

ORIGINAL RESEARCH

Comparison of stroke among Christians and Muslims in Thrace, Greece

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ABSTRACT

Introduction: Background and purpose: Previous studies have demonstrated significant racial differences in incidence, age of onset, outcome and subsequent risk factors of stroke. However, there is scarce evidence available for Muslim populations worldwide. Xanthi region, a mainly rural and remote area in northern Greece, which is characterized by a mixed Christian/Muslim population, is considered appropriate for further studies in this area.

Methods: A prospective clinical study, based on a cohort of 530 consecutive unselected patients, 366 Christians and 164 Muslims, who had their first documented episode of stroke between 1998 and 2002. Chi-square and Fisher's exact test for comparison between discrete parameters, Student's *t*-test for comparison between quantitative parameters and Pearson's *r* for correlations (along with Bonferroni's adjustment) were used. A multiple logistic regression model was performed for evaluation of religion and gender as independent predictors of type of stroke.

Results: Muslims, when compared with Christians: (1) present with ischemic stroke less often ($p = 0.049$); (2) suffer from stroke at a younger age (67.26 ± 9.77 vs 71.43 ± 10.88 years; $p < 0.001$); (3) show a significantly lower incidence rate (87.2 vs 173.9 cases/100 000 person*years; RR 1.994; $p < 0.001$); (4) have lower rates of diabetes ($p = 0.019$) and atrial fibrillation ($p < 0.001$) and (5) present similar mortality ($p = 0.347$).

Conclusions: Lower diabetes and atrial fibrillation rates among the Muslims of Thrace, Greece, might account for their low incidence of stroke. The contribution of culture-related habits (diet, occupation) remains to be investigated in further studies.



Key words: epidemiology, risk factors, women and minorities.

Introduction

Previous studies have demonstrated significant racial differences in incidence, age of onset, outcome and subsequent risk factors of stroke in mixed populations, especially in the USA¹⁻⁴.

An excess stroke mortality rate among African Americans is known and persists despite dramatic declines in stroke mortality between 1970 and 1990 for both white and African-American men and women. Only a portion of this excess stroke mortality among African Americans can be attributed to the higher prevalence of hypertension and diabetes and to the lower average socioeconomic status⁵.

Racial differences in risk factors have been documented among the white, black and Hispanic population of the USA¹. In an effort to investigate unexplained stroke or transient ischemic attack in both African-Americans and Caucasians, the former were found to have fewer complex thoracic aortic atheroma and fewer combined cardiac sources of embolus than the latter. This suggests that it is doubtful if atherosclerosis accounts for the differences in stroke incidence between them⁶. In a recent study carried out in the USA, race was not proved to be a predicting factor for future stroke events⁷.

A study involving Singaporean populations of Chinese, Malay and Indian origin failed to document differences in the prevalence of stroke among them. Nevertheless, it underlined the role of gender because the prevalence of stroke was found to be highest among Chinese men and lowest among Malay women⁸.

Minority population groups tend to present significant barriers concerning both acute stroke treatment and stroke prevention⁹. The former may be explained in some minority

groups by existing linguistic deficiencies in mainly older people that inhibit case history documentation, whereas the latter may be explained by different application of risk factors⁴. A recent study demonstrated that black stroke survivors had greater activity limitations than white stroke survivors¹⁰.

Studies investigating any powerful relationship between religion and stroke are rare in the literature. An interesting study has shown a significant lack of preventive health care practices, minimal avoidance of dietary cardiovascular risk factors, and a significant difference between men's and women's cardiovascular risk factor status in the old order Mennonite population, who represent cloistered Christian communities whose religious and cultural traditions pervade their dietary and health practices¹¹.

Focusing on either Muslims or Christians, the available literature is even more scarce. In a study investigating the beliefs of caregivers and traditional healers within the South African Indian Muslim community, regarding the etiology and treatment of stroke and the persons likely to be consulted in this regard, the participants expressed disillusionment with referrals to Western healthcare professionals whose treatment was often regarded as culturally inappropriate; they also emphasized the integral role played by family members in the treatment of illness and disease¹². Controversially, in a small sample comprising Christian stroke patients, a qualitative approach using a long interview method was employed to expand on spiritual practices expressed through prayer as a way of coping after stroke¹³.

Little, however, is known about stroke in Muslim populations. In a Turkish study investigating the role of Ramadan fasting in the incidence of stroke, no relationship was documented¹⁴. No true comparative study including Muslims has been carried out. However, similar studies



analyzing stroke incidence and mortality have been carried out in non-Muslim mixed populations with success¹⁵⁻¹⁷.

The aim of the present study was to detect possible differences concerning type, incidence, age of onset, outcome and subsequent risk factors of stroke in the mixed Christian/Muslim population of Xanthi region, Thrace, Greece. These data might be useful for evaluation of present healthcare status and for suggesting further action.

Methods

Setting

This study was performed in the Prefecture of Xanthi, a mainly rural and remote area in northern Greece. The area (Fig. 1) is inhabited by a population of 99 607 (mean true population estimate for the year 2000). Table 1 depicts mean true estimates for the same year according to religion (Christian : Muslim ratio: 52.81% : 47.19%) and gender (men : women ratio: 49.54% : 50.46%)¹⁸⁻¹⁹.

Study population and sample

The study was based on 530 consecutive unselected stroke patients, who suffered from their first documented episode of stroke and were hospitalized under the responsibility of the Internal Medicine Department in the local hospital between 9 February 1998 and 8 February 2002. Data concerning sex, age and religion were collected.

Data collection

For each patient entered in the study, as part of history documentation, based on previous admissions²⁰⁻²⁶, a detailed medical history was recorded including:

- Hypertension (abnormal systolic and/or diastolic arterial pressure during the period of hospitalization or positive record), diabetes (abnormal fasting

glucose and/or glycosylated haemoglobin levels or positive record), and hypercholesterolemia (LDL > 130 mg/dl)

- Tobacco (smoker or non-smoker) and alcohol (more or less than 20 g/day) habits
- Chronic or paroxysmal atrial fibrillation, previous myocardial infarction, heart failure
- Previous stroke
- Obstructive carotid angiopathy, peripheral vascular angiopathy
- Sick sinus syndrome, endocarditis, myocarditis
- Pulmonary embolism, use of contraceptives and polycythemia.

All patients underwent a thorough physical and neurological examination at least three times (on admission, 24 hours later and shortly before leaving the department). Additionally, a routine blood and serum test including hematocrit, hemoglobin and plasma levels of glucose, urea, creatinine, electrolytes and lipids, as well as a 12 lead ECG, chest radiography and CT scan were performed. All laboratory departments were on 24 hour duty and were qualitatively controlled by both internal and external control protocols. CT scan was selectively repeated after a period of 24-48 hours. In cases of unclear differential diagnosis, an MRI was performed. In the case of death, post-mortem findings were used only when it was impossible to document the underlying cause through medical record, physical examination and CT scan findings.

The cerebral infarcts were categorized on the basis of CT scan findings as lacunar when CT scan showed small, deep infarcts measuring 3-15 mm, corresponding to the clinical syndrome (pure motor hemiparesis, pure sensory stroke, hemiparesis-ataxia, dysarthria-clumsy hand, hemichorea-ballismus), non-lacunar (atherothrombotic, cardioembolic, by other causes, of unknown etiology) when the CT scan showed infarcts >15 mm and with negative CT scan. Hemorrhagic strokes were classified as intracranial hemorrhage (ICH), subarachnoid hemorrhage (SAH), or combined.



Figure 1: Map depicting the Xanthi district, Greece.

Table 1: Demographics and main descriptive statistics (mean \pm SD) of the population of the study

Variable	True population	No. cases	Age of onset
Total	99 607	530	70.14 \pm 10.71
Christians total	52 602	366	71.43 \pm 10.88
Ischemic		325	71.69 \pm 10.88
Hemorrhagic		41	69.33 \pm 10.78
Christian men	26 059	192	71.91 \pm 11.43
Ischemic		168	71.74 \pm 11.68
Hemorrhagic		24	73.09 \pm 9.61
Christian women	26 543	174	70.89 \pm 10.24
Ischemic		157	71.63 \pm 9.99
Hemorrhagic		17	73.09 \pm 9.61
Muslims total	47 005	164	67.27 \pm 9.77
Ischemic		134	66.93 \pm 9.93
Hemorrhagic		30	73.09 \pm 9.61
Muslim men	23 286	84	66.43 \pm 9.00
Ischemic		69	66.49 \pm 8.73
Hemorrhagic		15	66.13 \pm 10.47
Muslim women	23 719	80	68.16 \pm 10.51
Ischemic		65	68.26 \pm 10.78
Hemorrhagic		15	67.73 \pm 9.66



At the end of the hospitalization period, proposed treatment and the final outcome in terms of a modified Rankin scale were recorded²⁷. Fewer categories than those proposed by the modified Rankin scale were formed to allow statistical performance. In detail, categories 1 and 2, as well as 4 and 5 of the original Rankin Scale were unified in the modified scale used in the present study (as category 2 and 4, respectively). This modified Rankin scale ranged from 1 (no neurological damage) to 5 (death). Unfortunately, the requested one-year follow-up period was not achieved in all cases, especially those concerning the older Muslim population. Thus, risking severe bias, follow-up results were omitted.

Ethical issues

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000. The study was approved by the Ethics Committee of the Xanthi General Hospital.

Data analysis

Student's unpaired *t*-test used dichotomous variables. Chi-square and, alternatively, Fisher's exact test was used for discrete parameters when expected frequencies fell below 5. A modified χ^2 test was used for comparison of incidence rates based on the number of cases and the person-time units. Three-dimensional χ^2 test was used for the comparison of 2 x 2 tables between two groups. Pearson's *r* was used for correlation analysis. All tests were two-tailed. All mean values were accompanied by 95% confidence intervals. Relative risk was computed based on data from the 2 x 2 tables. The level of statistical significance was set at $p < 0.05$. A multiple logistic regression model (available online at <http://members.aol.com/johnp71/logistic.html>) was used for the detection of powerful relationships between religion, gender and type of stroke. All *p* values were given at two digits significance levels. Analysis was performed with the use of an interactive statistical tool

(<http://members.aol.com/johnp71/javastat.html>) and confirmed by the use of SPSS vers. 9.5 (SPSS Inc, Chicago, IL, USA).

Results

Types of stroke

All 530 cases of stroke were classified according to their type as ischemic (459 cases; 86.6%) or hemorrhagic (71 cases; 13.4%). Their distribution according to religion and gender is shown (Table 1). A multiple logistic regression model, which was used for the detection of any powerful relationship between religion and gender and type of stroke, revealed that the Christian religion was a probable risk factor for ischemic stroke (OR = 2.131, 95%CI 1.005-4.521, $p = 0.0486$). Neither gender was correlated with type (OR=1.062, 95%CI 0.481-2.343, $p = 0.883$), nor did an interaction exist between religion and gender (OR=0.714, 95%CI=0.255-2.000, $p = 0.521$).

Ischemic strokes were classified according to CT findings as lacunar (126 of 452 cases; 27.9%), non-lacunar (222 of 452 cases; 49.1%) and having a negative CT (104 of 452 cases; 23.0%).

Hemorrhagic strokes were classified as intracranial (66 of 78 cases; 84.6%), subarachnoid (9 of 78 cases; 11.5%) and combined hemorrhage (3 of 78 cases; 3.8%).

Age of onset

From the medical history of enrolled patients, 17 of 530 (3.2%) had potentially suffered from a previous episode of stroke that had remained unrecognized. Nevertheless, these patients were not omitted from further statistical analysis because the documentation of a previous stroke was insufficient. The mean age of stroke incidence was found to be 70.14 ± 10.71 years. Using Student's unpaired *t*-test, a difference between Christians (71.43 ± 10.88 years) and



Muslims (67.26 ± 9.77 years) was documented ($p < 0.001$), attributed to men ($p < 0.001$), rather than women ($p = 0.055$), and to ischemic ($p < 0.001$), rather than hemorrhagic ($p = 0.346$) strokes. Detailed data are included (Table 1).

Incidence rates of stroke

Incidence rates are summarized (Table 2) and are expressed in 100 000 persons*years. The numeric values represent the product of the number of cases (Table 1), the mean true population (Table 1) and the years of the study ($n = 4$).

Muslims presented lower incidence rates than Christians as far as total ($p < 0.001$) and ischemic stroke cases were concerned. This difference did not apply to hemorrhagic stroke cases and, thus, the positive correlation they present with the Muslim population is explained.

No difference was found in the distribution of ischemic and hemorrhagic stroke between men and women ($p = 0.457$; $2 \times 2 \times 2 \chi^2$).

Hospitalization period

There was no difference ($p = 0.581$; Student's unpaired t -test) in the mean duration of hospitalization between Christians (6.65 ± 3.21 days) and Muslims (6.83 ± 3.97 days).

Outcome

The patients' final outcomes are summarized (Table 3). Sixteen patients were dispatched to other hospitals and, thus, their outcome was not observed. Comparison between Christians and Muslims using the modified Rankin scale did not reveal any difference ($p = 0.111$; Student's unpaired t -test). A prominent difference was established after comparison between ischemic and hemorrhagic stroke ($p < 0.001$; Student's unpaired t -test).

Using Pearson's correlation coefficient, a worse outcome ($p < 0.001$) was correlated with older age, hemorrhagic stroke, diameter of hemorrhagic lesion, diameter of infarct, elevated mean temperature over the first 48 h, elevated mean

systolic BP over the first 48 h, elevated mean diastolic pressure over the first 48 h, presence of atrial fibrillation, smoking habits and elevated cholesterol.

Correlation of risk factors and other parameters with religion

The use of Pearson's correlation coefficient r revealed that Muslims suffering from stroke presented greater instances of elevated systolic ($p = 0.037$) and diastolic ($p = 0.025$) BP during the first 48 h after admission for stroke than did Christians, despite their similar medical records regarding hypertension ($p = 0.806$). Controversially, diabetes and atrial fibrillation were less usual in Muslims ($p = 0.019$ and $p < 0.001$). All other risk factors failed to present statistically significant correlations with religion. Moreover, neither the diameter of infarct or hemorrhage nor the temperature on admission correlated with religion. The statistically significant results were documented after the application of Bonferroni's adjustment (which is used to avoid type I errors in multiple correlations). The modified level of statistical significance was computed to be $\alpha = 0.0472$.

Discussion and Conclusions

The present study suggests that the Muslims of Thrace, Greece, have a lower incidence of total and ischemic strokes than the Christians. In fact, the overall incidence of stroke in the Muslims of Thrace (87 cases per 100 000 per year) is significantly lower than in other Muslim populations (137 cases per 100 000 per year in Isparta, Turkey)¹⁴ and below mean worldwide values²⁸. However, the Christians of the present study presented a similar average age of stroke onset and similar mortality when compared with those of the Athens Registry²⁹. Moreover, the present study concludes that the Muslims of Thrace suffered from stroke at a younger age than the Christians. In fact, the Muslims of Thrace who suffered from stroke were 5 years older than the Muslims of Izmir, Western Turkey, according to the Ege Stroke Registry (62.3 ± 12.0 years)³⁰. Because these two Muslim populations of different origins (mainly Pomaks in Thrace and Turks in



Izmir)³¹ suffered from stroke at a relatively young age, it may be interpreted that a common epigenetic factor is responsible.

What are the major stroke determinants that differ between the Christians and Muslims of Thrace? The data presented suggest that two risk factors differ between the two communities: diabetes mellitus and atrial fibrillation, both favoring Muslims. The Muslims' traditional cuisine, characterized by the consumption of animal fat instead of olive oil, seems to be balanced by their natural way of life, consisting of low calorie intake, plentiful exercise and manual work.

Although the Christians' and Muslims' medical records were similar regarding hypertension, the Muslims' elevated mean systolic and diastolic BP during the first 48 h suggests poor control of hypertension during the acute phase (prejudicial medical care), more severe strokes or a greater degree of hypertension. Because the final outcome is similar in Christians and Muslims, the first two are improbable, and thus a greater degree of hypertension might account for this difference.

Trends in population BP levels have been proposed to explain trends in stroke event rates³². Moreover, it is well documented that hemorrhagic strokes are more closely related to elevated BP than are ischemic strokes³³. Thus, the absence of a favorable difference concerning hemorrhagic strokes in Muslims and the lower mean age of onset may reflect a latent situation of uncontrolled hypertension. This potential handicap may be well overcome by the favorable difference in diabetes and atrial fibrillation in case of ischemic strokes.

What could foster hypertension in Muslims? A powerful difference between Muslim and all other subpopulations may be a surprisingly high incidence of depression, especially among women³⁴⁻³⁶. In a series of 4963 patients hospitalized in our department during the time of the present study, the incidence rates of suicide attempts due to severe depression was 44 per 100 000 per year among Christians and 83 per

100 000 per year among Muslims (V Papadopoulos, unpubl. data, 2005). Depression could be a mechanism that interacts with the effort to control hypertension; people suffering from depression may underestimate their disease and fail to comply with medical recommendations.

Additional differences between the Christians and Muslims of Thrace, was the level of education (a considerable proportion of Muslims remain undereducated), the types of occupation (the majority of Muslims work with agriculture, cattle-breeding and manual tasks) and the income per capita (relatively low in Muslims); these might play a role in stroke development. It has been documented that low socioeconomic status and poor education are negative predictors for stroke incidence and severity⁵. Moreover, Muslims encounter some restrictive parameters as far as proper use of medical services, due to the harsh landscape of many Muslim villages and the linguistic handicap of mainly older people. Finally, Muslims' strict religious observance of the Ramadan fasting period lead them to omit even medication, although a relevant paper claims that the Ramadan period is not negatively involved in differences concerning stroke incidence¹⁴.

Despite the fact that the present study has contributed to stroke epidemiology in Muslims, it has certain limitations. The relatively small sample size, its regional character and an inability to approach the few but existing non-hospitalized cases are some limitations. The number of stroke cases who remain non-hospitalized is believed to be small, because all emergencies reach the local hospital without the intervention of a physician or a GP. However, because there is no obvious reason for religion-related bias in these cases, it may be hypothesized that the present study is a merely a true incidence study that can temporarily substitute for an official stroke registry in the region. Nevertheless, taking into consideration the absence of similar studies, the present conclusions might offer a starting point for future efforts. A field survey targeting patients with previous stroke might be more appropriate in determining the real incidence of stroke and related risk factors in the region, thus providing a clearer view of differences.



Table 2: Incidence rates of stroke among Christian and Muslim population of the present study expressed per 100 000 persons*years

Variable	Christians	Muslims	χ^2	P	RR (± 95% CI)
Overall	173.9	87.2	55.566	<0.001	1.994 (1.659 – 2.397)
Ischemic (men)	160.2	73.0	30.731	<0.001	2.195 (1.657 – 2.906)
Ischemic (women)	152.6	66.4	32.523	<0.001	2.298 (1.720 – 3.071)
Hemorrhagic (men)	23.0	16.1	0.868	0.351	1.430 (0.758 – 2.696)
Hemorrhagic (women)	16.0	15.8	0	1	1.013 (0.513 – 2.001)

Table 3: Outcome of the stroke cases in the present study

Present study category	1	2	3	4	5	Total
Rankin scale analogue	0	1&2	3	4&5	6	
Christians ischemic	89	78	75	41	38	321
Christians hemorrhagic	5	7	6	5	16	39
Muslims ischemic	33	27	32	17	21	130
Muslims hemorrhagic	1	4	5	6	8	24
Total	128	116	118	69	83	514

In conclusion, the natural way of life (manual work and healthy nutrition) might explain the lower diabetes and atrial fibrillation rates and thus the low stroke incidence rate among the Muslims of Thrace. Thus, all care should be taken to encourage the traditional way of life which seems to exert a prophylactic effect concerning stroke development. Additionally, efforts should be made to clarify confounding factors such as education and occupation, and to investigate the true presence of hypertension among the Muslim population. Clarification should also be attempted regarding the value of targeted cost-effective non-pharmaceutical and pharmaceutical interventions, which may further assist public health status^{32,37-44}.

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