

## Widening Gap of Stroke Between East and West Eight-Year Trends in Occurrence and Risk Factors in Russia and Sweden

Birgitta Stegmayr, PhD; Tatyana Vinogradova, MD; Sofia Malyutina, MD; Markku Peltonen, PhD;  
Yuri Nikitin, MD, PhD; Kjell Asplund, MD, PhD

**Background and Purpose**—Stroke is declining in most of the western and northern European countries, whereas no such decline is seen in eastern Europe. The aim of this study was to investigate trends in stroke attack rates and 28-day case fatality and risk factor levels in Novosibirsk, Siberia, and northern Sweden during 1987–1994.

**Methods**—Within the World Health Organization Multinational Monitoring of Trends and Determinants in Cardiovascular Disease (MONICA) Project, acute stroke events and 28-day case fatality were registered in a standardized way in men and women aged 35 to 69 years. Cardiovascular risk factors were monitored in randomly selected men and women in the group aged 35 to 64 years in 1985–1986 and 1994–1995.

**Results**—Stroke attack rates increased significantly from 430 per 100 000 to 660 ( $P=0.005$ ) in men in Novosibirsk and from 298 to 500 ( $P=0.02$ ) in women. In northern Sweden, stroke attack rates varied between 244 and 303 per 100 000 in men and from 117 to 157 in women, with a small increasing trend in women ( $P=0.03$ ). The mortality rates were 5 times higher in Novosibirsk, and the case fatality was significantly lower in northern Sweden ( $P=0.0001$ ). The risk factor surveys showed significantly higher blood pressure, overweight, and more smoking men in Novosibirsk, while northern Sweden had higher cholesterol levels and more smoking women. Most risk factors showed stable or improving patterns over time.

**Conclusions**—Large differences in both attack rates and case fatality account for the large and widening gap in stroke mortality between Russia and Sweden. A higher prevalence of hypertension in Russia may explain much of the differences in stroke occurrence. In Russia, a marked increase in attack rates has occurred despite stable or improving patterns of conventional cardiovascular risk factors. (*Stroke*. 2000;31:2-8.)

**Key Words:** epidemiology ■ mortality ■ risk factors ■ stroke

According to routine mortality statistics, stroke, although declining, is still one of the leading cause of death and disability in most industrialized countries. International comparisons of stroke mortality and stroke incidence have shown large geographic variations.<sup>1-7</sup> During the last 2 decades, important changes have occurred in cardiovascular mortality, with a decrease in Japan, the United States, and western European countries and an increase in eastern Europe.<sup>3-9</sup> However, direct international comparisons are hampered by large variations between countries in methodology and quality of the official registers.

Within the World Health Organization (WHO) Multinational Monitoring of Trends and Determinants in Cardiovascular Disease (MONICA) Project, stroke incidence, mortality rates, and main risk factors were assessed with the use of a uniform protocol for event registration and for population surveys of cardiovascular risk factors.<sup>10</sup> Among the MONICA centers, Novosibirsk (Siberia) has the highest stroke incidence and mortality rates, with particularly high incidence rates in wom-

en.<sup>2,11</sup> The risk for having a stroke is almost twice as high in men and women in Novosibirsk than in northern Sweden, where the incidence rates are intermediate in the MONICA comparisons.

During the last decade, a marked increase in age-adjusted stroke mortality rates has been observed in several eastern European MONICA populations, as well as in Novosibirsk. During the same period, the rates have been declining in western European MONICA populations. The aim of the present study was to explore the reasons for the different time trends in stroke mortality. Can they be attributed to differences in attack rates or in case fatality? If due to differences in attack rates, to what extent can this be explained by population levels of conventional cardiovascular risk factors (hypertension, smoking, abnormal serum lipids, obesity, and diabetes)? We present cross-sectional as well as longitudinal comparisons between Novosibirsk and northern Sweden for 1987–1994.

Although stroke trends have been described from the individual MONICA centers,<sup>5,12</sup> no detailed direct comparisons have previously been made between East and West, and

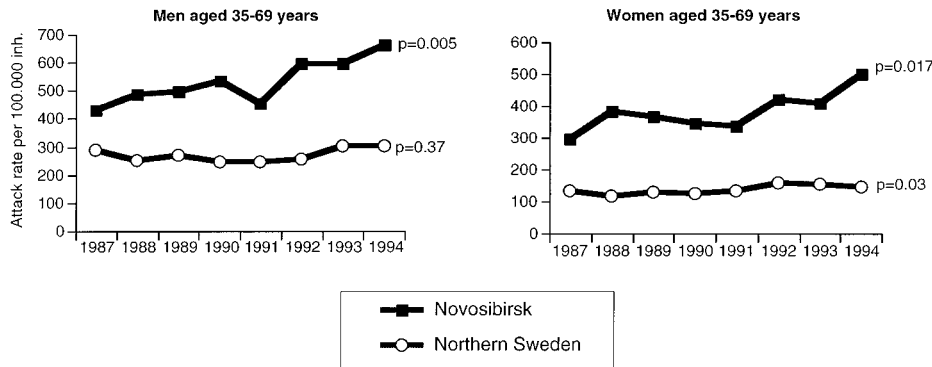
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From the Department of Medicine, Department of Public Health and Clinical Medicine, Umeå University (Sweden) (B.S., M.P., K.A.); and Institute of Internal Medicine, Siberian Branch of the Russian Academy of Medical Science, Novosibirsk, Russia (T.V., S.M., Y.N.).

Correspondence to Dr Birgitta Stegmayr, Department of Medicine, University Hospital, S-901 85 Umeå, Sweden. E-mail birgitta.stegmayr@medicin.umu.se

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**Figure 1.** Stroke attack rates per 100 000 men or women each year in groups aged 35 to 69 years in Novosibirsk and northern Sweden.

in analytical studies it has not been possible to relate stroke trends to changes in the population burden of risk factors. The uniform MONICA data permit, for the first time, such direct comparisons.

## Subjects and Methods

### Study Populations

The WHO MONICA Project was initiated in the early 1980s to analyze the reasons for the different secular trends in mortality from coronary heart disease and stroke between countries.<sup>13</sup> In the stroke component of the MONICA study, 20 populations in 11 countries were included.<sup>14</sup>

Since 1984, Novosibirsk has been participating in the MONICA Project. The target population of the present study is from 2 administrative districts (Oktyabrsky and Kirovsky). Data from Novosibirsk are compared with those from the Northern Sweden MONICA center, which covers the population of the 2 northernmost counties in Sweden (Norrbotten and Västerbotten). The target populations (35- to 69-year-old men and women) consist of 220 000 individuals in northern Sweden and 131 000 in Novosibirsk.

All acute strokes in men and women aged 35 to 69 years were registered with the use of WHO standardized methods for the MONICA study. In this study, all strokes occurring from January 1, 1987, to December 31, 1994, are included. Any acute event possibly attributed to stroke and occurring in the defined geographic areas was validated by the WHO criteria ("rapidly developed clinical signs of focal [or global] disturbance of cerebral function lasting more than 24 hours, unless interrupted by surgery or death, with no apparent cause other than a vascular origin").<sup>10,15</sup> Procedures for case finding and to ensure the completeness of the stroke register in Novosibirsk were performed by the local Stroke Register Department and were based on several sources of information: daily review of hospital admission and discharge records and ambulance and emergency service call registrations and weekly review of all autopsy protocols, all death certificates, and outpatient clinic data. This information was registered by 3 specially trained nurses in the Stroke Register Department. The patients were examined by neurologists either at the hospital or at home within 1 day from stroke onset. In out-of-hospital patients, the examination was repeated, if possible, 1 month after onset.

There are 9 acute-care hospitals in the Northern Sweden MONICA area. The area is also served by 64 primary health centers, 40 of which have an attached nursing home. Case findings were based on hospital discharge records, reports from general practitioners, and death certificates. In northern Sweden, >95% of all patients in the group aged 25 to 74 years were found to be treated in acute-care hospitals.<sup>14,15</sup> Validation studies of the MONICA stroke register have shown a completeness of 96%.<sup>16,17</sup>

In Novosibirsk the autopsy rates have been high over the years, approximately 77%, while in northern Sweden the autopsy rate in this age group (35 to 69 years) is approximately 25%. The opposite was seen for the use of CT scan. Of all surviving stroke events, a very low proportion was examined by CT scan in Novosibirsk

(0.2%), while in northern Sweden the proportion during the whole period was high (82%). Because of the low access to CT scan but the rather high autopsy rate in Novosibirsk, stroke subtypes were compared in the 2 populations only for fatal events.

In accordance with the terminology agreed on by the MONICA collaborators,<sup>10</sup> only "definite stroke" events were included in nonfatal cases, but both the "definite stroke" and "unclassifiable" data categories were included in fatal cases. The unclassifiable category was mainly used in fatal cases in which acute cerebrovascular disease had been given as a cause of death, but the clinical information was too limited to classify the event as a definite stroke. A fatal event was defined as death within 28 days of the onset of an acute stroke. If a new event occurred after the first 27 days, the event was regarded as a new stroke. All analyses were based on first-ever and recurrent stroke events combined, termed the "attack rate." Subarachnoid hemorrhages were excluded in this report.

### Population Risk Factor Surveys

Within the MONICA study, 3 population surveys were completed during the 10-year study period. In the present report, data from the first and the third population surveys were used. In Novosibirsk the population surveys took place in 1985–1986 and 1994–1995, and in northern Sweden they took place in 1986 and 1994. The population samples were randomly selected and stratified by sex and age (35 to 44, 45 to 54, 55 to 64 years), in total 1500 per survey in northern Sweden and 3347 to 3460 in Novosibirsk.

Blood pressure (BP) was measured with Hawksley's random-zero sphygmomanometer<sup>18</sup> in Sweden and with a regular mercury sphygmomanometer in Novosibirsk. Two BP measurements were performed on each participant in a sitting position after 5 minutes' rest. The mean value of the 2 measurements was used. The participants completed a form about history of hypertension and whether they had been taking drugs for high BP during the last 2 weeks.

Balance scales were used to measure the weight of the subjects to the nearest 0.2 kg; subjects wore only light clothes and no shoes. Height was measured without shoes to the nearest centimeter. Body mass index (BMI) was calculated as weight (kilograms) divided by height (meters) squared.

Total cholesterol and HDL cholesterol levels were measured in a venous blood sample after at least 4 hours' fast. In Novosibirsk, the samples were stored immediately at  $-20^{\circ}\text{C}$  and then deep-frozen (at  $-70^{\circ}\text{C}$ ), while in northern Sweden they were analyzed within 3 days. An enzymatic method was used for the cholesterol analyses. An external quality control of the cholesterol measurements was provided by the MONICA Quality Control Center in Prague, Czech Republic.<sup>19</sup>

An oral glucose tolerance test was performed in random subsamples of the participants; 75 g glucose was dissolved in 300 mL water and ingested within 5 minutes. A venous blood sample was taken in sodium fluoride tubes immediately before the glucose load and after 2 hours. The samples were analyzed by a hexokinase method. According to the former WHO criteria, subjects were classified as having diabetes if the fasting plasma glucose value was  $>7.7$  mmol/L or the 2-hour plasma glucose was  $>11.0$  mmol/L.

**TABLE 1. Mean Case Fatality (1987–1994) 0–7 Days and 8–27 Days (in Individuals Surviving the First 7 Days) after Onset of Stroke in the Group Aged 35–69 Years**

	Case Fatality, %			
	Men		Women	
	Novosibirsk	N Sweden	Novosibirsk	N Sweden
0–27 d	35.2	14.3	30.9	15.3
0–7 d	12.5	10.5	11.1	11.8
8–27 d*	25.7	4.3	21.8	4.1
% dying first 7 d	35.5	73.4	35.9	77.1

N indicates northern.

\*Case fatality in individuals surviving the first 7 days.

Information about smoking habits and previously known diabetes was obtained from a questionnaire, self-administrated by the participant. A smoker was defined as smoking  $\geq 1$  cigarette per day.

### Statistical Analyses

The attack rates were age standardized with a direct method to Segi's world standard population.<sup>20</sup> The weights used were 6, 6, 6, 5, 4, 4, and 3 for the groups aged 35 to 39, 40 to 44, 45 to 49, 50 to 54, 55 to 59, 60 to 64, and 65 to 69 years, respectively. The 95% CIs were calculated by simple normal approximation of the Poisson distribution for numbers of events within the group aged 35 to 69 years.<sup>21</sup> We used  $\chi^2$  statistics and/or Fisher's exact test to test differences in proportions. We used logistic regression (SPSS)<sup>22</sup> for testing for trends in stroke attack rates and case fatality.

## Results

### Stroke Rates

From January 1, 1987, to December 31, 1994, a total of 4453 stroke events (2090 men and 2363 women) occurred in Novosibirsk in the group aged 35 to 69 years. The corresponding figures for northern Sweden were 4063 events (2657 men and 1406 women). Figure 1 shows time trends in stroke attack rates (first and recurrent events combined) in men and women aged 35 to 69 years in Novosibirsk and northern Sweden. The attack rates in men varied from 430 to 660 per 100 000 inhabitants per year in Novosibirsk, with a significant increase during the observation period ( $P=0.005$ ). In northern Sweden, the attack rates in men varied between 244 and 303 per 100 000 per year (Figure 1) and did not change significantly over time ( $P=0.37$ ). In Novosibirsk, the attack rates in women were more than twice as high as in northern Sweden during the first year (Figure 1). The attack rates in women in Novosibirsk varied between 298 and 500

**TABLE 2. Annual Mortality Rates per 100 000 Inhabitants in the Group Aged 35–69 Years in the First 0–7 or 8–27 Days**

	Mortality Rates			
	Men		Women	
	Novosibirsk	N Sweden	Novosibirsk	N Sweden
0–7 d	69	28	43	16
8–27 d	112	10	71	5

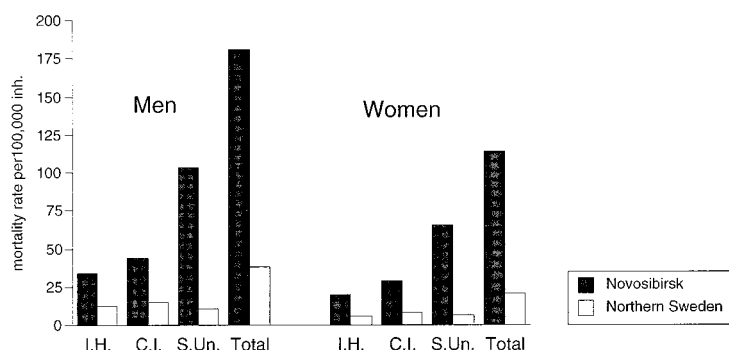
Rates are age standardized.

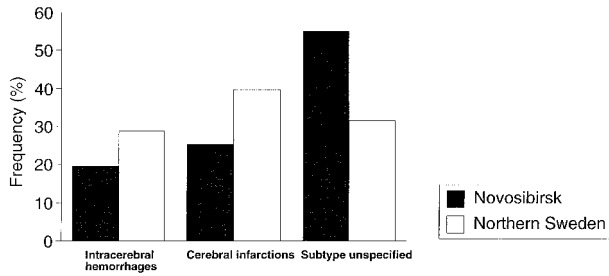
per 100 000 compared with 117 and 157 per 100 000 in northern Sweden. A statistically significant increasing trend in attack rates was seen over time for the women in Novosibirsk ( $P=0.017$ ). In northern Sweden a small increase of the stroke attack rates was seen in women over time ( $P=0.03$ ). The differences in stroke attack rates in women increased over the years and were 3.8 times higher in Novosibirsk than in northern Sweden during the last year of observation (1994).

During 1987–1994, the case fatality in Novosibirsk varied from 28% to 43% in men and from 21% to 38% in women. In northern Sweden, the case fatality was significantly lower ( $P<0.0001$ ) in both men and women compared with Novosibirsk and varied between 12% and 21%. No statistically significant trends in case fatality were seen over the years in Novosibirsk or in northern Sweden. Table 1 shows the mean case fatality rates during 1987–1994 in men and women in the 2 populations.

Death within the first week after a stroke is likely to be caused directly by the brain lesion (brain stem herniation), while patients dying after the first week often have preventable or treatable causes of death, such as pneumonia, pulmonary embolism, or cardiac disorders.<sup>23</sup> Case fatality rates were 11.8% (men and women together) in the first week in Novosibirsk and 10.9% in northern Sweden. Among those who survived the first week, case fatality in the ensuing 3 weeks (days 8 to 27) was 23.6% in Novosibirsk and 4.3% in northern Sweden (men and women together) (Table 1). In northern Sweden,  $>70\%$  of the deaths during the first 28 days occurred within the first week (Table 1).

In those aged 35 to 69 years, stroke mortality rates, as calculated from the MONICA registers, were approximately 5 times higher in both men and women in Novosibirsk compared with northern Sweden (Figure 2). In northern Sweden the mortality rates were consistent over the years in

**Figure 2.** Annual mortality rates per 100 000 men or women aged 35 to 69 years in total and in the different subgroups of stroke. I.H. indicates intracerebral hemorrhage; C.I., cerebral infarction; and S.Un., stroke subtype unspecified.



**Figure 3.** Proportion with intracerebral hemorrhage, cerebral infarction, and subtype unspecified in fatal stroke events (men and women together).

both men and women; the variation in Novosibirsk was considerable, and there were no trends over the years. Overall, mortality rates were 2 to 3 times higher in Novosibirsk than in northern Sweden during the first week and >10 times higher in the 8- to 27-day interval (Table 2).

Because of very few CT scans being performed in Novosibirsk but a relatively high autopsy rate, comparison of stroke subtypes with northern Sweden was possible only in fatal cases. Definite stroke diagnosis (intracerebral hemorrhage or cerebral infarction) was reached in only 43% of fatal cases in Novosibirsk and 68% in northern Sweden. Among those with a specific subtype diagnosis, the proportion of intracerebral hemorrhage was similar in the 2 populations (43.6% in Novosibirsk versus 42.1% in northern Sweden;  $P=0.67$ ), and there were no significant trends over the years in stroke subtypes in any of the populations (Figure 3). A marked excess of deaths from brain infarction, intracerebral hemorrhage, and unspecified stroke was seen in both sexes in Novosibirsk compared with northern Sweden.

### Risk Factors

In the population risk factor surveys in Novosibirsk, in the group aged 35 to 64 years, 2400 of 3347 (71.7%) invited men and women participated in the first survey and 2481 of 3460 (71.7%) participated in the final Survey. The corresponding figures in northern Sweden were 1263 of 1500 (84.2%) and 1195 of 1500 (79.7%).

Mean BP, both systolic and diastolic, was higher in Novosibirsk, especially in women. In Novosibirsk, approximately 30% of the men and 27% of the women had systolic BP  $\geq 160$  mm Hg or diastolic BP  $\geq 95$  mm Hg or treatment for elevated BP compared with approximately 20% in northern Sweden. A higher proportion of subjects in Novosibirsk stated that they used hypertensive drugs than in northern Sweden (except for men in the first survey) (Table 3). Of all treated subjects, only approximately half of the patients were well treated (data not shown). In men and women in Novosibirsk, diastolic BP decreased significantly in men ( $P<0.01$ ) and in women ( $P<0.001$ ) between the surveys. No significant trends between the 2 surveys were seen in systolic BP levels or in the proportion of subjects with elevated BP. In northern Sweden, diastolic BP decreased significantly ( $P<0.001$ ) in women but not in men (data not shown).

The population levels of total serum cholesterol were much lower in Novosibirsk than in northern Sweden. In both populations, decreases in cholesterol levels were seen, more

so in Novosibirsk than in northern Sweden (Table 3). Almost half of both men and women in northern Sweden had cholesterol levels  $>6.5$  mmol/L compared with  $<25\%$  in Novosibirsk. In both populations, the proportion with hypercholesterolemia decreased in the final survey. In both populations, HDL cholesterol levels were higher in the final survey than in the initial one; this was observed in both men and women. Triglyceride levels showed no consistent pattern between the sexes and the populations over the years (Table 3).

In Novosibirsk, there was no change in BMI in men between the surveys, but in women a small decrease was noted (Table 3). In northern Sweden, BMI increased slightly in both men and women. More than 40% of the women in Novosibirsk had a BMI  $\geq 30$ . In northern Sweden, approximately 14% of the men and women had severe overweight. In men, both in Novosibirsk and northern Sweden, an increase (not statistically significant) in the proportion with high BMI ( $\geq 30$  kg/m<sup>2</sup>) was seen between the surveys (Table 3).

An oral glucose tolerance test was performed only in the third survey in Novosibirsk. Therefore, only a cross-sectional comparison of the prevalence of diabetes was made between the 2 populations at the time of the final survey. There were no significant differences in proportion of participants with diabetes mellitus among men and women in the 2 populations between Novosibirsk and northern Sweden (Table 3).

In the first survey more than half of the men (56%) in Novosibirsk were daily smokers, but very few women smoked (3%). In the final survey the proportion has not changed in men, but the prevalence of smoking had doubled in women. In northern Sweden, more women than men were smokers. In men a decrease was seen between the surveys, from 23% to 21%, while a modest increase, from 27% in the first to 28% in the final survey, had occurred in women (Table 3).

### Discussion

In this study 2 MONICA populations were compared. When the WHO MONICA Project was designed in the early 1980s, it purported to cover "premature" cardiovascular disease. Therefore, the upper age limit was set at 65 years. However, optional extension of this age limit to age 69 years in Novosibirsk and 74 years in northern Sweden permitted comparisons of stroke rates in those aged 35 to 69 years in the present study.

Novosibirsk is characterized by very high stroke attack and mortality rates, especially in women.<sup>11,12</sup> Indeed, the attack rates in women are the highest of all participating centers in the WHO MONICA Project, and this study shows that they are increasing. Compared with the first years of the MONICA study, the stroke attack rate has increased by  $>50\%$  in both sexes. A study performed by Feigin et al<sup>12</sup> showed a tendency toward a decreasing trend in the incidence of stroke in all ages in Novosibirsk in 1982–1992. This trend has now been reversed so that stroke rates are now increasing in both men and women in the group aged 35 to 69 years. A similar upward trend has been observed in other eastern European populations,<sup>7,9,24–26</sup> while the incidence has been stable in most western countries<sup>4,5,27–29</sup> or decreasing, as in Finland.<sup>30,31</sup> In northern Sweden, stroke attack rates have not changed (or have changed only marginally) over the 8-year period covered by the present study.



It should be emphasized that, although the MONICA populations are large, they are not necessarily representative of the entire country from which they are derived.

In northern Sweden the case fatality after stroke is one of the lowest of all participating populations in the MONICA Project.<sup>11</sup> In first-ever strokes occurring in persons aged 35 to 74 years, it has steadily declined over the last decade.<sup>32,33</sup> The low case fatality rates in Sweden were confirmed in the present study. Case fatality rates were twice as high in Novosibirsk, and, in contrast to Sweden, no consistent change occurred over time in either men or women. These direct comparisons, performed with a uniform methodology, suggest that the widening gap in stroke mortality between East and West, here represented by Russia and Sweden, is mainly explained by increases in stroke attack rates in the East and declining case fatality in the West.

The year-to-year variations in attack and case fatality rates were greater in Novosibirsk than in northern Sweden. An obvious explanation is that societal changes have been more dramatic in Russia. Despite the profound changes, the Novosibirsk center has maintained uniform procedures for case ascertainment and evaluation of stroke events since the inception of MONICA.<sup>34,35</sup> In the MONICA Project, all participating populations have been subjected to an extensive data quality control of both stroke event registration<sup>15,35</sup> and risk factor surveys.<sup>19,36,37</sup> The quality of the data has been found to be adequate in most of the participating populations, including Novosibirsk. Internal validations performed at the Novosibirsk center have also failed to identify any major error that could explain the variations in case fatality over the years in Novosibirsk.

One possible limitation of the study is the poor availability of CT scan in Novosibirsk. Theoretically, it is possible that some of the cases, without performance of CT or autopsy, could include

tumors and subdural hemorrhages. This would mainly be seen in nonfatal events, because autopsy is performed in a large proportion of fatal events. The total proportion of tumors or subdural hemorrhages among cases with typical stroke symptoms has been shown to be very low,<sup>38</sup> and the increasing trend cannot be attributed to such misclassification when the same procedure has been used during the whole period.

Possible reasons for the high case fatality in Novosibirsk could be that the distribution of stroke subtypes is different, that stroke events are, on average, more severe in Novosibirsk than in Sweden, and/or that different management<sup>35</sup> results in different outcome. In the present study stroke subtypes were compared only in fatal cases, which was possible because of the relatively high autopsy rates in Russia.<sup>14</sup> No differences in the proportion of hemorrhagic versus ischemic stroke were observed in this subset of patients with fatal outcome, and no consistent time trends were present. The excess mortality in Novosibirsk was of similar magnitude in hemorrhagic and ischemic stroke. The possibility remains that the distribution of subtypes differs between the populations in cases of stroke that are not as severe.

Are strokes more severe in Russia than in Sweden? It is likely that stroke has become a less severe disease in western countries,<sup>32,33,39,40</sup> while the opposite has been implied by studies in eastern and central European populations.<sup>7,24–26</sup> For instance, in the beginning of the 1970s, case fatality in Gothenburg, Sweden, was at least as high (approximately 35%) as it is today in Novosibirsk.<sup>41</sup> It has gradually decreased over the last 3 decades.<sup>39</sup> Since the great majority of deaths within 1 week are the direct consequence of the brain lesion itself,<sup>42,43</sup> the fact that first-week case fatality is not higher in Novosibirsk than in northern Sweden indicates that acute strokes are probably not more severe in Novosibirsk. The main difference in case fatality after the first week indicates more secondary complications or comorbidity

**TABLE 3. Risk Factor Levels and Differences Between Populations**

Risk Factor	Men					
	First Survey			Final Survey		
	Novosibirsk (n=1188)	N Sweden (n=648)	Difference	Novosibirsk (n=1212)	N Sweden (n=582)	Difference
Systolic BP, mm Hg	134.5±1.17	132.2±1.29	2.30±1.73	134.9±1.24	130.8±1.49	4.11±1.94
Diastolic BP, mm Hg	89.0±0.73	83.0±0.75	6.0±1.05	87.6±0.67	83.0±0.96	4.6±1.17
Hypertensive treatment, %	7.2±1.45	9.1±2.21	−1.9±2.65	14.3±1.97	8.3±2.24	6.0±2.99
Elevated BP, %*	33.6±2.88	21.7±3.15	11.9±4.15	28.9±2.55	22.2±3.38	6.7±4.30
Total cholesterol, mmol/L	5.58±0.07	6.59±0.10	−1.01±0.11	5.23±0.06	6.29±0.10	−1.06±0.12
Cholesterol ≥6.5 mmol/L, %	14.6±2.14	52.0±3.85	−37.4±4.40	12.2±1.82	44.4±4.00	−32.2±4.40
HDL cholesterol, mmol/L	1.24±0.02	1.12±0.02	0.12±0.10	1.36±0.02	1.23±0.25	0.13±0.04
Triglycerides, mmol/L†	1.43±0.05	1.31±0.14	0.12±0.09	1.24±0.04	1.66±0.11	−0.42±0.11
BMI	26.15±0.21	26.02±0.27	0.13±0.36	26.11±0.20	26.44±0.30	−0.33±0.39
BMI ≥30, %	14.2±1.98	11.4±2.45	2.8±3.15	16.5±2.09	14.8±2.88	1.7±3.60
Daily smokers, %	56.0±3.12	23.2±3.25	32.8±4.55	56.3±2.80	20.6±3.41	35.7±4.51
Diabetes prevalence, %	NA	NA	NA	4.0±1.10	4.9±1.75	−0.9±2.84

Values are mean and 95% CI. N indicates northern; NA, not applicable.

\*Systolic BP ≥160 mm Hg or diastolic BP ≥95 mm Hg or on treatment for high BP.

†In northern Sweden, 99 men had triglyceride measured in the first survey and 311 in the final survey. For women, the respective numbers were 100 and 317.

in Novosibirsk. In later phases of acute stroke, these factors (complications and comorbidity), often preventable and/or treatable, are major determinants of death.<sup>44–46</sup> Among stroke patients surviving the first week, case fatality in the ensuing 3 weeks was 5 times higher in Novosibirsk than in northern Sweden. In Sweden, the nationwide introduction of dedicated stroke units may have contributed to the decline in acute-phase case fatality. Patients cared for in stroke units have lower case fatality and a better chance to be discharged home than patients treated in general wards.<sup>44,47</sup> Stroke units have not been introduced in Novosibirsk. In the present study it has not been possible to monitor other possible differences in stroke management in Novosibirsk versus northern Sweden.

Can differences in stroke attack rates between Novosibirsk and northern Sweden be explained by different burdens of cardiovascular risk factors in the 2 populations? BP levels are definitely higher and elevated BP is more prevalent in Novosibirsk. Although the proportion of individuals with hypertensive treatment increased in Novosibirsk over the study period, the treatment itself has not improved over time. Smoking rates are much higher for men in Russia than in Sweden, whereas the contrary is true for women. Although the prevalence of obesity is high in Novosibirsk, the prevalence of diabetes is equally common in Novosibirsk and northern Sweden. It seems unlikely that different levels of conventional cardiovascular risk factors in different populations can fully explain the much higher occurrence of stroke in Novosibirsk, particularly in women.

Similarly, the increasing trends in stroke attack rates in Novosibirsk cannot be explained by changes over time in population levels of conventional cardiovascular risk factors. In Novosibirsk, BP and serum cholesterol levels and prevalence of elevated BP and obesity declined during 1987–1994. Smoking rates, although very high, did not increase further in

men. In women they increased, but at low levels with only a small population attributable risk. Thus, the overall trends in conventional cardiovascular risk factors were in a beneficial direction during the time when stroke rates increased very markedly. There have been major changes in eastern Europe during the last decade. Unfortunately, we do not have any measure of the social changes and their importance on mortality and morbidity in stroke. It is evident that changes in socioeconomic determinants of stroke may have played a major role in the alarming increase in stroke rates in Novosibirsk. If so, it is evident from the present results that such socioeconomic determinants are not mediated by the most well-established biological risk factors.

In Europe (and Asian parts of Russia), there are very large and increasing differences in stroke mortality between East and West, here represented by Novosibirsk and northern Sweden. The diverging mortality trends are partly explained by increasing attack rates in the East and declining case fatality in the West. The much higher case fatality in Russia is probably not due to different stroke subtypes. Instead, difference in the management of the stroke patients during the first weeks after onset may contribute a great deal to the higher case fatality in Russia. A higher prevalence of hypertension in Russia may partly explain the differences in stroke occurrence. However, in Novosibirsk a marked increase in stroke attack rates has occurred despite stable or improving patterns of conventional cardiovascular risk factors.

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TABLE 3. Continued

Women					
First Survey			Final Survey		
Novosibirsk (n=1212)	N Sweden (n=615)	Difference	Novosibirsk (n=1216)	N Sweden (n=612)	Difference
137.5±1.40	129.6±1.43	7.90±2.00	136.2±1.33	126.7±1.62	9.44±2.10
88.4±0.75	80.9±0.82	7.48±1.77	86.5±0.68	78.5±0.87	8.00±1.11
16.3±2.08	11.0±2.47	5.3±3.23	23.0±2.36	7.5±2.09	15.5±3.15
37.5±2.73	20.0±3.16	17.5±4.17	38.4±2.68	16.8±2.96	21.6±3.99
5.92±0.07	6.55±0.10	−0.63±0.13	5.44±0.07	6.16±0.11	−0.72±0.13
24.8±2.57	50.2±3.95	−25.4±4.71	16.3±2.09	37.5±3.84	−21.2±4.37
1.35±0.02	1.36±0.27	−0.01±0.01	1.48±0.02	1.52±0.03	−0.04±0.01
1.30±0.04	1.11±0.07	0.19±0.14	1.28±0.04	1.36±0.07	−0.08±0.08
29.90±0.29	25.62±0.35	4.28±0.48	29.25±0.39	25.77±0.36	3.48±0.47
45.5±2.80	14.1±2.76	31.4±3.92	41.1±2.72	14.7±2.81	26.4±3.91
3.0±0.96	26.5±3.59	−23.5±3.65	5.9±1.30	27.6±3.54	−21.7±3.77
NA	NA	NA	6.6±1.40	5.6±1.82	1.0±3.21

the Joint Committee of the Northern Sweden Health Care Region, and the Norrbotten and Västerbotten County Councils.

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## Widening Gap of Stroke Between East and West: Eight-Year Trends in Occurrence and Risk Factors in Russia and Sweden

Birgitta Stegmayr, Tatyana Vinogradova, Sofia Malyutina, Markku Peltonen, Yuri Nikitin and Kjell Asplund

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