proportions of patients investigated with brain CT/MR scan and/or with a postmortem examination. Though we verified that there was no linear correlation between the year of the study and the standardized incidence of the different stroke types, the same could not be said in relation to the prevalence of VRF as a trend towards a lower incidence of PICH was found in repeated studies in Takashima [14], South London and Dijon [18, 29] (fig. 2). Nevertheless, in comparison with other studies, the prevalence of hypertension in patients from an urban area, representing a population-attributable risk for IS of 45.2% and for PICH of 73.6% [36], is among the highest (only exceeded in Oxfordshire [12] and Iquique [24]) for IS, and is the highest among Portuguese patients with PICH [15, 27, 37]; the same was found for diabetes mellitus, though the proportion of active smokers was relatively low compared to other studies [12, 15]. Besides traditional risk factors, environmental factors such as cold weather [38] and dietary habits may explain the relatively high variation shown in incidence rates.

There was no evidence of rural/urban differences in short- and long-term case fatality for the stroke types, though IS tended to be less fatal in patients from urban areas, whereas PICH and SAH were less fatal in patients from rural areas. The overall early case fatality after an IS (11.3%) found in this study is among the lowest values reported in all studies (range 10–26%) [12, 13, 15–26, 28, 32, 34]; the values for PICH (30.6%) and SAH (30.4%) are also among the lowest within the respective ranges (20–61% for PICH [23, 25] and 8–50% for SAH [15, 18, 20]). The cumulative risk of death at 7 years follows an identical pattern as the 28-day case fatality in rural/urban populations, and the values are close to those reported in Perth after a FELS and higher than in Oxfordshire after an IS and lower for haemorrhagic stroke for a 5-year follow-up [39, 40]. As in these studies, the proportional mortality from stroke in this study abruptly decreased after the acute phase. Neither stroke type nor residence was a predictor of long-term survival after the acute phase, but most risk factors were at the same time prognostic factors. Besides age <65 years, diabetes, atrial fibrillation, heart disease and smoking habits were predictors of poor survival, while hypercholesterolaemia was not. These results confirm recent findings [41, 42] and may justify why long-term survival is not associated with urban/rural environment. Since the stroke care chain is similar for patients from rural and urban areas, the older rural patients may have indeed a better survival than expected because risk/prognostic factors are less prevalent among them.

We have shown that the high incidence of stroke in rural compared to urban populations from northern Portugal is largely accounted for by the high incidence of cerebral infarcts, particularly in the rural elderly. The relatively better prognosis of IS and PICH in northern Portugal compared to other regions may result from the relatively high incidence of IS among the youngest age group living in the city as well as the relatively low prevalence of VRF in the eldest rural patients, pointing to different public health strategies. For better understanding the rural/urban differences in IS incidence, future analysis should be focused on the incidence of clinical subtypes of IS, aetiology and associated VRF.

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Disclosure Statement

The authors have no conflicts of interest with respect to this work.

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