Risk Factors for Ischemic Stroke in a Russian Community
A Population-Based Case-Control Study

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Background and Purpose—This study was conducted to determine the risk factors for ischemic stroke in a defined Russian population.

Methods—Our data are based on a population-based case-control study of 237 patients with first-ever ischemic stroke and 237 age- and sex-matched controls. Logistic regression methods for matched pairs were used to estimate the relative risk for the variables studied.

Results—In a multivariate analysis, hypertension, left ventricular hypertrophy on electrocardiography, ischemic heart disease, mitral valve disease, current cigarette smoking, and high body mass index were significant and independent risk factors for ischemic stroke in this Russian community.

Conclusions—The significant risk factors for ischemic stroke in Novosibirsk are similar to those from other populations and cohorts. This study, the first of stroke risk factors in Russia, has implications for clinical practice and the planning of stroke prevention in the population. (Stroke. 1998;29:34-39.)

Key Words: epidemiology ischemic risk factors stroke

Epidemiologic studies of the risk factors for stroke have been very important for defining several measures to prevent stroke and for increasing the understanding of the origin of stroke in different regions and populations. Despite numerous prior studies of the risk factors for stroke, much remains unknown and several inconsistencies continue to exist. No population-based case-control study of the risk factors for stroke in Russia has been reported. This study was designed to evaluate, in a population-based case-control study, the relative importance of the various risk factors contributing to ischemic stroke in Novosibirsk, Russia, using standardized methods, diagnostic criteria, and a multivariate logistic regression model.

Subjects and Methods

Cases

The cases were all incident cases of ischemic stroke, whether the patient was hospitalized or nonhospitalized and whether the stroke was fatal or nonfatal, occurring from January 1, 1992, through December 31, 1992, in residents of an administratively defined and representative district of Novosibirsk (86 660 females and 71 574 males), represented by a single (white) Russian population. A detailed description of the sources of information and the methods of data collection used in this study has been published previously.3

The study was done in the general representative population of the Oktiabrsky District of Novosibirsk, Russia. All new cases of stroke that occurred for 1 calendar year in the Oktiabrsky District of Novosibirsk were registered and analyzed. Immediate notification containing information on all new cases of stroke or alleged stroke and stroke mortality came to the Stroke Registry Department on an ongoing basis. These notifications came from primary care physicians, neurologists, inpatient and outpatient clinics, pathologists, and forensic-medicine experts. The completeness of the information was verified by three specially trained research nurses of the Stroke Registry Department who (1) checked daily the death certificates for all deaths in the study region to identify persons with stroke (for those with a diagnosis of stroke, the clinical records were reviewed); (2) checked weekly the hospital registrations, hospitalization refusals, and all autopsy protocols (in the study region there were only two hospitals in which patients with stroke could be hospitalized; old stroke at brain autopsy was not included in this study); (3) checked weekly the outpatient clinic data; and (4) checked daily all ambulance call registrations within and just outside the study region. On the basis of these overlapping sources of information, all patients with stroke or suspected stroke were examined and interviewed by a specially trained cerebrovascular neurologist of the Stroke Registry Department at the hospital or at home as soon as possible after the episode of stroke or alleged stroke became known to the department. In addition, one of the authors (V.L.F.) reviewed all the records weekly and categorized patients according to the best diagnostic information available.

The definition of stroke and type of stroke were based on standard criteria.2 On the basis of the results of clinical examination (including autopsy findings when available) and CT, the subtypes of stroke were classified as cerebral infarction (ischemic stroke), intracerebral hemorrhage, and subarachnoid hemorrhage. Only persons 50 years or older with first ischemic stroke who survived the first 30 days were included in this study. Ischemic stroke was defined as the acute onset (minutes to hours) of a focal neurologic deficit consistent with a lesion of vascular origin that persisted for more than 24 hours with or without CT scan documentation (CT does not show frank hemorrhage). CT head scans were obtained in 84 of the survivors with ischemic stroke (35.4%), including 57 of 86 patients (66.2%) younger than 65 years and 27 of 151 patients (17.9%) 65 years or older. Information about risk factors of interest from previously (before the stroke date...
completed medical forms was reviewed when available, but only a few cases had a prior medical record to review.

Controls
The controls were a representative sample of the population of Novosibirsk from which the age- and sex-specific prevalence rates for each risk factor were estimated. For each case of first ischemic stroke, a control was selected from the population in which the cases arose for the period studied. A control was selected by identifying a person of the same sex who was born in the same year as one of the patients but who had not had a prior stroke at the reference date corresponding to the date of stroke. A control must have been a resident of Novosibirsk for at least 1 year before the reference date because this criterion was required for the patients with stroke. In addition, controls were selected from persons who visited the district outpatient clinic for any medical consultation nearest the date of onset of stroke in each case. The distribution of diagnoses among controls was as follows: cardiovascular disorders, 35%; common cold and other disorders of the respiratory system, 20%; gastrointestinal disorders, 15%; rheumatic and musculoskeletal disorders, 12%; posttraumatic disorders, 8%; and other disorders, 10%. Controls also must have had a medical record form indicating that there had been a medical contact within 1 year before the stroke date. If an eligible control patient did not have a recorded blood pressure or information about other potential risk factors studied (such as smoking, body mass index, family history) within his or her visit to the outpatient clinic or within 1 year of the reference date, the control patient underwent additional clinical examination and interview at home or in the outpatient clinic, and this information was recorded within 2 weeks after enrollment. The date of that examination was recorded as the reference date. The only variables measured in controls at the reference date were arterial blood pressure, weight, and height (if they had not been measured and recorded previously).

The medical record form designed for this study was completed in a standardized fashion for both cases and controls.

Risk Factors
In the cases and controls, the occurrence of a risk factor was determined from clinical examination, diagnostic procedures, and evidence in the medical record. The presence of each of the following conditions at the time of the stroke or reference date was determined: cigarette smoking, hypertension, ischemic heart disease (angina pectoris or myocardial infarction), cardiac arrhythmias (atrial fibrillation or flutter, sick sinus syndrome), presence of valvular heart disease (mitral valve disease, aortic valve disease), congenital heart disease, left ventricular hypertrophy by ECG, diabetes mellitus, TIA, BMI, and family history of stroke in first-degree relatives. A cardiac diagnosis had to have been made before the onset of stroke or reference date or at the time of first evaluation for the patients with stroke and the controls. Similarly, previously undocumented information about other potential risk factors of interest (such as smoking, history of TIA, family history of stroke, weight, and height) was obtained during the first evaluation (uncertain or unknown data were coded separately).

Unknown or missing data occurred relative to only two variables (family history in 24 cases and 14 controls, and alcohol intake in 14 cases). For the case-control matched analysis, the logistic procedure eliminated pairs in which either the case or the control had missing values for a particular variable.

Hypertension
Subjects were considered to have hypertension if they either had the diagnosis of hypertension or were treated for hypertension before the stroke or reference date. In addition, if a control had no recorded blood pressure before the reference date but had a diastolic pressure of 95 mm Hg or more or a systolic pressure of 160 mm Hg or more on two or more occasions during the study evaluation, he or she was considered to have hypertension. If a patient with stroke had a previously recorded normal blood pressure or did not have a diagnosis of hypertension in previous record forms but had a sustained blood pressure of 160/95 mm Hg or more on at least two occasions during their evaluation for stroke after the acute phase (at or about 30 days after the stroke) or received antihypertensive treatment throughout the entire period of emergency treatment and follow-up (first 30 days after stroke), he or she was considered to have hypertension. Patients with stroke who had transient hypertension resulting from increased intracranial pressure (Cushing’s reflex) and who did not receive antihypertensive treatment or received it for only a limited period during the evaluation, including patients whose blood pressure was less than 160/95 mm Hg at the time of dismissal, were not considered to have hypertension.

Left Ventricular Hypertrophy
This condition was coded as being present when it was documented in an ECG report.

Myocardial Infarction
The diagnosis was based on three criteria: (1) a documented clinical history of acute myocardial infarction, (2) the presence of serial ECG changes indicative of myocardial damage, and (3) diagnostic increase of serum enzyme values (serum glutamic-oxaloacetic transaminase, lactate dehydrogenase, and creatine phosphokinase). “Silent” myocardial infarction (that is, ECG changes suggestive of myocardial infarction which were not associated with clinical symptoms and increased serum enzyme concentrations) was not included.

Angina Pectoris
This condition was defined as chest discomfort or pain that (1) was described as heavy, tight, constricting, crushing, pressing, or squeezing; (2) might radiate into the neck, jaw, shoulder, or upper arm; (3) was often related to, or precipitated by, exertion, stress, excitement, or exposure to cold or wind; (4) was of short duration, usually lasting less than 5 minutes; and (5) was promptly relieved by rest or nitroglycerin.

Congestive Heart Failure
This condition was diagnosed in subjects with coexistence of at least four of the following criteria: (1) dyspnea on ordinary exertion (not due to pulmonary disease), (2) paroxysmal nocturnal dyspnea, (3) acute pulmonary edema described in hospital records, (4) distended neck veins (in other than in the supine position and in the absence of venous obstruction), (5) bilateral ankle edema (not known to be due to some other condition), (6) rales in the absence of pulmonary congestion (pulmonary venous congestion, prominent pulmonary veins, or pleural effusion), (7) third heart sound, and (8) radiographic evidence of pulmonary congestion (pulmonary venous congestion, prominent pulmonary veins, or pleural effusion).

Atrial Fibrillation or Flutter
The diagnosis had to be documented in an ECG report (episodes of atrial fibrillation that alternated with periods of sinus rhythm as well as lone atrial fibrillation or flutter were included).

Mitrval Valve Disease
A clinical diagnosis of mitral stenosis was made if the subject had a rumbling diastolic murmur audible at the cardiac apex. A clinical diagnosis of mitral regurgitation was made if the subject had an apical pansystolic or late systolic murmur radiating into the axilla. A clinical diagnosis of mixed mitral valve disease was made if the criteria for both mitral stenosis and regurgitation were present.

Aortic Valve Disease
Aortic valve disease referred to aortic stenosis or aortic regurgitation. A clinical diagnosis of aortic stenosis was made if a subject had a systolic ejection murmur audible at the apex or aorta area or both which radiated into the neck. The diagnosis of aortic stenosis required the presence of an aortic murmur and a diminished, slow carotid upstroke at physical examination. A clinical diagnosis of aortic
regurgitation was made if a subject had a high-pitched, early diastolic murmur best heard along the left sternal border. A diagnosis of mixed aortic valve disease was made if the clinical criteria for both aortic stenosis or sclerosis and regurgitation were present.

**Sick Sinus Syndrome**
This was judged to have been present if the diagnosis was made by a cardiologist on the basis of clinical and ancillary findings.

**Body Mass Index**
BMI was calculated as weight in kilograms divided by height in meters squared.

**Transient Ischemic Attack**
TIA was diagnosed in subjects with focal neurologic symptoms relating to focal cerebral, brain stem, or retinal ischemia with abrupt onset and complete resolution within 24 hours.

**Diabetes**
Diabetes mellitus was diagnosed if a subject had the diagnosis documented by a physician on the medical record or if the fasting blood glucose level was more than 120 mg/dL. Only persons whose diagnosis was made before stroke onset or within 30 days after the onset of stroke or reference date were considered to have diabetes.

**Cigarette Smoking**
A smoker was one who smoked at least one cigarette a day. Among cases and controls, it was determined whether the person never smoked, was a current smoker, or was a former smoker (ceased smoking for more than 6 months before stroke or reference date).

**Family History of Stroke**
A positive family history of stroke was diagnosed if a subject had a first-degree relative (parent or sibling) who had had a stroke.

**Statistical Methods for Risk Factor Analysis**
Logistic regression analysis was used to estimate the odds ratio (and 95% confidence interval) associated with each risk factor. The parameters of each model were estimated with the conditional-likelihood approach as implemented in PROC LOGIST, and P<.05 was considered evidence that the coefficient was different from zero and the odds ratio different from 1. After each variable was assessed individually, those that were significantly (adjusting for age and sex) associated with the risk of ischemic stroke were identified.

In general, assessing individual variables not in the model at each step added the most significant variable to the model. This process continued until no variable not in the model made a significant (P<.05) contribution. However, when two or more variables had probability values that were more or less equivalent, the variable that was the more physiologically relevant was selected for entry. Also, when one variable could play the role of two, that single variable was selected on the principle of parsimony. Interaction and higher-order variables were included in this process, and when several variables logically formed a set, they were considered as a set and included only collectively. As this process continued, any variable previously entered could be removed if its probability value within the model suggested that it was no longer significant. When a “final” model for the whole group was derived, each variable not in the model was then reassessed to determine whether any might make a significant contribution. Tests for interactions were also evaluated for each risk factor analyzed.

**Results**
This study included 237 cases of first ischemic stroke and 237 age- and sex-matched controls. The distributions for age and sex were the same for the cases and controls because the matching was precise. The average age (±SD) was 67.8±9.2 years (median, 68.0 years) for the patients with stroke and 67.8±9.2 years (median, 68.0 years) for the controls; the male:female ratio was 0.6 in each group.

**Table 1. Distribution of Risk Factors in Patients with Stroke (Cases)* and Controls in Novosibirsk, Russia, 1992**

<table>
<thead>
<tr>
<th>Study Factor</th>
<th>Cases (n=237)</th>
<th>Controls (n=237)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Transient ischemic attack</td>
<td>27</td>
<td>11.4</td>
</tr>
<tr>
<td>Hypertension</td>
<td>201</td>
<td>84.8</td>
</tr>
<tr>
<td>Left ventricular hypertrophy</td>
<td>43</td>
<td>18.1</td>
</tr>
<tr>
<td>Angina pectoris</td>
<td>77</td>
<td>32.5</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>21</td>
<td>8.9</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>93</td>
<td>39.2</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>17</td>
<td>7.2</td>
</tr>
<tr>
<td>Mitral valve disease</td>
<td>24</td>
<td>10.1</td>
</tr>
<tr>
<td>Aortic valve disease</td>
<td>10</td>
<td>4.2</td>
</tr>
<tr>
<td>Atrial fibrillation or flutter</td>
<td>36</td>
<td>15.2</td>
</tr>
<tr>
<td>Sick sinus syndrome</td>
<td>6</td>
<td>2.5</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>17</td>
<td>7.2</td>
</tr>
<tr>
<td>Cigarette smoking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ever smoked</td>
<td>84</td>
<td>35.4</td>
</tr>
<tr>
<td>Current smoker</td>
<td>46</td>
<td>19.4</td>
</tr>
<tr>
<td>Former smoker</td>
<td>38</td>
<td>16.0</td>
</tr>
<tr>
<td>Family history of stroke</td>
<td>43</td>
<td>18.1</td>
</tr>
<tr>
<td>Body mass index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>27.9</td>
<td></td>
</tr>
<tr>
<td>Standard deviation</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>20.8-38.1</td>
<td></td>
</tr>
</tbody>
</table>

*Age older than 50 years and survived 30 days after stroke.

Table 1 summarizes the proportion of risk factors among the two groups. The most frequent risk factors among the cases of ischemic stroke were arterial hypertension (84.8%), ischemic heart disease (angina pectoris or myocardial infarction) (39.2%), and cigarette smoking (35.4%). The mean BMI±SD was 27.9±3.2 in patients with stroke and 26.4±3.9 in controls.

In the univariate analyses (Table 2), hypertension, left ventricular hypertrophy, TIA, acute myocardial infarction, angina pectoris, aortic valve disease, congestive heart failure, mitral valve disease, atrial fibrillation or flutter, cigarette smoking, positive family history of stroke, and BMI were significantly associated with the risk of ischemic stroke, but diabetes mellitus and sick sinus syndrome were not. The risk of ischemic stroke was higher in current cigarette smokers than in those who had never smoked or were former smokers.

When multiple logistic regression analysis was performed (Table 3), the risk factors that remained independently significant (adjusting for age and sex) were, in decreasing order of odds ratio, mitral valve disease, left ventricular hypertrophy, hypertension, current cigarette smoking, ischemic heart disease, and BMI.

**Discussion**
This study provides estimates of the relative risk of ischemic stroke associated with various factors that are easily assessed in general practice in Russia. The use of overlapping sources of information about all new cases of stroke along with CT scan
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<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Coefficient</th>
<th>P Value</th>
<th>Odds Ratio</th>
<th>95% CI†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transient ischemic attack</td>
<td>.9853</td>
<td>.0078</td>
<td>2.7</td>
<td>1.30–5.54</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1.8171</td>
<td>.0001</td>
<td>6.2</td>
<td>3.58–10.57</td>
</tr>
<tr>
<td>Left ventricular hypertrophy</td>
<td>2.6120</td>
<td>.0001</td>
<td>13.6</td>
<td>4.22–44.01</td>
</tr>
<tr>
<td>Angina pectoris</td>
<td>.9214</td>
<td>.0001</td>
<td>2.5</td>
<td>1.60–3.95</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>1.9608</td>
<td>.0015</td>
<td>7.11</td>
<td>2.11–23.88</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>1.1372</td>
<td>.0001</td>
<td>3.1</td>
<td>1.99–4.88</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>1.4555</td>
<td>.0001</td>
<td>4.3</td>
<td>1.44–12.76</td>
</tr>
<tr>
<td>Mitral valve disease</td>
<td>2.1353</td>
<td>.0005</td>
<td>8.5</td>
<td>2.53–28.28</td>
</tr>
<tr>
<td>Aortic valve disease</td>
<td>2.3164</td>
<td>.0005</td>
<td>10.1</td>
<td>3.07–39.27</td>
</tr>
<tr>
<td>Atrial fibrillation or flutter</td>
<td>.7136</td>
<td>.0160</td>
<td>2.0</td>
<td>1.14–3.65</td>
</tr>
<tr>
<td>Sick sinus syndrome</td>
<td>1.0928</td>
<td>.1809</td>
<td>3.0</td>
<td>0.60–14.79</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>.6242</td>
<td>.1306</td>
<td>1.9</td>
<td>0.83–4.19</td>
</tr>
<tr>
<td>Cigarette smoking (ever smoked vs. never)</td>
<td>1.0228</td>
<td>.0038</td>
<td>2.8</td>
<td>1.39–5.55</td>
</tr>
<tr>
<td>Current cigarette smoking vs. nonsmoking or past smoking</td>
<td>.8545</td>
<td>.0101</td>
<td>2.4</td>
<td>1.22–4.51</td>
</tr>
<tr>
<td>Current cigarette smoking vs. nonsmoking</td>
<td>1.3690</td>
<td>.0013</td>
<td>3.9</td>
<td>1.71–9.03</td>
</tr>
<tr>
<td>Past cigarette smoking vs. nonsmoking</td>
<td>.8041</td>
<td>.0332</td>
<td>2.2</td>
<td>1.07–4.68</td>
</tr>
<tr>
<td>Family history of stroke</td>
<td>.9905</td>
<td>.0001</td>
<td>2.7</td>
<td>1.42–5.09</td>
</tr>
<tr>
<td>Body mass index</td>
<td>.1319</td>
<td>.0001</td>
<td>1.1</td>
<td>1.08–1.21</td>
</tr>
</tbody>
</table>

*Age older than 50 years and survived 30 days after stroke.†CI indicates confidence interval.

The verification of the diagnosis of ischemic stroke in many cases (35.4%) ensured completeness and accuracy of the ascertainment of cases and controls and risk factor prevalence in each group. Thus, the possible bias connected with the use of only hospital subjects was avoided. The use of standardized criteria and uniform methods added to the reliability of the data collection and comparison of risk factors. However, the interviewing method used for identifying some risk factors may have contributed to recall bias, especially in patients with severe stroke (in approximately 20% of all cases, a close relative or other informant was interviewed). Because many patients did not have pertinent medical data recorded before the stroke or reference date, introduction of this possible recall bias was unavoidable. To diminish this bias, the study was restricted to patients with first ischemic stroke who survived the first 30 days after stroke onset. However, even though the difference in the accuracy of recall of information between patients and controls may be questioned, we believe that the method used to collect data with respect to the risk factors that were significant in the final multivariate model did not result in biased conclusions. To avoid data collection bias, the data collection was highly standardized and done in the same way for cases and controls. In addition, all cases and controls were interviewed by the same stroke research team members with regard to the risk factor information (family members were approached if no information was obtainable from the patient) if information of relevance was insufficient in the medical records.

Another limitation of our study was that a relatively large number of patients with ischemic stroke did not have a CT scan of the head. Although the distinction between intracerebral hemorrhage and ischemia is seldom difficult clinically, we cannot exclude that some cases could have had small hemorrhages rather than ischemic stroke alone. Certainly, selection of controls from outpatient clinics may introduce a selection bias, but in the current study, we believe that this bias was small to negligible because only three outpatient clinics in the study area where the cases arose provided medical care for the entire population of the study area. Thus, both cases and controls were members of the same base population and had an equal opportunity to utilize these outpatient clinics before the reference date. The similarity in the prevalence of risk factors between our controls aged 50 to 64 years and the general population of the same age in Novosibirsk suggests that controls are representative of the general population. In addition, medical problems among controls were typical for the general population and were not directly related to the risk factors of interest. Because the risk factors for ischemic and hemorrhagic stroke are somewhat different, the comparison was limited to risk factor studies using population-based observations in which risk factors for ischemic stroke were considered.

Our data indicate that hypertension, left ventricular hypertrophy shown on ECG, ischemic heart disease, mitral valve disease, current cigarette smoking, and high BMI in multivariate analysis were significantly associated with ischemic stroke. No independently significant association with the risk of ischemic stroke was found for TIA, atrial fibrillation or flutter, or congestive heart failure. Significant associations of hypertension, ECG abnormalities (including atrial fibrillation, left ventricular hypertrophy, and cigarette smoking), with ischemic stroke have been reported. No association with a positive family history of stroke has been reported in a multivariate analysis. Similar to our findings, atrial fibrillation was a significant risk factor for ischemic stroke in a univariate analysis but was not significant in a time-dependent multivariate analysis in a Rochester, Minnesota,
cohort study. A more recent study in the Rochester population did show that atrial fibrillation was a significant risk factor for stroke and that there was an interaction with age for hypertension, TIA, and cigarette smoking.

Our data about the independent significance of hypertension and current cigarette smoking for ischemic stroke are in agreement with population-based studies in Australia. However, the Australian studies did not evaluate left ventricular hypertrophy, valvular heart disease, angina pectoris, and atrial fibrillation or flutter, as we did in our study.

Our conclusion regarding the significance of current cigarette smoking and the insignificance of past cigarette smoking (ex-smoking) for ischemic stroke is consistent with the results from most, but not all, studies. The mechanisms by which cigarette smoking is thought to increase the likelihood of ischemic stroke include increased fibrinogen levels, platelet adhesiveness, and reduced cerebral blood flow, due mainly to atheroma formation associated with smoking and higher blood viscosity in chronic smokers.

During recent years, obesity (including body fat distribution and waist-to-hip ratio) has received increased attention as a possible risk factor for stroke, but the data are inconsistent. In a nested case-control study in Norway, subjects in the top quintile of BMI (>29.24) had the highest risk of ischemic stroke, and those in the second-lowest quintile of BMI (23.23 to 25.06) had the lowest risk, but the difference in risk between these groups was not significant. The estimated influence of a high BMI on the risk of stroke has been significant in some studies, but insignificant in others. The atherogenic effect of obesity has been suggested as a pathophysiologic mechanism responsible for the increased risk of cerebrovascular disease in overweight people. Our findings of a significant association of BMI with the risk of ischemic stroke suggest that obesity may be a more potent risk factor for ischemic stroke than previously has been appreciated, although we were unable to adjust for serum lipid levels. The estimated odds ratio of BMI (1.1) indicates that the risk of ischemic stroke increases by 10% per one unit of increasing BMI (for example, for a person with a given height of 170 cm and a baseline weight of 75 kg, an increase in weight of 5 kg will lead to about a 17% increased risk of having ischemic stroke). To easily interpret the influence of increasing BMI on the risk of ischemic stroke, a simplified table of odds ratio for different increases of weight for a person with a given height is provided (Table 4).

The odds ratio for TIA in the univariate analysis was relatively high (2.7), but it was not independently associated with ischemic stroke after adjusting for other factors in the multivariate analysis. Another surprising finding was the lack of an association between diabetes mellitus and the risk of ischemic stroke in both the univariate and the multivariate analyses. Because there was no prior medical record for most of the cases, the prevalence of TIA, diabetes mellitus, and atrial fibrillation or flutter may have been underestimated in the cases, and thus the estimate of the odds ratios would be decreased.

The lack of an association between diabetes mellitus, TIA, atrial fibrillation or flutter, and congestive heart failure and the risk of ischemic stroke in our study also could be related to the fact that patients with the most severe ischemic strokes (fatal cases) who were excluded from this study could be more likely to have the highest prevalence of these risk factors.

The high mortality rates from acute myocardial infarction in the population of Novosibirsk aged 25 to 64 years may be a result of early death from myocardial infarction for many patients with diabetes mellitus, thereby precluding the occurrence of stroke and decreasing the impact of diabetes mellitus on stroke in the population. The high odds ratio for mitral valve disease may reflect the relative lack of treatment of this disease in the population studied. This may be a partial explanation of the relatively large number of strokes in young age groups in Russia.

One study suggested that acute myocardial infarction and cardiac arrhythmias had a lower odds ratio in older persons than younger ones. Our study does not show a difference in the odds ratio with age for any of the significant risk factors. The association of hypertension with left ventricular hypertrophy on ECG appears to reflect long-standing untreated or inadequately treated hypertension. Also of importance is the high proportion of hypertension, ischemic heart disease, and cigarette smoking among the cases compared with that in studies of other populations.

In conclusion, this study has, for the first time, indicated that hypertension, left ventricular hypertrophy on ECG, ischemic heart disease, mitral valve disease, current cigarette smoking, and high BMI are the major risk factors for ischemic stroke in a Russian community. All of these factors are potentially amenable to preventive or therapeutic strategic measures to decrease the risk of stroke in the population.

Acknowledgments

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