

## Stroke Mortality Trends in the Population of Klaipėda From 1994 to 2008

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**Key words:** stroke; mortality; trends.

**Summary.** The objective of the study was to evaluate the trends in stroke mortality in the population of Klaipėda aged 35–79 years from 1994 to 2008.

**Material and Methods.** Mortality data on all permanent residents of Klaipėda aged 35–79 years who died from stroke in 1994–2008 were gathered for the study. All death certificates of permanent residents of Klaipėda aged 35–79 years who died during 1994–2008 were examined in this study. The International Classification of Diseases (ICD-9 codes 430–436, and ICD-10 codes I60–I64) was used. Sex-specific mortality rates were standardized according to the Segi's world population; all the mortality rates were calculated per 100 000 population per year. Trends in stroke mortality were estimated using log-linear regression models. Sex-specific mortality rates and trends were calculated for 3 age groups (35–79, 35–64, and 65–79 years).

**Results.** During the entire study period (1994–2008), a marked decline in stroke mortality with a clear slowdown after 2002 was observed. The average annual percent changes in mortality rates for men and women aged 35–79 years were –4.6% ( $P=0.041$ ) and –6.5% ( $P=0.002$ ), respectively. From 1994 to 2002, the stroke mortality rate decreased consistently among both Klaipėda men and women aged 35–64 years (20.4% per year,  $P=0.002$ , and 14.7% per year,  $P=0.006$ , respectively) and in the elderly population aged 65–79 years (13.8% per year,  $P=0.005$ ; and 12% per year,  $P=0.019$ ).

During 2003–2008, stroke mortality increased by 16.3% per year in middle-aged men (35–64 years), whereas among women (aged 35–64 and 65–79 years) and elderly men (aged 65–79 years), the age-adjusted mortality rate remained relatively unchanged.

**Conclusions.** Among both men and women, the mortality rates from stroke sharply declined between 1994 and 2008 with a clear slowdown in the decline after 2002. Stroke mortality increased significantly among middle-aged men from 2003, while it remained without significant changes among women of the same age and both elderly men and women.

### Introduction

Public concern about high stroke-related morbidity, mortality, and disability levels has been growing globally. During the last few decades, the routine statistics of cerebrovascular disease mortality have presented different rates in Europe and countries peripheral to Europe. For both sexes, markedly higher rates have been noted moving from west to east, with some exception (1–3). In the majority of Western European countries, the stroke mortality has significantly decreased during the last decades (4–6). The death rate from cerebrovascular diseases in the majority of Central and Eastern European countries also decreased in the 20th century, and this rate remains markedly higher compared with Western countries (1–3). It is estimated that the population aged more than 65 years will make up

35% of the whole population in Europe by 2050, and this will be a serious challenge to health care systems of all nations (7).

Epidemiological stroke research carried out in Lithuania indicates that Lithuania is a country with an increased stroke risk. An epidemiological study recently carried out in Kaunas on the basis of the WHO MONICA project has revealed a different trend in stroke mortality during 1986–2002 in the middle-aged population: a decrease in the mortality rate from ischemic stroke and intracerebral hemorrhage in women and an increase in the mortality rate from all types of stroke and ischemic stroke in men (8).

The objective of the present study was to evaluate stroke mortality trends in the population of Klaipėda aged 35–79 years from 1994 to 2008.

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### Material and Methods

Mortality data on all permanent residents of Klaipėda aged 35–79 years who died from stroke during 1994–2008 were gathered for the study. The official mortality statistics data for 1994–2008, obtained from Klaipėda Civil Registration Office, were used for the mortality analysis. All the death certificates (statistical form No. 106/a) that were filled in and coded by the physician certifying the death were checked for the permanent population of Klaipėda. The International Classification of Diseases, the 9th revision (ICD-9, codes 430–436), was used for the period 1994–1996, and the 10th revision (ICD-10, codes I60–I64) was used for the period 1997–2008.

The annual population counts for the denominators were obtained from the statistical department of Klaipėda city. The stroke mortality rates per 100 000 population of Klaipėda were evaluated. The age-adjusted mortality rates were calculated using the Segi's world population for direct standardization. The 95% confidence intervals were calculated in respect of the Poisson distribution of the events within the age groups. Data for men and women were analyzed separately.

Initially, scatterplots opposing mortality rates and calendar years were built in order to better visualize the function that might better express the relationship between these variables. Exponential or low-degree polynomial models were expected to fit better to the mortality rate. As a measure of the model precision, the coefficient of determination ( $R^2$ ) was used. Nevertheless, the aim of the presented analyses was to look for an increase (or decrease) in the rates. Trends were analyzed using the method of linear regression on logarithms of the age-standardized annual rates. The regression coefficient multiplied by 100 was used as approximated annual percent change, which is presented in this

article. Confidence intervals (CI) for the coefficient  $b$  from the regression models were used to estimate confidence intervals for annual percent change in mortality.

The linearity assumption for the annual percent change was tested by visual inspection and by calculating the  $R^2$  for different models. During the entire study period (1994–2008), a marked decline in stroke mortality with a clear slowdown after 2002 was observed. Significant changes in the trends were identified, the observed period was divided, and the annual percent change was calculated for the two periods: from 1994 to 2002 and from 2003 to 2008. Mortality rates and trends were calculated for 3 age groups (35–79, 35–64, and 65–79 years).

### Results

The stroke mortality rate decreased consistently in both sexes in the population of Klaipėda during 1994–2008. Table shows the trends in stroke mortality rates by age and sex from 1994 to 2008. The age-adjusted stroke mortality rate in the population of Klaipėda aged 35–79 years declined from 251.3 (95% CI, 176.0 to 326.6) to 146.7 (95% CI, 127.6 to 202.0) per 100 000 population in men and from 170.3 (95% CI, 149.1 to 201.9) to 61.8 (95% CI, 60.2 to 122.4) per 100 000 population in women. The lowest mortality rate was documented in 2001, i.e., 64.9 (95% CI, 52.8 to 86.2) per 100 000 population in men and 49.2 (95% CI, 47.2 to 91.8) per 100 000 population in women. During the entire study period (1994–2008), the average annual percent change in mortality rates was  $-4.6\%$  (95% CI,  $-8.9$  to  $-0.2$ ) in men ( $R^2=0.23$ ,  $P=0.041$ ) and  $-6.5\%$  (95% CI,  $-10.0$  to  $-3.0$ ) in women ( $R^2=0.52$ ,  $P=0.002$ ).

Time trends in stroke mortality rates during 1994–2008 by age group and sex are presented in Fig. 1 A–C. During 1994–2002, a decrease in the

Table. Age-Adjusted Stroke Mortality Rates by Sex and by Age Group in Klaipėda From 1994 to 2008

Year	Age-Adjusted Mortality Rate per 100 000					
	Men			Women		
	35–64 years	65–79 years	35–79 years	35–64 years	65–79 years	35–79 years
1994	102.0	1021.0	251.3	74.6	664.5	170.3
1995	104.6	819.9	220.6	47.2	735.2	158.7
1996	100.8	737.3	204.1	47.0	580.4	133.5
1997	62.4	904.7	199.0	36.5	775.1	156.3
1998	94.9	376.8	183.6	50.5	815.0	174.5
1999	48.1	731.6	158.9	31.4	405.3	92.0
2000	39.3	489.4	111.5	18.9	393.4	79.6
2001	17.0	312.6	64.9	16.1	220.3	49.2
2002	33.3	348.8	84.4	29.9	389.3	88.2
2003	30.5	272.7	69.4	23.0	266.0	58.5
2004	55.6	485.9	125.4	20.9	394.1	81.4
2005	59.8	606.8	148.5	26.3	377.1	83.2
2006	56.8	446.4	119.9	30.0	332.1	79.0
2007	77.7	447.8	137.7	44.1	335.4	91.3
2008	78.8	497.7	146.7	20.2	276.8	61.8

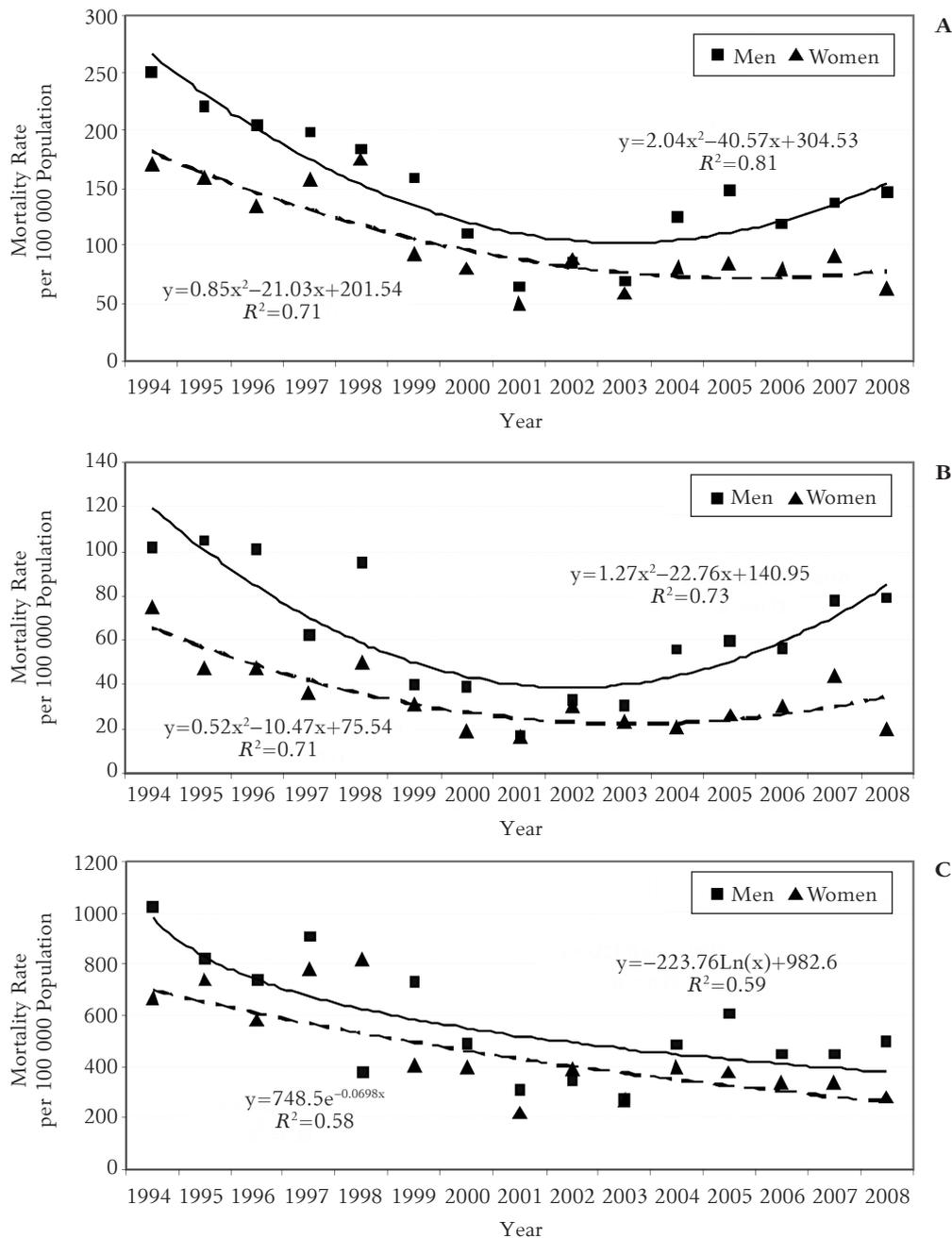


Fig. 1. Trends in stroke mortality rate per 100 000 population during 1994–2008 in Klaipėda by age group and sex A, aged 35–79; B, 35–64; C, 65–79 years.

age-adjusted stroke mortality rate was observed in both men and women in all the studied age groups (35–79, 35–64, and 65–79 years). During recent years, it has been observed that the continuing decline in stroke mortality rate has slowed down. This slowing was seen for both sexes and all age groups. Trends in log mortality rates for the population aged 35–79, 35–64, and 65–79 years by sex are shown in Figs. 2–4.

The age-adjusted mortality rate per 100 000 population declined during 1994–2002 annually

by  $-15.8\%$  (95% CI,  $-21.7\%$  to  $-9.9\%$ ;  $P < 0.001$ ) in men and by  $-12.8\%$  (95% CI,  $-21.2\%$  to  $-0.5\%$ ;  $P = 0.008$ ) in women aged 35 to 79 years. During 2003–2008, these trends were rather flat and insignificant. The mortality rates tended to increase by  $11\%$  per year ( $P = 0.107$ ) in men and by  $1.5\%$  per year ( $P = 0.762$ ) in women, but the increase was insignificant (Fig. 2).

The most dramatic changes occurred in men aged 35–64 years with a  $-20.4\%$  decrease per year (95% CI,  $-30.8\%$  to  $-9.9\%$  per year;  $P = 0.002$ )

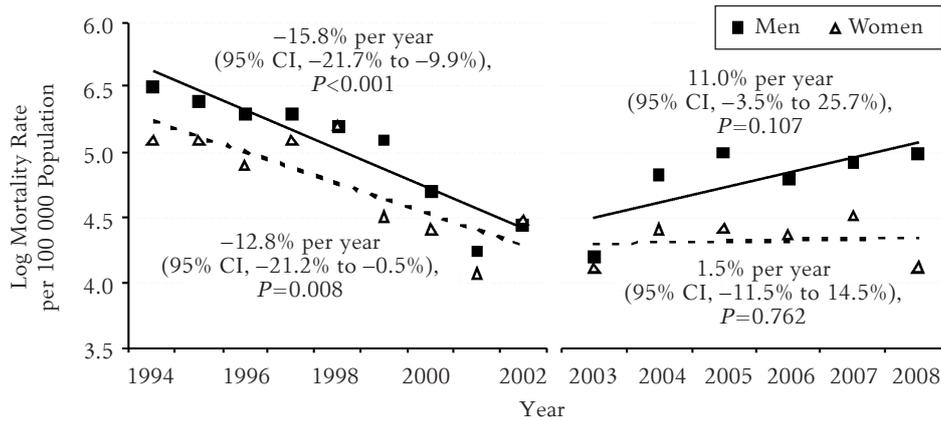


Fig. 2. Trends in log stroke mortality rate per 100 000 population during 1994–2008 for individuals aged 35–79 years by sex

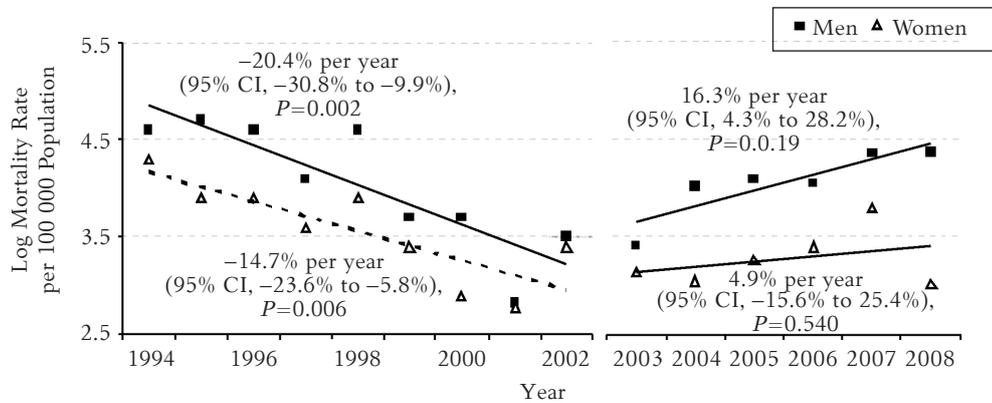


Fig. 3. Trends in log stroke mortality rate per 100 000 population during 1994–2008 for individuals aged 35–64 years by sex

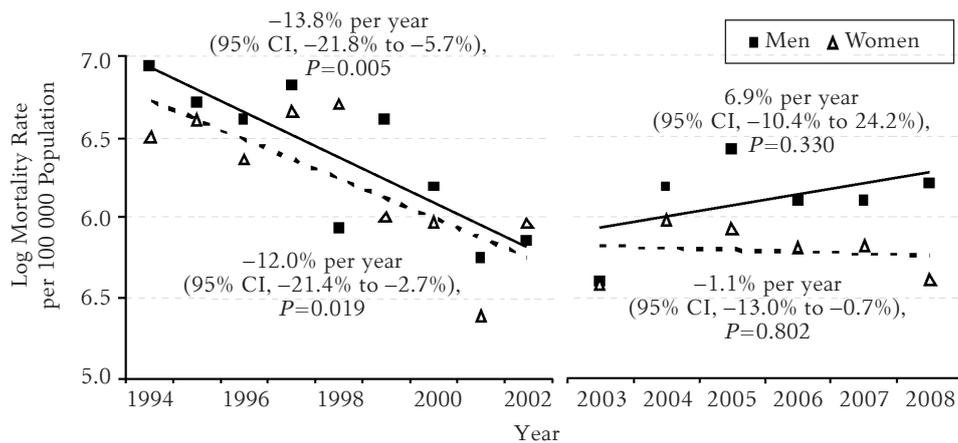


Fig. 4. Trends in log stroke mortality rate per 100 000 population during 1994–2008 for individuals aged 65–79 years by sex

during 1994–2002 and a 16.3% increase per year (95% CI, 4.3% to 28.2% per year;  $P=0.019$ ) during 2003–2008 (Fig. 1B and Fig. 3). The study revealed that during 1994–2002, the mortality rates from stroke were decreasing among women of the same age by  $-14.7\%$  per year (95% CI,  $-23.6\%$  to  $-5.8\%$ ;  $P=0.006$ ) and remained stable (4.9% per year; 95% CI,  $-15.6\%$  to  $25.4\%$ ;  $P=0.540$ ) during 2003–2008 (Fig. 3).

The fitted exponential trends demonstrated that the mortality rate among men ( $R^2=59\%$ ) and women ( $R^2=58\%$ ) aged 65–79 years decreased considerably during 1994–2008 (Fig. 1C). During 1994–2002, the decreasing mortality trend was observed both in men and women: by  $-13.8\%$  per year (95% CI,  $-21.8\%$  to  $-5.7\%$ ;  $P=0.005$ ) and  $-12.0\%$  per year (95% CI,  $-21.4\%$  to  $-2.7\%$ ;  $P=0.019$ ), respectively. During 2003–2008, no further change was observed, and neither the increasing mortality trend among men nor decreasing among women aged 65–79 years was statistically significant (6.9% per year;  $P=0.330$ , and  $-1.1\%$  per year;  $P=0.802$ , respectively) (Fig. 4).

## Discussion

Our study showed high age-adjusted stroke mortality rates in Klaipėda city compared with Western countries: during the first year of the study (1994), the mortality rate in men aged 35 to 79 years was 251.3 per 100 000 population (95% CI, 176.0 to 326.6), and in the last year (2008), it was 146.7 per 100 000 population (95% CI, 127.6 to 202.0). The mortality rate in women of the same age was 170.3 per 100 000 population (95% CI, 149.1 to 201.9) in 1994 and 61.8 per 100 000 population (95% CI, 0.8 to 122.4) in 2008. The stroke mortality rate for the same period remarkably differs in various countries: from 24.1 per 100 000 population in men and 27.3 per 100 000 population in women in Mexico to 274.3 per 100 000 population in men and women in Bulgaria and 347.2 per 100 000 population in women in Russia (9). During the last decade of the 20th century, the average mortality rate from stroke in European countries was 41.2 per 100 000 population compared with 27.6 per 100 000 population in Canada and the United States (10). In the population of Belgrade, the average standardized mortality rate from all types of stroke during 1989–2003 was 90.8 per 100 000 population: 98.0 and 82.4 per 100 000 for men and women, respectively (11).

From the global perspective, Eastern European countries (republics of the former Soviet Union and Bulgaria) are in the leading position in stroke mortality; meanwhile, Switzerland and the United States are the countries with the lowest stroke mortality rate, which is 8 times lower compared with the postsocialist countries of Europe (9, 11, 12).

The epidemiological study showed a decrease in cardiovascular and other-cause mortality in Eastern Europe during 1990–2000. Overall, this decrease started about 25 years later compared with Western European countries (2). During the study period, stroke mortality rates decreased rapidly in Western European countries; in the United States from 1997 to 2007, the annual stroke death rate decreased 34.3%, and the actual number of stroke deaths declined 18.8% (13). The stroke mortality in England during 1979–2004 showed a steady and consistent decline without any slowdown trends for the last 25 years (6). The Oxford Vascular Study reported a decrease in stroke mortality during 1981–2004 (14). Finish researchers indicated a decreased mortality from all types of stroke for both sexes and all age groups (15). In Poland, stroke mortality rates were continuously increasing, but the sharpest increase was observed between 1991 and 2000. In Hungary, the stroke mortality rates did not show a clear trend until 1993 and, thereafter, declined by  $>2\%$  per year. In the Baltic States, the stroke mortality rate declined by  $\sim 30\%$  between 1993 and 2000 (2). The decline in stroke mortality for the period of study has been also stated by other authors (5, 16). However, the decline has slowed greatly in recent years. In our study, the greatest slowdown in the declining trend was seen from 2000.

Analysis of stroke mortality by sex revealed a higher mortality rate among men; however, the difference in older age groups was less significant. Similar findings have also been reported by other authors (11). Moreover, our study showed that between 1994 and 2002, the decline in stroke mortality rates in men was greater than that in women (2, 13). Other epidemiological studies stated that sex differences in stroke mortality were present in the countries where the stroke mortality rate was high ( $>200$  per 100 000 population); however, in the countries with a lower stroke mortality rate ( $<100$  per 100 000 population), the difference in mortality rates between sexes was significantly lower (17). The causes of these differences are complex, but this may be explained by different trends in smoking behavior in men and women (2, 13) or by characteristic features of hormone balance; research investigating the sexual dimorphism of stroke is only in its early stages (18).

Numerous studies have given various causes for the decrease in the mortality rate: improved socioeconomic conditions and, therefore, higher-quality stroke prevention and decreased morbidity (5, 19); decrease in stroke severity over time in part explaining the decrease in the fatality rate at 1 month after onset (20); better quality of stroke treatment management, better acute stroke treatment, and the decrease in early case fatality (21). Having analyzed

cardiovascular and other death causes in Western and Eastern Europe, the authors have stated that among causes of cardiovascular disease-related death, the changes in nutrition and improved treatment of the diseases play a major role (2).

During the second study period (2003–2008), the results showed an increased stroke mortality rate among middle-aged (35–64 years) men in Klaipėda. The epidemiological survey using the WHO standardized methodology carried out in Kaunas during 1998–2002 reported very similar findings. The causes of the stroke mortality increase in middle-aged men were not revealed, since during the period of study, there were no significant changes in classical risk factors for stroke observed among men (22); therefore, the authors suggested that the increase in stroke mortality could have been caused by other, nonclassical, stroke risk factors, e.g., psychosocial or socioeconomic changes (8). Research data obtained by other authors indicated that economic conditions, increase in alcohol consumption, or depression influenced the mortality from heart diseases and strokes (19, 21, 23). Another survey, which was carried out by employing official data of the mortality registry in Kaunas region, also reported the increase in stroke mortality in men and women aged 25–64 during 2000–2004 (24). The authors did not indicate the causes of increasing mortality rates during the study period.

The prevalence of the major cardiovascular risk factors in Klaipėda city has not been studied yet; therefore, the factors that caused a significant increase in stroke mortality in men aged 35–64 during 2003–2008 can only be presumed. As the development of the Lithuanian economy shows, the economic indices during the study period till 2008 were improving; however, the increase in the stroke mortality rate in Klaipėda necessitates comprehensive analysis of the related causes and poses new chal-

lenges to the city community and health professionals.

The epidemiological survey on the lifestyle risk factors carried out in Lithuania during the last decade revealed that habits of our citizens were not favorable to health (25); smoking epidemics reached the “maturity” stage, and the number of smokers was presumed to grow (26); the high level of hypercholesterolemia was observed (22); and the nutrition of men was found less corresponding to the healthy eating recommendations than that of women (27). It was also stated that overweight in the male population increased (28), and though alcohol intake remained rather stable, beer consumption increased (29). According to the study on risk factors in Kaunas, arterial hypertension, smoking, and increased malondialdehyde concentration in blood serum during the last decade have significantly increased the risk of mortality from stroke in elderly men (30). Considering these data, it can be presumed that stroke risk profiles in Klaipėda and Kaunas are alike; therefore, the factors causing stroke mortality could be similar. Thus, in order to develop medical care for cerebrovascular patients in Klaipėda, it is recommended to improve the quality of primary and secondary stroke prevention, especially for a middle-aged male population, in the nearest future.

### Conclusions

Among both men and women, the mortality rates from stroke strongly declined between 1994 and 2008 with a clear slowdown in the decline after 2002. Stroke mortality increased significantly from 2003 among middle-aged men, while it remained without significant changes among women of the same age and both elderly men and women.

### Statement of Conflict of Interest

The authors state no conflict of interest.

## Klaipėdos gyventojų mirtingumo nuo galvos smegenų insulto pokyčiai 1994–2008 m.

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**Raktažodžiai:** galvos smegenų insultas, mirtingumas, pokyčių kryptys.

**Santrauka.** *Tyrimo tikslas.* Nustatyti 35–79 metų Klaipėdos gyventojų mirtingumo nuo galvos smegenų insulto pokyčius per 1994–2008 m. laikotarpį.

*Tyrimo medžiaga ir metodai.* Tyrimo objektas – visi abiejų lyčių 35–79 metų Klaipėdos gyventojai, Klaipėdos miesto civilinės metrikacijos biuro duomenimis, mirę nuo galvos smegenų insulto 1994–2008 m. (9-tosios ir 10-tosios peržiūros Tarptautinės ligų klasifikacijos kodai atitinkamai – 430–436 ir I60–I64). Vyrų ir moterų mirtingumo nuo galvos smegenų insulto rodikliai 100000 gyventojų per metus buvo standartizuoti pagal amžių, standartu naudojant Segi pasaulio populiaciją. Mirtingumas ir mirtingumo

rodiklių kasmečiai vidutiniai pokyčiai buvo vertinami tarp 35–64 metų, 65–79 metų ir 35–79 metų vyrų ir moterų atskirai. Standartizuoto mirtingumo pokyčių kryptims analizuoti naudotas logaritminės tiesinės regresijos modelis.

**Rezultatai.** Analizuojamuoju laikotarpiu (1994–2008) 35–79 metų vyrų mirtingumas nuo galvos smegenų insulto mažėjo vidutiniškai 4,6 proc. per metus ( $p=0,041$ ); moterų – 6,5 proc. per metus. ( $p=0,002$ ), tačiau per šį laikotarpį mirtingumas nuo galvos smegenų insulto mažėjo netolygiai, t. y. nuo 2002 m. nustatytas mažėjimo sulėtėjimas.

Per 1994–2002 m. laikotarpį vyrų ir moterų mirtingumas nuo galvos smegenų insulto mažėjo tolygiai: 35–64 metų – atitinkamai – 20,4 proc. per metus,  $p=0,002$  ir 14,7 proc. per metus,  $p=0,006$ ; 65–79 metų – atitinkamai – 13,8 proc. per metus,  $p=0,005$  ir 12 proc. per metus,  $p=0,019$ .

Per 2003–2008 m. laikotarpį mirtingumas nuo galvos smegenų insulto didėjo tarp vidutinio amžiaus (35–64 metų) vyrų – 16,3 proc. per metus ( $p=0,019$ ), tačiau tarp to paties amžiaus moterų ir tarp pagyvenusio amžiaus (65–79 metų) abiejų lyčių asmenų mirtingumas iš esmės nekito.

**Išvados.** Tiek vyrų, tiek moterų mirtingumo nuo galvos smegenų insulto rodikliai reikšmingai sumažėjo analizuojamuoju laikotarpiu, tačiau mirtingumas mažėjo netolygiai, t. y. nuo 2002 m. nustatytas mažėjimo sulėtėjimas. Laikotarpiu nuo 2003 iki 2008 m. tarp vidutinio amžiaus vyrų nustatytas statistiškai reikšmingas mirtingumo nuo galvos smegenų insulto didėjimas, o mirtingumas tarp to paties amžiaus moterų ir tarp pagyvenusio amžiaus (65–79 metų) abiejų lyčių asmenų išliko nepakitęs.

## References

- Redon J, Olsen MH, Cooper RS, Zurriaga O, Martinez-Beneito MA, Laurent S, et al. Stroke mortality and trends from 1990 to 2006 in 39 countries from Europe and Central Asia: implications for control of high blood pressure. *Eur Heart J* 2011;32(11):1424-31.
- Kesteloot H, Sans S, Kromhout D. Dynamic of cardiovascular and all-cause mortality in Western and Eastern Europe between 1970 and 2000. *Eur Heart J* 2006;27(1):107-13.
- Müller-Nordhorn J, Binting S, Roll S, Willich SN. An update on regional variation in cardiovascular mortality within Europe. *Eur Heart J* 2008;29(10):1316-26.
- Stegmayr B, Eriksson M, Asplund K. Declining mortality from subarachnoid hemorrhage: changes in incidence and case fatality from 1985 through 2000. *Stroke* 2004;35(9):2059-63.
- Lavallée PC, Labreuche J, Spieler J-F, Jouglu É, Amarenco P. Stroke and vascular mortality trends in France: 1979-2001. *Neuroepidemiology* 2007;29:78-82.
- Goldacre MJ, Duncan M, Griffith M, Rothwell PM. Mortality rates for stroke in England from 1979-2004. Trends, diagnostic precision, and artifacts. *Stroke* 2008;39(8):2197-203.
- Truelsen T, Piechowski-Jozwiak B, Bonita R, Mathers C, Bogousslavsky J, Boysen G. Stroke incidence and prevalence in Europe: a review of available data. *Eur J Neurol* 2006;13(6):581-98.
- Rastenytė D, Šopagienė D, Jurėnienė K. Vidutinio amžiaus Kauno gyventojų mirtingumo nuo galvos smegenų insulto pokyčiai per pastaruosius 17 metų. (Trends in stroke mortality in a middle aged Kaunas population over the last 17-year period.) *Neurologijos seminarai* 2005;9(24):107-12.
- Tanaka H, Iso H, Yokoyama T, Yoshiike N, Kokubo Y. Cerebrovascular disease. In: Detels R, McEwan J, Beaglehole R, Tanaka H, editors. *Oxford textbook of public health*. 4th ed. Oxford: Oxford University Press; 2002. Vol. 3. p. 1193-226.
- Wolf-Maier K, Cooper RS, Banegas JR, Giampaoli S, Hense HW, Joffres M, et al. Hypertension prevalence and blood pressure levels in 6 European countries, Canada, and the United States. *JAMA* 2003;289:2363-9.
- Pekmezovic T, Tepavcevic DK, Jarebinski M, Kostic M, Bumbasirevic L. Trends in mortality from different subtypes of stroke in the population of Belgrade (Serbia). *Clin Neurol Neurosurg* 2008;110(1):51-7.
- Bertuccio P, Levi F, Lucchini F, Chatenoud L, Bosetti C, Negri E, et al. Coronary heart disease and cerebrovascular disease mortality in young adults: recent trends in Europe. *Eur J Cardiovasc Prev Rehabil* 2011;18(4):627-34.
- Roger VL, Go AS, Lloyd-Jones DM, Adams RJ, Berry JD, Brown TM, et al; American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics – 2011 update: a report from the American Heart Association. *Circulation* 2011;123:e18-e209.
- Rothwell PM, Coull AJ, Giles MF, Howard SC, Silver LE, Bull LM, et al. Change in stroke incidence, mortality, case-fatality, severity and risk factors in Oxfordshire, UK from 1981 to 2004 (Oxford Vascular Study). *Lancet* 2004;363(9425):1925-33.
- Pajunen P, Pääkkönen R, Hämäläinen H, Keskimäki I, Laatikainen T, Niemi M, et al. Trends in fatal and nonfatal strokes among persons aged 35 to ≥85 years during 1991–2002 in Finland. *Stroke* 2005;36(2):244-8.
- Sturgeon JD, Folsom AR. Trends in hospitalization rate, hospital case fatality, and mortality rate of stroke by subtype in Minneapolis-St. Paul, 1980–2002. *Neuroepidemiology* 2007;28(1):39-45.
- Kuller LH. Epidemiology and prevention of stroke, now and in the future. *Epidemiol Rev* 2000;22(1):14-27.
- Turtzo LC, McCullough LD. Review. Sex-specific responses to stroke. *Future Neurology* 2010;5(1):47-59.
- Cabral NL, Gonçalves AR, Longo AL, Moro CH, Costa G, Amaral CH, et al. Trends in stroke incidence, mortality and case fatality in Joinville, Brazil: 1995–2006. *J Neurol Neurosurg Psychiatry* 2009;80(7):749-54.
- Numminen H, Kaste M, Aho K, Waltimo O, Kotila M. Decreased severity of brain infarct can in part explain the decreasing case fatality rate of stroke. *Stroke* 2000;31:651-5.
- Avendano M, Kunst AE, van Lenthe F, Bos V, Costa G, Valkonen T, et al. Trends in socioeconomic disparities in stroke mortality in six European countries between 1981–1985 and 1991–1995. *Am J Epidemiol* 2005;161(1):52-61.
- Domarkienė S, Tamošiūnas A, Rėklaitienė R, Šidlauskienė D, Jurėnienė K, Margevičienė L, ir kt. Širdies ir kraujagyslių ligų svarbiausių rizikos veiksnių pokyčiai tarp vidutinio amžiaus Kauno gyventojų 1983–2002 metais. (Trends in main cardiovascular risk factors among middle-aged Kaunas population between 1983 and 2002.) *Medicina (Kaunas)* 2003;39(12):1193-9.
- Brenner MH. Commentary: economy growth is the basis of mortality rate decline in the 20th century-experience

- of United States 1901–2000. *Int J Epidemiol* 2005;34(6):1214–21.
24. Rėklaitienė R, Janilionis V, Noreika M, Tamošiūnas A, Virvičiūtė D, Šopagienė D. Effects of age, period and cohort on stroke mortality among a middle-aged Lithuanian urban population from 1980 to 2004. *Scand J Public Health* 2008;36(6):573–9.
25. Grabauskas V, Zaborskis A, Klumbienė J, Žemaitienė N. Lietuvos paauglių ir suaugusių žmonių gyvenamosios pokyčiai 1994–2002 metais. (Changes in health behavior of Lithuanian adolescents and adults over 1994–2002.) *Medicina (Kaunas)* 2004;40(9):884–91.
26. Helasoja V, Lahelma E, Prättälä R, Patja KM, Klumbienė J, Pudule I, et al. Determinants of daily smoking in Estonia, Latvia, Lithuania, and Finland in 1994–2002. *Scand J Public Health* 2006;34(4):353–62.
27. Petkevičienė L, Kriaučionienė V, Klumbienė J. Lietuvos vyrų ir moterų mitybos įpročių skirtumai. (Differences in nutrition's habits of men and women in Lithuania.) *Lietuvos bendrosios praktikos gydytojas* 2004;8:165–8.
28. Grabauskas V, Petkevičienė J, Klumbienė J, Vaisvalavičius V. Antsvorio ir nutukimo dažnio priklausomybė nuo socialinių bei gyvenamosios veiksmų (Lietuvos suaugusių žmonių gyvenamosios tyrimas). (The prevalence of overweight and obesity in relation to social and behavioral factors.) *Lithuanian health behavior monitoring* *Medicina (Kaunas)* 2003;39(12):1223–30.
29. Klumbienė J, Petkevičienė J, Dregval L. Habits of alcohol consumption among Lithuanian adult population: a basis for planning health. *Am J Health Promot* 2002;4(5).
30. Lukšienė DI, Černiauskiene LR, Šopagienė D, Tamošiūnas A, Margevičienė L. Rizikos veiksnių ir jų derinių įtaka Kauno pagyvenusių vyrų mirtingumui nuo galvos smegenų insulto. (Influence of risk factors and their combination on risk of mortality from stroke in Kaunas elderly men.) *Medicinos teorija ir praktika* 2008;14(1):71–5.

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