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Background and Purpose—Population-based data on transient ischemic attack (TIA) incidence are scarce. This study defines incidence rates of first-ever TIA in Novosibirsk, Russia, during 1987–1997 and compares the incidence of first TIA with that of first stroke.

Methods—This is a prospective registry population-based study of all new cases of TIA and stroke in an overall population of 455 765 residents of Novosibirsk. All new TIA and stroke incident cases (whether inpatient or outpatient) that occurred during 1987–1988 and 1996–1997 study periods were recorded and analyzed. A 95% CI was estimated for all age- and sex-specific strata.

Results—During the 2 study periods, a total of 211 patients with first TIA were registered in the population studied. The crude annual TIA incidence rate per 100 000 residents was 16 (95% CI, 8 to 33) in 1987–1988 and 29 (95% CI, 9 to 87) in 1996–1997; these rates standardized to the European population were 17 (95% CI, 8 to 34) and 27 (95% CI, 9 to 79), respectively. Eighty-three percent of TIAs occurred in the carotid arteries (rate, 48/100 000), 10% occurred in the vertebrobasilar territory (rate, 6/100 000), and 7% of cases had a TIA of uncertain distribution (rate, 2/100 000).

Conclusions—Unlike stroke incidence rate, the incidence rate of TIA in Novosibirsk is similar to that in other populations and constitutes approximately 10% of stroke incidence. For the last decade (1987–1997), there was a tendency, although statistically insignificant, toward increasing incidence rate of TIA in the population studied. (Stroke. 2000;31:9-13.)

Key Words: epidemiology ■ incidence ■ stroke ■ transient ischemic attack

Population-based data on transient ischemic attack (TIA) incidence are scarce. Although incidence of TIA has been reported for numerous sites worldwide, only few incident population-based studies on TIA in all age groups of the population have been reported thus far.¹⁻¹¹ No such data in Russia have ever been published in the international literature. However, data on TIA incidence trends are important in determining mechanisms and factors responsible for the occurrence of this disorder. Thus far only 2 truly population-based studies²⁻⁴ have addressed a relationship between TIA and stroke incidence rates over a period of 1 or a few decades. Herein we summarize the TIA incidence rates in Novosibirsk, Russia, for the last 10 years, from 1987–1988 to 1996–1997, and we compare the incidence of first TIA with that of first stroke obtained in the same study population and during the same study periods.

Subjects and Methods

This prospective registry population-based study was conducted during 1987–1988 and 1996–1997 in the general, unselected, and representative districts of Novosibirsk, Oktjabrsky District and Leninsky District. The population at risk, as determined by all-union census estimates in 1989, was 155 091 residents (85 028 women and 70 063 men) in Oktjabrsky District and 300 674 residents (163 850 women and 136 824 men) in Leninsky District. All new TIA and stroke incident cases (whether inpatient or outpatient) that occurred during the specified periods were recorded and analyzed.

Immediate notification of all new cases of TIA/stroke or alleged TIA and stroke came to the TIA and Stroke Registry Department (TSRD) of the study district on an ongoing basis by telephone from 8 AM to 6 PM on workdays. These notifications came from primary care physicians, neurologists, and inpatient and outpatient clinics. The completeness of the information was verified by research personnel of the TSRD, who weekly checked inpatient and outpatient clinic data, including all ambulance call registrations within and just outside the study district, hospital registrations, and hospital referrals (in the study district, TIA and stroke patients can be hospitalized or otherwise medically served only in specified clinics). On the basis of these overlapping sources of information, all new patients with TIA/stroke or suspected TIA/stroke were examined daily and interviewed by a specially trained neurologist (cerebrovascular disease expert) of the TSRD (S.V.S.) at home or at the hospital as soon as possible after the episode of TIA/stroke or alleged TIA/stroke became known to the TSRD. Additionally, 2 of the
The definitions of TIA and stroke were based on standardized criteria.12,13 TIA was diagnosed clinically in subjects with focal neurological symptoms relating to focal cerebral, brain stem, or retinal ischemia with abrupt onset and complete resolution within 24 hours (usually within minutes). Isolated diplopia, vertigo, focal symptoms associated with migraine, or other nonspecific symptoms were not considered TIA. TIA patients with focal motor or sensory symptoms affecting 1 side of the body or with aphasia/dysphasia, amaurosis fugax (retinal ischemia), or any combination of these symptoms were considered to have TIA in the carotid system. Those TIA patients who had motor and/or sensory symptoms on both sides of the body, a combination of unilateral motor/sensory as well as any brain stem symptoms (such as vertigo, diplopia, dysphagia, ataxia, or dysarthria), ataxia of gait, bilateral clumsiness of the arms and/or legs, diplopia, dysarthria, bilateral homonymous hemianopsia, or any combination of these symptoms were regarded as patients with vertebrobasilar TIA. Those TIA patients who had symptoms occurring in both carotid and vertebral distributions were considered to exhibit TIA symptoms of uncertain distribution.

Stroke was defined as rapidly developed signs of focal (or global) disturbance of cerebral function lasting >24 hours (unless interrupted by surgery or death), with no apparent nonvascular cause (this category included cerebral infarction, intracerebral hemorrhage, and subarachnoid hemorrhage); methods of stroke case ascertainment and criteria for diagnosis of stroke subtypes have been described elsewhere.13,14 These data had to be sufficiently well documented to ensure a high likelihood that a TIA or stroke had occurred. Only persons with definite diagnosis of first-ever-in-a-lifetime TIA or stroke were included in the analysis. In this study, TIA patients who had a history of stroke were excluded from the analysis.

The number of first-ever TIA and stroke cases was expressed as an annual rate per 100 000 of the population of the corresponding age and sex. Denominator age- and sex-specific person-years were estimated from all-union census data for Oktjabrsky and Leninsky districts of Novosibirsk in 1989 to calculate age- and sex-specific TIA incidence rates for 1987–1988 and 1996–1997. TIA incidence rates were computed with data pertaining to 2 different districts (Oktjabrsky and Leninsky districts of Novosibirsk). The data of 1 of the 2 districts (Oktjabrsky District) were available only for the survey of 1996–1997, while in the survey of 1987–1988 we used data derived from the 2 districts. For the purpose of comparison of TIA and stroke incidence rates, we used our stroke register data in Oktjabrsky District of Novosibirsk (the stroke register method has been described elsewhere).13 Age and sex adjustment of the incidence rates was done by a direct method with the European population as a standard.15 The difference in rates was assessed by comparison of the 95% CI, which was computed by the method described by McDonnell et al.16

**Results**

During the 2 study periods (1987–1988 and 1996–1997), we registered a total of 211 patients with first-ever-in-a-lifetime TIA (118 women and 93 men): 122 patients in 1987–1988 (64 women and 58 men) and 89 patients in 1996–1997 (54 women and 35 men). Age- and sex-specific TIA incidence rates by study period are shown in the Table. Overall, the TIA incidence increased considerably with age in both men and women, as did stroke incidence rates (for groups aged <45, 45 to 64, 65 to 74, and ≥75 years, stroke incidence rates per 100 000 residents were 17, 375, 734, and 1875 in 1987–1988 and 15, 389, 1262, and 2236 in 1996–1997, respectively). The overall age- and sex-adjusted incidence rate for acute cerebrovascular events (TIA and stroke combined) was 211/100 000 in 1987–1988 (95% CI, 49 to 954) and 266/100 000 in 1996–1997 (95% CI, 91 to 779).

The ratio of age-adjusted TIA incidence rates of men to women was 1.1 in 1987–1988 and 0.9 in 1996–1997; for stroke cases at the same study periods, these ratios were 1.2 and 1.0, respectively. However, in the group aged 45 to 64 years, the overall TIA incidence rate in men (59/100 000) was 26% higher than that in women (44/100 000). Of the 211 TIA events, 7% occurred in persons younger than 45 years, 32% in the group aged 45 to 64 years, 14% in the group aged 65 to 74 years, and 6% in persons aged ≥75 years. The corresponding figures for strokes were 8%, 34%, 35%, and 23%. For the 10-year study period, there was a statistically insignificant increase in the age- and sex-adjusted incidence rates of TIA: 17/100 000 in 1987–1988 (95% CI, 8 to 34) and 27/100 000 in 1996–1997 (95% CI, 9 to 79). Age- and sex-adjusted stroke incidence rates increased from 195/100 000 (95% CI, 41 to 919) in 1987–1988 to 239/100 000 (95% CI, 81 to 700), but the increase was statistically insignificant. The ratio of age- and sex-adjusted incidence rates of stroke to TIA for these study periods also did not change significantly (12 in 1987–1988 and 9 in 1996–1997; overall for the entire study period, approximately 10). No statistically significant difference in the mean age of patients with TIA and stroke was noted: the mean age of TIA patients ranged from 39 to 89 years and in 1996–1997 was 62.3 ±11.4 years in men and 66.5 ±11.2 (±SD) years in women; the mean age of men and women with stroke in 199214 was 63.1 ±12.8 and 66.3 ±12.7 (±SD) years, respectively.

Of the 89 TIA cases in 1996–1997, 74 (83%) occurred in the carotid arteries, 9 (10%) occurred in the vertebrobasilar territory, and 6 cases (7%) had a TIA of uncertain distribution. The overall incidence rate of TIA in the carotid artery distribution was 48/100 000 (95% CI, 38 to 60) (in men, 38/100 000 [95% CI, 26 to 56]; in women, 55/100 000 [95% CI, 41 to 74]), 6/100 000 for vertebrobasilar distribution TIA (95% CI, 3 to 11) (in men, 6/100 000 [95% CI, 2 to 15]; in women, 6/100 000 [95% CI, 2 to 14]), and 2/100 000 for TIA of uncertain distribution (95% CI, 1 to 4) (in men, 3/100 000 [95% CI, 1 to 9]; in women, 1/100 000 [95% CI, 0 to 7]).

**Discussion**

Because diagnosis of TIA is sometimes difficult even among experienced neurologists and because patients with first TIA often are not hospitalized,17 the conduct of a population-based TIA incident study requires uniform application of strict TIA criteria throughout the study period and very thorough search of all available sources of information, with particular attention to outpatient clinics and general practitioners. To further facilitate identification of all new incident TIA cases, we performed teaching courses for general practitioners of the study area throughout the study period. A comprehensive record of all new cases of TIA and stroke, with the use of overlapping sources of information from outpatient and inpatient clinics (95% of all TIA cases were identified in the outpatient clinics) and standardized diagnostic criteria, ensured the reliability of case ascertainment and neurological observations (97% of the stroke patients and 100% of the TIA patients were examined by a neurologist of the TSRD) and allowed us to minimize the possibility of incomplete or biased case ascertainment. In addition, patients with poorly...
documented TIA or stroke were not included in the analysis, and case ascertainment in 1996–1997 was identical to that in 1987–1988. The importance of using standard methods to measure the incidence of TIA, with reliable and maximally complete case ascertainment, has been emphasized by many authors.1,4 Simultaneous identification of TIA and stroke cases in the same study populations eliminated a possibility of misclassification of TIA cases as stroke cases and vice versa. To increase interobserver reliability of the diagnosis of TIA, all TIA patients were evaluated by the same neurologist of the TSRD (S.V.S.). We also examined every patient with TIA/stroke or suspected TIA/stroke as soon as the TSRD received information about the patient (mean time between the attack onset and our assessment of the patient was approximately 2 days). Because the addition of CT scanning only marginally sharpens the diagnosis of all stroke (by <2%),16 the study data, based on standardized and thorough clinical observations, should be reliable for incidence rates. Study districts were representative of Novosibirsk, and factors that can influence the risk of cerebrovascular events, such as age/sex and socioeconomic status, were well comparable in the 2 study districts.

In comparison with other population-based epidemiological studies,1,4,6,19 our data suggest that the incidence rate of TIA for all ages in Novosibirsk in 1996–1997 (31/100 000 per year), age- and sex-adjusted to the US white population in 1980, as calculated for these studies by Brown and colleagues,4 is similar to that in Oxfordshire, England, in 1981–1986 (36/100 000); Söderhamn, Sweden, in 1975–1978 (33/100 000) and 1983–1986 (38/100 000); and Estonia, USSR, in 1970–1973 (37/100 000) but is twice as low as that in Rochester, Minnesota, in 1985–1989 (68/100 000). Our data on the TIA incidence rate, age- and sex-adjusted to the US white population in 1980, in Novosibirsk in 1987–1988 (18/100 000 per year) are similar to those for Hisayama, Japan, in 1961–1982 (22/100 000).4,20 The overall TIA incidence rate in Novosibirsk adjusted to the European population (27/100 000; 95% CI, 9 to 79) is similar to that reported in a population-based study in Spain (21/100 000; 95% CI, 12 to 30)7 and Italy (42/100 000; 95% CI, 33 to 54).5 In Dijon, France, the world-standardized incidence of TIA over the 10-year period (1985–1994)2 varied from 8.4 to 29.2 cases per 100 000 residents per year in men and from 3.9 to 18.8 cases per 100 000 residents per year in women, but these changes were not statistically significant. However, the mean age of TIA patients in Novosibirsk (62 years in men and 66 years in women) appears to be lower than that in some

### Age- and Sex-Specific TIA Incidence Rates by Study Periods per 100 000 Persons per Year, in Novosibirsk, Russia, 1987–1988 and 1996–1997*

<table>
<thead>
<tr>
<th>Age Group, y</th>
<th>Study Periods</th>
<th>Men</th>
<th>Women</th>
<th>Total</th>
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</thead>
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<tr>
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<td>Rate</td>
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<tr>
<td>&lt;45</td>
<td>1987–1988</td>
<td>4</td>
<td>255 504</td>
<td>2</td>
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<td></td>
<td>1996–1997</td>
<td>2</td>
<td>102 716</td>
<td>2</td>
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<td></td>
<td>1996–1997</td>
<td>9</td>
<td>7264</td>
<td>124</td>
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<tr>
<td>≥75</td>
<td>1987–1988</td>
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<td>5852</td>
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<td></td>
<td>1996–1997</td>
<td>5</td>
<td>2200</td>
<td>227</td>
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<tr>
<td>Total</td>
<td>1987–1988</td>
<td>58</td>
<td>343 684</td>
<td>17</td>
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<tr>
<td>AAR†</td>
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<td>17</td>
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<td>ASAR¶</td>
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</table>


†Age-adjusted rates (AAR) to the European population in 1976.
‡Age- and sex-adjusted rates (ASAR) to the European population in 1976.
§AAR to the US white population in 1980.
¶ASAR to the US white population in 1980.

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∞ indicates value >100 000.
European countries. Because of the small proportion of population aged \(\geq 65\) years in Novosibirsk (7.5%), identification of a small number of additional TIA or stroke cases would have markedly altered the incidence rate. This resulted in very wide CIs obtained in groups of the population aged 65 to 74 and \(\geq 75\) years. In contrast to other population-based studies, TIA patients in Novosibirsk aged \(\geq 75\) years constituted only 6% of all TIA patients. This may reflect the fact that (1) elderly patients in Novosibirsk do not seek medical attention as much as younger patients and/or (2) transient cerebrovascular events in elderly patients are often overlooked by general practitioners. Thus, there is a possibility that the true TIA incidence rate in Novosibirsk is somewhat higher than our findings in the present study.

In agreement with a recent population-based study in Rochester, Minnesota, where no significant change in TIA incidence for the last 3 decades (1960–1989) was reported, and with a recent population-based study in Dijon, France, where the incidence of TIA for 1985–1994 was stable, we found no significant change in the incidence rate for first-ever TIA in Novosibirsk for the last 10 years. However, there was a tendency toward increasing TIA rate: the overall incidence of TIA, age- and sex-adjusted to the European population, in Novosibirsk in 1996–1997 (27/100 000 [95% CI, 9 to 79]) was 38% higher than that in 1987–1988 (17/100 000 [95% CI, 8 to 34]). The absence of any statistically significant changes in the incidence of TIA in our population may partially be explained by a relatively small number of TIA cases per study period, resulting in the low statistical power of our study. The increase in TIA incidence, although statistically insignificant, in Novosibirsk in 1996–1997 compared with 1987–1988 was most prominent in the older age group (Table ). This increase corresponded to that in stroke and other chronic noninfectious disorders. This can be attributed to well-known social and economic changes observed in Russia for the last decade (such as differences in medical care, in the proportion of patients at risk who received effective treatment and prevention, and in the prevalence of risk factors), and, given the role of carotid and vertebral atherosclerosis in the pathogenesis of TIAs, it may reflect an increase in the prevalence of atherosclerotic large-vessel arterial disease in the population during the last decade. Although it is possible that the population at risk in 1989 was somewhat different from that in 1996–1997, we believe that these differences were not great enough to substantially distort the inferences (the migration rate in the population studied was \(< 1\)% per year, and there is indirect evidence that Novosibirsk had almost as many inhabitants in 1996–1997 as in 1987–1988).

The TIA incidence rate in 1987–1988, age- and sex-adjusted to the European population, was 9% of the annual stroke incidence rate in 1987–1988, and this proportion did not change significantly in 1996–1997, averaging approximately 10% for the entire study period. These ratios are similar to those reported in Sweden (16%), Estonia, USSR (18%), and Japan (5.5%) but are approximately 4 times lower than that reported in Rochester, Minnesota (41%). During 1985–1994, the ratio of TIA to ischemic stroke incidence in Dijon, France ranged from 14% to 35% in men and from 15% to 39% in women. While some methodological differences may account for the differences in the ratio of TIA to stroke in the populations compared, we agree with Brown et al. that a true between-countries difference in the ratio of TIA to stroke is possible. A similar correlation of very low TIA incidence with relatively high stroke incidence was noted in Hisayama, Japan, in 1961–1982 and in Kamogawa, Japan, in 1996–1997. However, the reason for relatively low incidence of TIA compared with the high stroke incidence in Novosibirsk remains to be studied. The low percentage of hospitalized patients with TIA (5%) in Novosibirsk is indicative of both the low awareness of the population with regard to symptoms of acute cerebrovascular events and the rather passive attitude of general practitioners toward treatment and management of patients with TIA.

Our data on the distribution of TIAs (80% of all TIAs occurred in the carotid distribution) are very similar to those reported in other population-based studies in Western Europe and the United States. Similar to these studies, the percentage of carotid TIAs in Novosibirsk is substantially higher than that reported in Japan. Our data confirm previous observations that TIA incidence, like incidence rates of acute myocardial infarction, exhibits no substantial geographic differences. A similarity of certain epidemiological characteristics of TIA and stroke observed in Novosibirsk further justifies the suggestion that TIA is a mild form of ischemic stroke. However, the absence of large geographic differences in the TIA incidence rates between various countries together with no significant change in the incidence of TIA over the last decades suggests that genetic and environmental factors play a lesser role in the occurrence of TIA than they do in the occurrence of ischemic stroke. This hypothesis should be tested in further studies.

The results of our population-based study indicate that unlike stroke incidence in Novosibirsk, Russia, TIA incidence rates in the population studied are similar to those in most other populations. As in other populations, the incidence of TIA increases with advancing age and constitutes approximately 10% of the annual stroke incidence rate. For the last decade in Novosibirsk, TIA incidence rates have shown a tendency to increase, especially in the older age group of the population, although this was statistically insignificant; this has correlated well with the increase in stroke incidence. Our data have implications for the planning of medical care and designing of clinical trials for TIA and stroke patients and for determining the cause of trends in acute cerebrovascular events.

Acknowledgments

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