

Stroke epidemiology in Karabük city Turkey: Community based study

Nilay Padir Şensöz^a, Ülkü Türk Börü^a, Cem Bölük^{a,*}, Adnan Bilgiç^b, Özgür Öztop Çakmak^c, Arda Duman^d, Mustafa Taşdemir^e

^a University of Health Sciences, Dr. Lütfi Kırdar Kartal Research and Training Hospital, Department of Neurology, Istanbul, Turkey

^b Ereğli State Hospital, Department of Neurology, Ereğli, Turkey

^c Koç University, Department of Neurology, Istanbul, Turkey

^d Maltepe State Hospital, Department of Neurology, Istanbul, Turkey

^e Istanbul Medeniyet University, Department of Public Health, Istanbul, Turkey



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ABSTRACT

Introduction: Stroke has been projected to increase in developing countries like Turkey. Information about the prevalence of stroke may uncover the etiology of stroke and overcome its impact burden. However, data is limited due to a lack of studies based in Turkey and neighboring regions. We aimed to investigate the prevalence and risk factors of stroke in the Turkish city of Karabük and to pave the way for future epidemiological studies in Turkey.

Methods: The study was designed as a cross-sectional, door-to-door survey. The questionnaire was completed by a trained team in the presence of the participants according to their answers. Patients who had been diagnosed with stroke prior to the survey were re-examined by a neurologist.

Results: 3131 persons who were above 44 years old were screened. 129 of them were found to have had a stroke previously. The prevalence rate of stroke above 44 years was found to be 4.12% (98% confidence level and \pm 2% margin of error). 72.1% of stroke patients had hypertension. Male/female ratio was 0.72.

Conclusion: This study showed a high prevalence rate of stroke in Karabük Turkey with a low male/female ratio when compared to other studies.

1. Introduction

Stroke is the second most common cause of death among the adult population in the developed world. In addition, it is a leading cause of disability also. Its impact on global health and the health care system is predicted to rise significantly [1–3].

Recent studies showed that stroke prevalence all over the world is increasing [4,5]. Most of these studies are based in Europe and North America. The actual prevalence of stroke in the Middle East and Turkey is unclear. There is only one published Turkish study that was conducted in Denizli, and it was a door-to-door survey [6].

Therefore, this study was carried out for the purpose of finding out the prevalence rate in a particular part of Turkey.

2. Materials and methods

The study was conducted in the form of a cross-sectional, door-to-door survey. It was undertaken in conjunction with a Multiple Sclerosis (MS) prevalence study also carried out in Karabük.

2.1. Study area

Karabük is a city in the Western Black Sea region of Turkey. It is located between 40.08° North Latitude and 32.04° East Longitude. The altitude of the city is 280 m. The city is 760 km². 60% of its surface is covered in trees. In winter, it is cold and snowy and in the summer, it is hot and the average rain fall is 780 mm. According to the 2014 census, the population of the city center is 132,658. Karabük is home to homogenous Turkish people, migration rate is low. Most people work as laborers in the iron and steel factory or are retired factory workers. Karabük was built in the 1930s as the seat of the iron and steel industry of Turkey. There are also chemical plants that produce sulfuric acid and phosphates, nearby are the Zonguldak coal fields. One of the major steel producers in Turkey, named *Kardemir (Karabük Iron and Steel Works)*, is located in Karabük which was built in 1937. It has been in operation since 1937. It is the main source of air pollution [7].

* Corresponding author at: Dr. Lütfi Kırdar Kartal Training and Research Hospital Neurology Department, Cevizli Street, 34890 Istanbul, Turkey.
E-mail address: cem.boluk@sbkeah.gov.tr (C. Bölük).

2.2. Sample size calculation

Sample size was calculated as 3.111 persons with a 98% confidence level and a $\pm 2\%$ margin of error. Ten out of 27 neighborhoods were determined with simple random sampling. Home visits were performed at each neighborhood until specified participant numbers were reached.

2.3. Data collection

We used a modified validated version of the questionnaire (sensitivity 85.7%, specificity 99%) created by WHO for developing countries which we had previously used in our study on the prevalence of stroke in Şile, Istanbul. The questionnaire consisted of following questions; participants were asked whether they had been diagnosed with cerebrovascular disorders by a doctor, whether or not they needed help with day to day activities; whether or not they had had a stroke in the last six months.

Risk factors were asked in the second section. The presence of a high blood pressure diagnosis by a doctor, the presence of a diabetes diagnosis by a doctor, the presence of coronary heart disease or other heart diseases diagnosis by a doctor, the presence of hyperlipidemia diagnosis by a doctor, whether or not they consume alcohol more than once a week, whether or not they are currently a smoker. The survey was completed in accordance with participants' answers.

20 surveyors were grouped together from locals in the city. 4 teams were formed consisting of one doctor, a local nurse and 5 surveyors. On the first day, these teams were trained on questionnaire completion methods as well as diseases.

The survey was carried out door to door and face to face. Those who declared that they had suffered a stroke diagnosed by a doctor were examined by the neurologist from the team. If the person was unable to express themselves, a relative was questioned in their home. In the event that no one was home, the same house was visited the next day. The survey was conducted between 1 and 30 April 2014.

2.4. Case ascertainment

Neurological and laboratory findings of the patients were examined by a neurologist. At the end of the survey, all patients were re-examined by an experienced neurologist.

2.5. Statistical analysis

All data was recorded electronically and statistical analyses was performed using PASW Statistics 18.0 software. Frequency distributions and percentages were calculated. Results were considered to be statistically significant at the level of $p < 0.05$.

3. Results

In total, 3452 persons above 44 years old were approached and 321 of them declined to participate in the study. 3131 (90.7%) were screened. 1479 (47%) of them were men, 1652 (53%) of them were women. Their mean age was 59.3 ± 11.6 years old.

It was found that 129 persons had suffered a stroke. The prevalence rate of stroke above 44 years was found to be 4.12%. The crude prevalence rate of stroke in Karabük according to age and sex distribution is shown in [Table 1](#).

111 (86%) patients had had an ischemic stroke, 18 (14%) patients had had a hemorrhagic stroke. The demographical characteristics of the stroke patients are shown in [Table 2](#)

Risk factors; Hypertension was found in 41.6% of the total population. Diabetes mellitus was found in 22.9% of the total population. Heart disease was found in 16.2% of the total population. 22.4% of them had hyperlipidemia. 17.6% of them were current smokers. 2.7% of them consume alcohol currently. Risk factors of the screening

population are shown in [Table 3](#).

Stroke patients' risk factors; 93 (72.1%) of them had hypertension. 45 (34.9%) of them had diabetes mellitus. 48 (37.2%) of them had heart disease. 57 (44.2%) of them had hyperlipidemia. 16 (12.4%) of them were current smokers. 3 (2.3%) of them consume alcohol. Risk factors in stroke patients are illustrated in [Table 4](#).

4. Discussion

The results of the study illustrate that in Karabük city center the prevalence rate of stroke among those over 44 years is rather high. The female rate is higher than that of men. The prevalence rate increases with age.

Unfortunately, stroke prevalence in Turkey is unknown as there is only one published study. This study was undertaken in Denizli in an urban area between 2010 and 2011. Their study methodology was similar to ours in that it was a field study. Their results showed a 0.9% stroke prevalence in over 44 years old [\[6\]](#).

In 2013, a second study which was a PhD study was conducted by our clinic as a door-to-door survey in Şile, Istanbul, which is a coastal town by the Black Sea. Of the total population, 1429 of all over 44 year olds were screened in that survey. The stroke prevalence rate was found to be 2.9% (unpublished data).

Among the three regions, the highest prevalence rate belongs to Karabük. The high prevalence rate in this area may be due to the presence of a steel factory which causes documented air pollution. According to official records, particulate matter levels in Karabük are 10 times higher than WHO's threshold and six times higher than the EPA threshold [\[8\]](#). Recent studies indicate a link between air pollution and stroke. In one such study, the relationship between high $PM_{2.5}$ levels and an increase in stroke risk was seen to be linear. In addition, a strong link between exposure to black carbon and NO_2 markers of traffic pollution and stroke was found to be significant. These findings are in agreement with past studies suggesting that traffic pollution may trigger ischemic strokes [\[9–12\]](#). A study conducted in Karabük showed that the accumulation of trace elements caused DNA variation in Lichens and this effect was highest in the Sample Lichens exposed after six months [\[13,14\]](#). A multiple sclerosis prevalence study, that was being undertaken at the same time in Karabük, showed a high prevalence rate when compared to other areas in Turkey (unpublished data). Air pollution not only causes stroke but several other neurologic illnesses also [\[15\]](#).

The feasible reason for the relatively low prevalence rate in Şile may be due to the fact that it is a rural area without industrialization, urbanization and air pollution. Most studies recorded that the prevalence rate of stroke in urban areas is significantly higher than in rural areas. Several studies indicated high prevalence rates in urban areas globally, including Spain, China and India [\[16–19\]](#).

Despite the Denizli study being carried out in an urban area, the prevalence was found to be very low, compared to two other studies in Turkey. A study recorded that the Mediterranean diet has a preventive effect in relation to stroke [\[20\]](#). Ischemic stroke had a statistically significant inverse association with the Mediterranean diet. Together with regular physical activity and not smoking, their analyses suggest that over 80% of coronary heart disease, 70% of stroke, and 90% of type 2 diabetes can be avoided by healthy food choices that are consistent with the traditional Mediterranean diet [\[21\]](#).

The varying results of these three studies from Turkey could possibly not be caused by genetic factors. Lifestyle, diet and environmental factors may play a part in the prevalence of stroke.

It is difficult for us to compare our study results with those of our neighbors. This is because the prevalence rate of stroke in our neighboring countries and the Middle East is unknown. A study from Iran recorded a considerably higher incidence rate than in most Western countries. The annual incidence of first ever stroke in Iran was found to be 0.139% [\[22\]](#).

Table 1
Prevalence rate of stroke according to sex and age.

Age	Females			Males			Total		
	Population	Case	PR	Population	Case	PR	Population	Case	PR
45–54	701	13	1.9	652	5	0.8	1353	18	1.3
55–64	410	12	2.9	388	12	3.1	798	24	3.0
65–74	306	21	6.9	249	11	4.4	555	32	5.8
75–84	185	23	12.4	161	22	13.7	346	45	13
≥ 85	50	6	12.0	29	4	13.8	79	10	12.7
All age	1652	75	4.5	1479	54	3.7	3131	129	4.1

Abbreviations: PR; Prevalence Rate %.

Table 2
Clinical and demographical characteristics in 129 stroke patients.

Characteristics	Number
Mean age	69.9 ± 11.8
Gender	
Female	75 (58.1%)
Male	54 (41.9%)
Male/Female	0.72
Stroke subtypes	
Ischemic	111 (86.0%)
Hemorrhagic	18 (14.0%)

Most stroke prevalence studies are sourced in Europe. The prevalence rate varies between 3.8 and 8.7% [17]. A community based three racial cross-sectional survey from Asia showed the prevalence rates in China 4.3%, in Malaysia 3.74% and in India 3.69% [5].

Some studies recorded a two times higher prevalence rate in men when compared to women [16,17,19]. The results of our study showed an opposite trend. The reason for this result should be investigated.

4.1. Limitations of the study

This study did not include transient ischemic attacks because TIA patients can recover without being admitted to hospital or they may forget about it due to its short duration. For this reason, the prevalence rate value may appear a low.

4.2. Advantages of the study

One advantage of this study that was a cross-sectional study carried out door-to-door. There is an important weakness for prevalence studies conducted according to medical records in both Turkey and developing countries to show healthy results, due to a lack of compulsory enrollment at clinics in the patients' local area. It is possible for patients to seek treatment at multiple centers. In addition to this, bed bound patients may not be able to even visit a hospital and may not have up to date medical records.

Another advantage of the study is that patients or participants were seen by a neurologist in the field and then again by an experienced

Table 3
Risk factors' proportions according to age groups among the study population.

Age	45–54	55–64	65–74	75–84	≥ 85	Total
Risk factors						
Hypertension	351(27.0%)	377(29.0%)	328(25.2%)	210(16.1%)	36(2.8%)	1302
Diabetes	221(30.8%)	219(30.5%)	175(24.4%)	89(12.4%)	14(1.9%)	718
Heart disease	137(27.0%)	135(26.6%)	126(24.9%)	91(17.9%)	18(3.6%)	507
Hyperlipidemia	214(30.5%)	212(30.2%)	168(24.0%)	91(13.0%)	16(2.3%)	701
Current smoker	368(66.8%)	117(21.2%)	43(7.8)	22(4.0%)	1(2.0%)	551
Current alcohol intake	57(67.9%)	19(22.6%)	7(8.3)	1(1.2%)	0	84

neurologist at the medical center of the city. As this study was carried out together with the local neurologist in Karabük, a big percentage of participating patients were being followed up by the local neurologist and their records were used in the diagnosis.

In conclusion, our study showed that, stroke prevalence was at a higher rate when compared to previous study undertaken in Turkey. The prevalence rate of stroke in women was found to be higher than in men. Further studies will be needed in order to discover the wider prevalence rate of stroke in Turkey.

Conflict of interest

The authors declare they have no conflict of interest with respect to this research study and paper.

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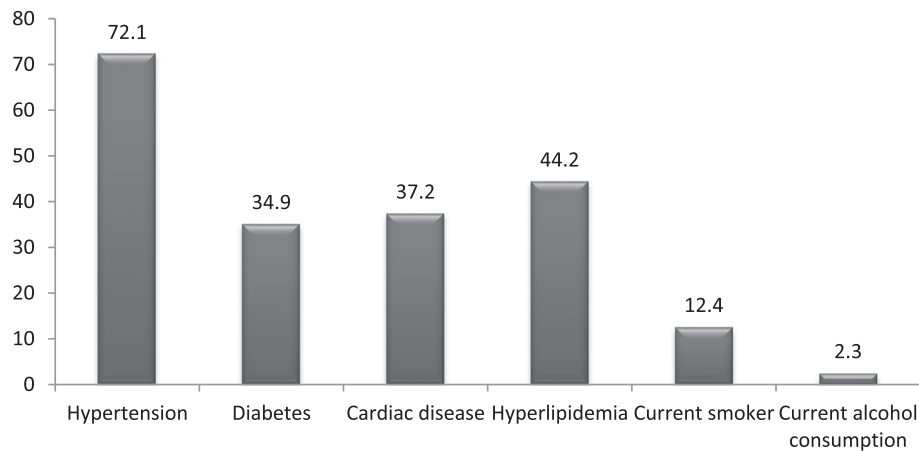
Ethical approval

The study was approved by The Dr. Lutfi Kırdar Kartal Training and Research Hospital Ethics Committee (Ref:/89,513,307/1009/234). In addition, permission was granted by The Karabük Public Health Directorate.

Informed consent

Verbal consent was obtained from individuals during the screening survey.

Table 4
Prevalence (%) of risk factors in patients with stroke.



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