

Trends and Regional Disparities in Ischemic Heart Disease and Cerebrovascular Disease in Croatia, 1997–2006

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ABSTRACT

The aim of this study was to analyze mortality and hospital morbidity from ischemic heart disease (IHD) and cerebrovascular disease (CVD) in the population aged 18+ years in different regions of Croatia, in 1997 to 2006 period. Mortality data were supplied by Central Bureau of Statistics, while hospital morbidity data were obtained from hospital discharge database at Croatian National Institute of Public Health. In Mediterranean region rates of IHD mortality were lower, while rates of hospitalization due to IHD have been higher than those for Croatia in the entire period. Rates of IHD mortality for Continental part have not been different from mean rates for Croatia while rates of hospitalization due to IHD have been lower than rates for Croatia in entire period. Rates of CVD mortality and rates of hospitalization due to CVD for Mediterranean part have been lower than rates for Croatia, while both rates for Continental part have been higher than rates for Croatia during entire period. This analysis identified the regions in which significant deviations from the general trend suggest the need for creation of a new national public health intervention model, focusing on changeable behaviour (lifestyles) risk factors.

Key words: mortality, hospital morbidity, ischemic heart disease, cerebrovascular disease, regions, Croatia

Introduction

The number of elderly is growing rapidly worldwide, with over 580 million people who are older than 60 years, and the projected figure reaching to 1 billion by the year 2020¹. With the increase in life expectancy, the leading causes of death have shifted dramatically from infectious diseases to noncommunicable diseases and from younger to older age groups. About 75% of deaths in persons older than the age of 65 in industrialized countries are attributable to the cardiovascular diseases and cancer². Ischemic heart disease (IHD) and cerebrovascular disease (CVD) continues to be the leading cause of death in adults in developed countries. During the entire 20th century, a dynamic worldwide changes in IHD and CVD mortality were recorded. Many Western European countries and US documented a rise in mortality from IHD and CVD until the 1960s and 1970s, with substantial declines since those peaks. The changes in mortality from IHD and CVD in the western world during recent decades have not been regionally homogenous. Mortality time trend differences have been shown both between and within countries^{3–5}. Trends for IHD and CVD mortality have been strikingly different in Eastern European

countries compared with the Western European countries and US including high rates of IHD and CVD mortality in Eastern Europe that continue to rise and an ominous epidemic of IHD and CVD^{6–11}.

Although international variation in IHD and CVD mortality rates is not well understood, temporal and cross-population variations in lifestyle, socio-environmental, and medical care determinants within countries and between countries may provide a partial explanation^{12–22}.

IHD and CVD in Croatia have been increasing constantly and present the leading cause of death in Croatia in the last two decades^{23–31}. In 2006, 25 611 people (rate 577/100 000) died from circulatory disease group, with a 51% share in total mortality. The leading diagnostic entities are ischemic heart disease and cerebrovascular diseases with their respective shares of 38% and 32% in circulatory disease group. From ischemic heart disease died 4 730 men, with a 19% share in all-cause mortality and from cerebrovascular diseases died 3 369 men (13% share in all-cause mortality causes of death). Ischemic heart disease is the leading diagnosis of death in women to, of

which 5 092 women died (20% share in all-cause mortality). It is followed by cerebrovascular diseases, responsible for 4 706 deaths (19% share in all-cause mortality)³².

According to ischemic heart disease – related mortality, Croatia with its standardized mortality rate of 160/100 000 belongs to European countries with medium high mortality rates. The European region average is 210/100 000 and EU 103/100 000. Eastern European countries generally have higher mortality rates than Croatia, while Western and Southern (Mediterranean) Europe has lower mortality rates than Croatia. Mortality due to cerebrovascular diseases are similar in Croatia (standardized rates: 126/100 000) and European region (127/100 000). Eastern European countries generally have higher mortality rates than Croatia, while Western, Southern (Mediterranean) Europe and EU has lower mortality rates than Croatia³³.

In this paper we present burden of IHD and CVD in terms of the number of hospital admissions and deaths caused by these disease. The primary aim of the present study was to analyze mortality and morbidity from IHD and CVD in the population aged 18+ years in different regions of Croatia, in 10-year period, from 1997 to 2006. A further aim was to identify regions in which significant deviations from the general trend might suggest a need for health care interventions, from health promotion and primary prevention, early diagnosis and treatment to patient rehabilitation..

Materials and Methods

Mortality data for 10-year period (1997–2006) were supplied by Central Bureau of Statistics, while hospital morbidity data for 9-year period (1998–2006) were obtained from hospital discharge database at Croatian National Institute of Public Health. Data for hospital morbidity included only 9-year period as they have been available in digital form at county level only since 1998.

International Classification of Diseases, 10th revision (ICD-10) was used in all the years under study for coding of both mortality and morbidity data according to WHO instructions. Data for hospital morbidity comprise all hospitalizations in all hospitals in Croatia (both public and private), except prison hospital.

Diagnostic codes were selected as defined in ICD-10: I20-I25 for ischemic heart disease; I60-I69 for cerebrovascular diseases. Population data were obtained from Census 2001.

National, county and Continental/Mediterranean part mortality and hospital morbidity age- and sex-adjusted rates with 95% CI were calculated using European standard population – old as the standard for direct adjustment. Mediterranean part of Croatia for our analysis included seven counties (Istra, Primorje-Gorski kotar, Lika-Senj, Zadar, Šibenik-Knin, Split-Dalmatia and Dubrovnik-Neretva) which encompass coastal area characterized by Mediterranean nutrition and lifestyle which have been reported as inversely associated with cardiovascu-

lar and cerebrovascular mortality. Remaining 13 counties and City of Zagreb formed Continental part in which nutritional habits and lifestyle resemble those in Central European countries (Hungary, Slovenia, Austria). Counties were grouped in Continental and Mediterranean part only for purpose of this study, the only official regional units in Croatia are counties which were too small for purpose of our analysis.

Mortality and hospital morbidity rate trends were evaluated by log-linear regression model at county, Continental/Mediterranean part and national level. The average annual percent change for each rate was calculated from regression model and ANOVA was used to obtain its significance level ($p < 0,05$).

Results

Rates of IHD mortality for Mediterranean part have been significantly lower than rates for Croatia in entire period 1997–2006, except for 1998, 1999 and 2000 for which rates were not significantly different, while rates of IHD mortality for Continental part have not been different from the mean rates for Croatia (Table 1).

In 2006, 8 counties had higher rates of IHD mortality than rate for Croatia: Zagreb, Sisak-Moslavina, Koprivnica-Križevci, Bjelovar-Bilogora, Primorje-Gorski Kotar, Lika-Senj, Osijek-Baranja and Istria, while 5 counties had lower rates of IHD mortality than rate for Croatia: Zadar, Šibenik-Knin, Split-Dalmatia, Međimurje and City of Zagreb. In remaining 8 counties IHD mortality rates did not differ from rate for entire Croatia (Table 1).

Between 1997 and 2006, the age- and sex-adjusted rates of IHD mortality significantly increased in seven counties: Zagreb, Sisak-Moslavina, Karlovac, Požega-Slavonija, Brod-Posavina, Osijek-Baranja and Vukovar-Srijem. No significant change was recorded in remaining counties, in Continental and Mediterranean parts and in Croatia as a whole (Table 1, Figure 1).

Rates of hospitalization due to IHD for Mediterranean part have been significantly higher than rates for Croatia in 1999, 2000, 2004 and 2005, while rates of hospitalization due to IHD for Continental part have been significantly lower than rates for Croatia in 2000, 2004 and 2005 (Table 2).

In 2006, 5 counties had higher rates of hospitalization due to IHD than rate for Croatia: Primorje-Gorski Kotar, Virovitica-Podravina, Brod-Posavina, Zadar and Istria, while 8 counties had lower rates than rate for Croatia: Zagreb, Varaždin, Bjelovar-Bilogora, Šibenik-Knin, Split-Dalmatia, Dubrovnik-Neretva, Međimurje and City of Zagreb. In remaining 8 counties IHD hospitalization rates did not differ from rate for entire Croatia (Table 2).

The age- and sex-adjusted rates of IHD hospitalizations significantly increased between 1998 and 2006 in two counties: Koprivnica-Križevci and Osijek-Baranja. No significant change was recorded in remaining coun-

ties, in Continental and Mediterranean parts and in Croatia as a whole (Table 2, Figure 2).

Rates of cerebrovascular disease (CVD) mortality for Mediterranean part have been lower than rates for Croatia, while rates for Continental part have been higher than rates for Croatia during entire period 1997–2006 (Table 3).

In 2006, 11 counties (all from Continental part) had higher rates of CVD mortality than rate for Croatia: Krapina-Zagorje, Sisak-Moslavina, Karlovac, Koprivnica-Križevci, Bjelovar-Bilogora, Virovitica-Podravina, Požega-Slavonija, Brod-Posavina, Osijek-Baranja, Vukovar-Srijem and Međimurje, while 6 counties (5 of which



Fig. 1. Regional trends in ischemic heart disease – age- and sex-adjusted mortality rates: Croatia, 1997–2006. Black-significant increase, white-significant decrease, grey – no change. The number denotes the ratio of each county to the 2006 mean rate for Croatia (asterisk denotes significant difference).



Fig. 2. Regional trends in cerebrovascular diseases – age- and sex-adjusted mortality rates: Croatia, 1997–2006. Black-significant increase, white-significant decrease, grey – no change. The number denotes the ratio of each county to the 2006 mean rate for Croatia (asterisk denotes significant difference).

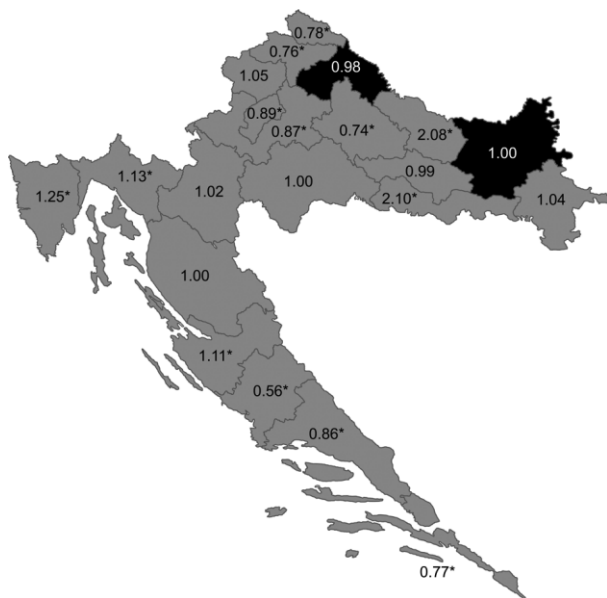


Fig. 3. Regional trends in ischemic heart disease – age- and sex-adjusted hospital morbidity rates: Croatia, 1998–2006. Black-significant increase, white-significant decrease, grey – no change. The number denotes the ratio of each county to the 2006 mean rate for Croatia (asterisk denotes significant difference).



Fig. 4. Regional trends in cerebrovascular diseases – age- and sex-adjusted hospital morbidity rates: Croatia, 1998–2006. Black-significant increase, white-significant decrease, grey – no change. The number denotes the ratio of each county to the 2006 mean rate for Croatia (asterisk denotes significant difference).

TABLE 1
ISCHEMIC HEART DISEASE (I20–I25) – AGE- AND SEX-ADJUSTED MORTALITY RATES

County		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Rate ratio between county and national rate for 2006	Average annual percentage change (%)	p
Croatia		180.59	181.65	169.02	174.40	166.04	165.52	195.67	171.78	188.38	186.35		0.58	0.3556
	CI5%	176.75	177.79	165.31	170.64	162.37	161.85	191.69	168.05	184.47	182.45			
	CI95%	184.43	185.51	172.72	178.12	169.70	169.18	199.65	175.50	192.31	190.25			
Continental part		186.96	181.99	169.58	178.51	172.02	171.04	201.18	176.96	193.71	192.81		0.78	0.2532
	CI5%	182.09	177.19	165.00	173.82	167.41	166.43	196.16	172.26	188.76	187.87			
	CI95%	191.82	186.79	174.17	183.19	176.62	175.64	206.20	181.67	198.67	197.74			
Mediterranean part		166.81	178.48	165.52	164.48	152.66	153.74	183.61	160.68	176.97	173.08		0.28	0.7073
	CI5%	160.56	172.01	159.32	158.33	146.68	147.81	177.12	154.60	170.58	166.73			
	CI95%	173.07	184.94	171.71	170.64	158.64	159.68	190.10	166.76	183.36	179.43			
Zagreb		191.25	194.09	182.28	190.76	185.98	196.73	237.09	198.60	214.58	207.08	1.11*	1.56	0.0467
	CI5%	175.34	178.02	166.79	175.30	170.77	180.78	219.57	182.45	197.88	190.67			
	CI95%	207.17	210.16	197.76	206.23	201.19	212.69	254.62	214.75	231.28	223.48			
Krapina-Zagorje		172.72	188.98	166.91	187.88	167.93	181.75	226.54	177.38	190.09	191.43	1.03	1.17	0.2563
	CI5%	151.35	166.66	146.51	166.45	147.63	160.21	202.42	156.62	168.12	169.49			
	CI95%	194.08	211.31	187.31	209.30	188.24	203.29	250.67	198.14	212.06	213.36			
Sisak-Moslavina		169.75	209.79	187.31	223.95	218.34	224.13	253.27	232.64	272.55	256.49	1.38*	4.35	0.0005
	CI5%	151.40	189.40	168.36	202.96	197.95	203.16	231.36	211.29	248.89	233.38			
	CI95%	188.09	230.17	206.26	244.94	238.72	245.10	275.19	253.98	296.21	279.60			
Karlovac		123.43	128.16	130.97	142.33	156.97	160.78	179.59	183.58	178.25	183.29	0.98	5.14	<0.0001
	CI5%	107.11	111.37	114.13	125.24	139.15	142.02	160.03	163.74	158.41	163.20			
	CI95%	139.76	144.96	147.81	159.43	174.79	179.53	199.15	203.41	198.08	203.38			
Varaždin		184.53	169.62	160.52	197.65	174.98	186.96	200.35	172.23	193.50	168.19	0.90	0.33	0.7149
	CI5%	165.06	150.53	142.47	177.39	155.99	166.99	179.83	153.27	173.39	149.98			
	CI95%	203.99	188.71	178.57	217.92	193.97	206.93	220.87	191.18	213.61	186.40			
Koprivnica-Krizevci		271.92	242.57	242.54	203.15	195.77	220.09	209.00	190.04	222.10	225.15	1.21*	-2.00	0.0942
	CI5%	244.38	216.71	216.04	179.47	172.38	195.47	184.40	166.64	197.03	200.04			
	CI95%	299.46	268.42	269.04	226.82	219.15	244.70	233.60	213.45	247.17	250.25			
Bjelovar-Bilogora		185.95	182.01	168.69	164.88	139.21	136.92	176.17	159.80	203.14	227.73	1.22*	1.53	0.4104
	CI5%	163.70	160.25	148.15	144.59	120.08	117.60	154.16	139.22	179.83	203.12			
	CI95%	208.19	203.77	189.23	185.16	158.34	156.25	198.18	180.38	226.44	252.35			
Primorje-Gorski Kotar		235.21	242.66	215.05	229.67	204.23	201.94	227.85	191.28	232.36	227.20	1.22*	-0.75	0.4122
	CI5%	219.26	226.53	199.76	214.15	189.37	187.28	212.30	177.25	216.62	211.60			
	CI95%	251.17	258.79	230.34	245.19	219.09	216.60	243.39	205.31	248.10	242.81			

Lika-Senj		173.97	184.82	168.42	183.43	160.13	147.76	194.32	172.86	216.73	230.75	1.24*	2.38	0.1145
	CI5%	143.94	153.77	138.51	151.77	131.59	119.81	163.00	143.36	183.98	196.63			
	CI95%	203.99	215.87	198.33	215.08	188.66	175.71	225.64	202.36	249.48	264.88			
Virovitica-Podravina		228.31	211.03	221.46	184.61	208.04	201.41	248.48	196.75	187.97	193.99	1.04	-1.21	0.25568
	CI5%	197.03	181.26	191.09	156.54	178.19	172.56	216.87	168.98	160.63	165.22			
	CI95%	259.59	240.80	251.82	212.67	237.89	230.26	280.10	224.52	215.31	222.76			
Požega-Slavonija		146.25	136.43	132.50	161.75	158.06	156.50	186.30	167.74	216.41	219.71	1.18	5.28	0.00005
	CI5%	119.57	110.64	107.53	135.01	131.43	130.30	157.05	140.24	185.07	187.88			
	CI95%	172.92	162.22	157.47	188.48	184.70	182.71	215.54	195.24	247.75	251.54			
Brod-Posavina		135.32	140.42	133.44	146.41	169.30	155.81	184.22	156.19	209.32	198.08	1.06	4.72	0.00008
	CI5%	117.45	122.45	116.55	128.01	149.31	137.39	163.42	136.71	186.80	176.18			
	CI95%	153.20	158.39	150.34	164.82	189.29	174.24	205.01	175.67	231.85	219.97			
Zadar		130.72	132.76	124.70	119.90	111.14	123.62	147.18	138.36	149.59	156.51	0.84*	2.27	0.0517
	CI5%	114.38	116.51	108.72	104.57	96.31	108.03	130.23	121.64	132.39	139.03			
	CI95%	147.07	149.00	140.67	135.23	125.98	139.20	164.14	155.08	166.80	173.99			
Osijek-Baranja		140.30	165.21	166.59	152.40	135.61	139.78	185.29	167.62	194.70	210.45	1.13*	3.36	0.0331
	CI5%	126.87	151.13	152.26	138.13	122.71	126.59	169.81	152.98	178.67	194.12			
	CI95%	153.73	179.28	180.92	166.67	148.50	152.97	200.78	182.26	210.74	226.78			
Šibenik-Knin		156.39	161.14	204.00	144.83	133.53	153.60	184.06	169.22	174.45	148.40	0.80*	0.00	0.9974
	CI5%	135.94	140.79	172.66	125.48	114.70	133.55	162.34	148.48	153.56	128.51			
	CI95%	176.83	181.48	235.34	164.17	152.37	173.65	205.77	189.95	195.34	168.29			
Vukovar-Srijem		137.88	159.85	171.89	159.28	140.75	149.24	188.19	185.87	209.87	179.36	0.96	3.22	0.0230
	CI5%	120.52	141.37	152.89	140.80	123.25	130.68	167.82	165.77	188.19	159.48			
	CI95%	155.25	178.34	190.88	177.76	158.26	167.80	208.55	205.98	231.55	199.23			
Split-Dalmatija		132.80	140.09	128.27	118.58	118.41	118.00	140.24	123.61	133.71	132.11	0.71*	-0.04	0.9651
	CI5%	122.55	129.43	118.25	108.96	108.72	108.28	129.78	113.69	123.38	121.78			
	CI95%	143.05	150.75	138.28	128.20	128.09	127.72	150.71	133.53	144.04	142.44			
Istria		200.59	215.92	229.40	231.82	223.85	219.04	272.03	230.52	231.12	215.92	1.16*	0.99	0.2805
	CI5%	182.66	197.38	210.82	212.69	204.90	200.85	251.43	211.37	212.05	197.28			
	CI95%	218.53	234.47	247.98	250.95	242.80	237.22	292.63	249.67	250.19	234.56			
Dubrovnik-Neretva		119.36	164.67	127.96	122.64	97.64	98.46	122.40	113.44	121.86	224.65	1.21	1.83	0.5376
	CI5%	101.83	143.76	109.18	104.43	81.82	82.39	104.35	96.08	103.94	189.58			
	CI95%	136.88	185.59	146.74	140.85	113.46	114.54	140.45	130.81	139.77	259.71			
Međimurje		207.36	205.71	196.79	185.30	190.55	188.41	226.05	214.23	189.93	152.40	0.82*	-1.40	0.2550
	CI5%	181.26	179.09	170.97	160.37	164.87	163.23	198.49	187.40	164.28	129.84			
	CI95%	233.47	232.33	222.60	210.23	216.22	213.60	253.61	241.06	215.59	174.96			
City of Zagreb		222.10	183.23	153.39	175.86	168.16	149.18	174.80	149.48	157.40	165.79	0.89*	-2.37	0.0631
	CI5%	212.02	174.02	145.00	166.96	159.42	140.94	165.88	141.19	148.86	156.99			
	CI95%	232.17	192.44	161.78	184.76	176.90	157.41	183.71	157.77	165.95	174.59			

* significant difference

TABLE 2
CEREBROVASCULAR DISEASES (160–169) – AGE- AND SEX-ADJUSTED MORTALITY RATES

County	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Rate ratio between county and national rate for 2006	Average annual percentage change (%)	P
Croatia	156.04	158.04	160.23	150.33	149.53	151.92	150.43	143.56	148.17	147.10		-0.91	0.0037
	CI5%	152.53	154.53	146.90	146.10	148.45	147.00	140.19	144.74	143.67			
	CI95%	159.55	161.54	163.78	153.76	152.96	153.86	146.93	151.60	150.53			
Continental part	171.49	171.88	176.92	166.04	161.27	167.42	165.65	159.37	161.85	164.67		-0.77	0.0183
	CI5%	166.94	167.36	172.31	161.59	156.86	162.89	161.16	154.96	160.17			
	CI95%	176.03	176.41	181.53	170.49	165.68	171.94	163.78	166.32	169.18			
Mediterranean part	124.97	130.10	127.13	118.88	126.35	121.74	120.86	113.36	121.70	113.45		-1.14	0.0112
	CI5%	119.60	124.67	121.76	113.68	120.99	116.47	115.63	108.32	116.45			
	CI95%	130.34	135.53	132.50	124.07	131.70	127.01	118.39	126.95	118.54			
Zagreb	195.06	193.94	190.44	179.45	155.59	181.35	151.17	150.99	158.66	144.71	0.98	-3.35	0.0007
	CI5%	179.49	178.26	174.96	164.57	141.77	166.06	137.65	144.27	131.07			
	CI95%	210.62	209.62	205.93	194.32	169.41	196.64	164.69	173.04	158.35			
Krapina-Zagorje	235.90	217.51	208.91	203.48	211.34	211.32	193.55	206.35	178.76	188.17	1.28*	-2.17	0.0018
	CI5%	211.68	194.58	186.41	180.84	188.37	188.53	171.64	183.71	166.50			
	CI95%	260.13	240.44	231.41	226.12	234.31	234.12	215.47	228.99	209.85			
Sisak-Moslavina	149.09	133.44	153.84	167.41	173.31	168.25	171.09	171.07	186.65	175.73	1.19*	2.70	0.0029
	CI5%	132.08	117.37	136.89	149.85	155.02	150.46	153.57	167.45	157.07			
	CI95%	166.10	149.52	170.80	184.98	191.60	186.05	188.61	205.86	194.39			
Karlovac	155.36	129.80	143.50	164.48	150.03	139.17	171.41	157.90	174.49	172.50	1.17*	2.17	0.0414
	CI5%	137.08	113.29	125.71	145.88	132.29	122.49	139.85	154.40	153.35			
	CI95%	173.65	146.30	161.30	183.08	167.77	155.85	175.95	194.58	191.65			
Varaždin	197.15	174.99	178.36	170.60	161.43	161.91	184.69	148.07	148.79	151.19	1.03	-2.52	0.0056
	CI5%	177.08	156.92	159.40	152.25	143.48	143.92	165.37	130.82	134.17			
	CI95%	217.22	193.06	197.31	188.94	179.38	179.90	204.02	165.32	168.20			
Koprivnica-Križevci	188.88	213.42	209.70	182.94	208.65	202.36	182.28	200.61	182.96	212.78	1.45*	-0.16	0.8372
	CI5%	166.34	189.35	186.32	160.96	185.05	178.80	177.33	160.40	188.69			
	CI95%	211.42	237.49	233.09	204.91	232.25	225.92	203.80	223.89	205.52			
Bjelovar-Bilogora	232.08	223.12	232.91	243.77	200.17	209.79	215.96	206.06	229.57	217.15	1.48*	-0.80	0.2608
	CI5%	208.21	199.64	208.86	219.00	178.24	186.54	192.65	183.23	205.24			
	CI95%	255.96	246.60	256.96	268.55	222.10	233.03	239.26	228.90	253.89			
Primorje-Gorski Kotar	109.71	119.74	119.47	99.49	117.53	106.83	113.63	91.65	98.10	89.72	0.61*	-2.53	0.0192
	CI5%	98.87	108.49	108.29	89.16	106.32	102.65	81.91	87.81	79.88			
	CI95%	120.55	130.99	130.64	109.82	128.74	124.60	101.39	108.39	99.56			

Lika-Senj		124.55	124.19	138.08	139.19	128.57	143.63	122.54	113.59	144.66	103.50	0.70	-1.11	0.3750
	CI5%	98.49	99.26	110.81	111.89	103.62	116.46	98.45	90.54	118.42	80.59			
	CI95%	150.62	149.12	165.34	166.50	153.53	170.79	146.63	136.64	170.91	126.41			
Virovitica-Podravina		256.72	252.58	248.81	194.99	203.76	220.55	229.72	204.95	167.38	214.29	1.46*	-2.93	0.0320
	CI5%	225.02	221.83	217.68	167.88	175.22	190.17	198.34	176.08	144.06	183.76			
	CI95%	288.41	283.34	279.93	222.09	232.30	250.93	261.09	233.82	190.71	244.83			
Požega-Slavonija		211.11	204.63	189.30	205.58	211.61	206.19	187.69	197.01	185.34	184.06	1.25*	-1.22	0.0320
	CI5%	180.53	174.23	161.24	176.04	180.87	174.91	158.27	167.40	156.15	155.03			
	CI95%	241.69	235.03	217.37	235.11	242.34	237.48	217.11	226.63	214.52	213.08			
Brod-Posavina		156.44	148.81	151.67	168.01	155.08	175.27	163.27	185.03	191.78	204.46	1.39*	3.21	0.0006
	CI5%	137.68	130.74	133.27	148.29	136.62	155.08	144.17	163.90	170.84	183.04			
	CI95%	175.20	166.88	170.08	187.73	173.54	195.46	182.36	206.16	212.71	225.88			
Zadar		120.91	133.39	114.02	136.10	129.65	147.38	121.24	126.64	131.69	121.75	0.83*	0.17	0.8483
	CI5%	105.42	117.32	98.970	119.85	113.91	130.52	105.97	111.02	116.16	106.45			
	CI95%	136.39	149.46	129.07	152.35	145.39	164.23	136.51	142.26	147.21	137.06			
Osijek-Baranja		171.13	194.37	225.68	190.89	190.34	199.83	215.32	200.78	199.61	217.14	1.48*	1.31	0.1423
	CI5%	156.49	178.95	208.94	175.62	175.09	183.78	198.72	184.81	183.69	200.25			
	CI95%	185.77	209.80	242.42	206.16	205.59	215.88	231.92	216.76	215.52	234.04			
Šibenik-Knin		163.37	163.78	139.81	156.36	150.40	139.94	153.85	137.50	135.42	143.73	0.9	-1.62	0.0257
	CI5%	142.81	143.10	121.33	136.64	131.29	121.30	134.06	118.84	117.33	124.50			
	CI95%	183.93	184.46	158.30	176.08	169.51	158.58	173.65	156.16	153.52	162.96			
Vukovar-Srijem		131.66	173.47	171.03	188.25	179.47	194.34	199.17	180.47	208.08	190.43	1.29*	3.15	0.0141
	CI5%	114.83	153.91	152.86	168.16	159.67	174.15	178.16	160.49	186.78	169.42			
	CI95%	148.50	193.03	189.20	208.34	199.26	214.52	220.18	200.44	229.39	211.44			
Split-Dalmatija		131.72	140.84	129.73	116.18	134.05	123.90	130.59	124.17	143.06	131.04	0.89*	0.07	0.9241
	CI5%	121.55	130.53	119.66	106.77	123.88	114.16	120.60	114.43	132.52	121.03			
	CI95%	141.89	151.15	139.80	125.58	144.22	133.64	140.59	133.92	153.61	141.06			
Istria		111.26	96.75	115.55	105.13	104.12	94.17	93.78	97.31	98.81	94.33	0.64*	-1.59	0.0386
	CI5%	98.03	84.46	102.22	92.30	91.20	81.76	81.67	85.00	86.25	82.12			
	CI95%	124.49	109.04	128.87	117.97	117.04	106.58	105.89	109.62	111.38	106.54			
Dubrovnik-Neretva		127.49	137.01	153.85	128.55	126.94	128.98	112.31	114.57	102.99	106.03	0.72*	-3.29	0.0032
	CI5%	109.57	118.57	134.28	110.66	109.09	110.99	95.67	97.56	87.23	89.39			
	CI95%	145.40	155.46	173.41	146.45	144.80	146.97	128.95	131.58	118.75	122.68			
Međimurje		217.90	212.39	214.27	185.09	173.68	237.72	198.97	175.83	159.19	175.29	1.19*	-2.65	0.0478
	CI5%	190.87	185.62	187.16	160.50	149.16	209.30	172.84	151.21	136.00	151.08			
	CI95%	244.93	239.17	241.38	209.69	198.20	266.14	225.09	200.45	182.37	199.49			
City of Zagreb		134.05	136.90	136.52	111.66	114.58	110.30	109.12	102.42	103.90	109.63	0.75*	-3.15	0.0013
	CI5%	126.31	129.14	128.70	104.63	107.41	103.25	102.12	95.58	97.08	102.60			
	CI95%	141.79	144.66	144.34	118.70	121.76	117.36	116.11	109.26	110.72	116.67			

* significant difference

TABLE 3
ISCHEMIC HEART DISEASE (I20–I25) – AGE- AND SEX-ADJUSTED HOSPITAL MORBIDITY RATES

County	1998	1999	2000	2001	2002	2003	2004	2005	2006	Rate ratio between county and national rate for 2006	Average annual percentage change (%)	P
Croatia	311.71	288.68	378.95	374.47	366.37	368.44	275.59	316.51	370.74		0.53	0.7656
	CI5%	306.75	283.90	373.46	369.02	361.00	363.03	270.91	311.53	365.28		
	316.67	293.46	384.44	379.92	371.74	373.85	280.27	321.49	376.21			
Continental part	306.64	278.84	354.23	373.13	364.24	363.00	251.72	297.37	377.77		0.53	0.8020
	CI5%	300.62	273.08	347.73	366.46	357.68	246.24	291.46	371.03			
	312.66	284.60	360.74	379.79	370.81	369.60	257.21	303.29	384.51			
Mediterranean part	323.61	309.15	430.36	377.23	370.74	380.45	324.79	356.97	357.98		0.47	0.7466
	CI5%	314.73	300.54	420.17	367.77	361.33	370.90	315.98	347.70	348.50		
	332.49	317.75	440.55	386.70	380.15	389.99	333.59	366.24	367.47			
Zagreb	222.25	180.62	321.32	316.07	322.60	326.10	185.54	156.37	323.65	0.87*	0.01	0.9988
	CI5%	205.99	165.96	301.70	296.43	302.96	170.53	142.91	303.80			
	238.52	195.29	340.94	335.71	342.24	345.82	200.56	169.84	343.51			
Krapina-Zagorje	287.37	175.39	278.17	256.83	272.72	576.67	319.30	190.95	387.67	1.05	4.32	0.3928
	CI5%	260.69	155.06	251.81	231.68	246.81	290.98	168.92	356.51			
	314.04	195.71	304.54	281.98	298.63	614.38	347.62	212.98	418.83			
Sisak-Moslavina	437.07	458.34	515.94	329.63	399.85	500.39	298.04	373.31	369.92	1.00	-3.22	0.1882
	CI5%	409.22	429.09	484.59	304.92	373.10	469.69	274.17	346.58			
	464.92	487.58	547.28	354.35	426.60	531.08	321.92	400.05	396.30			
Karlovac	343.16	355.74	431.75	445.21	430.84	332.61	71.07	388.93	377.99	1.02	-5.27	0.5024
	CI5%	315.11	327.89	400.23	413.19	399.67	305.29	58.29	359.10			
	371.20	383.59	463.27	477.24	462.00	359.93	83.85	418.77	407.72			
Varaždin	188.20	208.66	315.23	380.21	346.85	401.66	235.90	244.01	280.70	0.76*	2.60	0.4950
	CI5%	168.85	188.10	290.36	353.00	320.37	372.99	214.31	221.94			
	207.54	229.22	340.11	407.41	373.33	430.33	257.50	266.08	304.12			
Koprivnica-Križevci	179.98	181.06	268.27	283.49	216.30	280.82	263.87	305.54	361.53	0.98	7.46	0.0050
	CI5%	157.21	157.68	240.42	254.87	191.47	251.99	236.51	276.08			
	202.76	204.45	296.12	312.11	241.14	309.65	291.23	335.00	393.59			
Bjelovar-Bilogora	187.45	204.74	252.45	285.87	248.66	278.92	254.48	206.10	274.41	0.74*	2.59	0.2154
	CI5%	165.87	181.49	226.79	258.66	223.48	251.77	228.86	183.01			
	209.03	227.98	278.11	313.07	273.85	306.06	280.10	229.19	301.67			
Primorje-Gorski Kotar	487.48	391.69	523.21	373.95	365.55	410.49	448.10	475.13	418.83	1.13*	-0.41	0.8181
	CI5%	464.51	371.23	499.50	354.00	345.78	389.50	426.15	452.69			
	510.45	412.15	546.93	393.90	385.33	431.48	470.05	497.57	441.63			

Lika-Senj		328.05	443.05	450.42	311.89	332.76	320.35	269.44	273.90	371.45	1.00	-3.19	0.1876
	CI5%	284.60	394.81	400.05	270.44	290.09	277.35	230.79	234.76	323.69			
	CI95%	371.51	491.28	500.80	353.35	375.43	363.35	308.09	313.04	419.22			
Virovitica-Podravina		554.77	448.36	115.99	356.49	288.09	108.51	576.03	663.42	771.85	2.08*	7.81	0.4575
	CI5%	507.83	406.88	94.22	319.47	254.75	87.70	529.50	613.71	718.27			
	CI95%	601.71	489.83	137.77	393.52	321.43	129.33	622.56	713.12	825.44			
Požega-Slavonija		240.79	244.14	369.83	385.33	351.55	354.89	116.90	181.77	368.30	0.99	-2.58	0.6529
	CI5%	208.51	211.50	330.06	343.91	312.94	314.97	93.58	152.90	327.88			
	CI95%	273.07	276.77	409.60	426.74	390.17	394.82	140.22	210.64	408.71			
Brod-Posavina		406.53	397.28	405.29	498.76	493.73	164.86	47.57	705.42	780.04	2.10*	-1.76	0.8861
	CI5%	377.62	368.55	375.70	466.03	461.59	145.92	37.28	666.48	738.88			
	CI95%	435.44	426.02	434.89	531.49	525.88	183.79	57.86	744.37	821.20			
Zadar		366.36	333.83	391.49	369.75	403.27	444.38	463.69	365.90	412.86	1.11*	2.15	0.1155
	CI5%	338.61	307.53	362.70	342.02	374.06	413.81	432.61	338.36	383.38			
	CI95%	394.11	360.13	420.17	397.49	432.47	474.96	494.78	393.44	442.34			
Osijek-Baranja		241.75	218.68	270.13	284.61	314.55	376.37	319.39	339.81	369.58	1.00	6.25	0.0012
	CI5%	225.15	203.06	252.72	266.91	295.89	355.41	300.63	320.01	349.18			
	CI95%	258.35	234.30	287.53	302.31	333.21	397.32	338.15	359.60	389.99			
Šibenik-Knin		175.81	281.73	322.85	301.48	290.88	262.04	125.93	181.73	206.16	0.56*	-4.40	0.3008
	CI5%	153.05	253.43	292.02	272.35	261.60	234.89	106.58	158.17	180.07			
	CI95%	198.57	310.03	353.68	330.60	320.17	289.19	145.27	205.29	232.25			
Vukovar-Srijem		235.14	248.15	237.87	319.49	374.22	356.92	203.99	257.20	387.31	1.04	3.23	0.3272
	CI5%	213.85	226.35	216.29	294.58	347.59	331.01	184.18	235.29	359.72			
	CI95%	256.42	269.94	259.45	344.40	400.86	382.83	223.81	279.11	414.91			
Split-Dalmatija		209.60	197.64	332.91	355.08	328.95	324.90	246.79	317.27	319.11	0.86*	4.10	0.1672
	CI5%	196.66	185.08	316.49	338.30	312.70	308.81	232.87	301.23	302.87			
	CI95%	222.54	210.21	349.33	371.86	345.20	340.99	260.70	333.30	335.36			
Istria		438.42	420.50	662.20	544.15	533.85	508.74	382.19	446.29	463.65	1.25*	-1.27	0.5851
	CI5%	411.41	394.20	629.60	514.63	504.81	479.95	357.71	419.32	435.51			
	CI95%	465.43	446.81	694.79	573.67	562.90	537.53	406.67	473.26	491.80			
Dubrovnik-Neretva		192.19	211.30	284.45	306.06	316.96	352.35	240.26	262.37	287.17	0.77*	3.49	0.1924
	CI5%	168.16	186.31	255.32	276.33	286.86	320.94	213.43	234.82	257.86			
	CI95%	216.22	236.29	313.57	335.79	347.07	383.77	267.09	289.93	316.47			
Međimurje		255.99	257.99	316.16	329.86	386.16	348.65	249.65	301.35	288.10	0.78*	0.87	0.6844
	CI5%	227.50	229.35	284.11	296.97	350.22	315.10	220.98	269.74	256.29			
	CI95%	284.49	286.62	348.20	362.75	422.11	382.21	278.32	332.97	319.91			
City of Zagreb		378.07	310.24	445.15	471.50	420.30	399.60	295.46	241.25	328.38	0.89*	-3.77	0.1916
	CI5%	365.02	298.38	431.03	456.96	406.58	386.23	283.90	230.90	316.13			
	CI95%	391.13	322.10	459.26	486.04	434.02	412.97	307.02	251.60	340.63			

* significant difference

TABLE 4
CEREBROVASCULAR DISEASES (160–169) – AGE- AND SEX-ADJUSTED HOSPITAL MORBIDITY RATES

County		1998	1999	2000	2001	2002	2003	2004	2005	2006	Rate ratio between county and national rate for 2006	Average annual percentage change (%)	P
Croatia	CI5%	296.97	280.03	277.25	306.80	300.68	275.40	228.27	284.44	323.73		-0.17	0.9014
	CI95%	292.17	275.36	272.63	301.96	295.88	270.81	224.08	279.74	318.72			
Continental part	CI5%	301.77	284.69	281.88	311.65	305.48	279.99	232.47	289.14	328.75		-0.97	0.5971
	CI95%	334.65	300.95	302.98	345.56	339.20	298.20	230.88	290.77	352.62			
Mediterranean part	CI5%	328.36	294.97	297.04	339.23	332.89	292.30	225.65	284.88	346.18		1.94	0.0538
	CI95%	340.94	306.93	308.92	351.89	345.51	304.10	236.12	296.67	359.07			
Zagreb	CI5%	222.25	238.43	225.26	228.70	224.06	230.47	223.48	273.50	267.87	0.87*	-0.98	0.713
	CI95%	215.03	230.96	218.02	221.45	216.91	223.29	216.36	265.58	259.92			
Krapina-Zagorje	CI5%	229.46	245.90	232.49	235.95	231.21	237.64	230.59	281.42	275.83	1.54*	2.43	0.1287
	CI95%	238.09	204.00	261.73	266.42	267.86	246.55	161.82	190.08	280.97			
Sisak-Moslavina	CI5%	221.26	188.48	244.36	248.98	249.93	229.48	148.02	174.65	262.31	1.20*	1.70	0.5136
	CI95%	254.93	219.52	279.10	283.87	285.79	263.62	175.62	205.50	299.63			
Karlovac	CI5%	378.04	343.42	388.14	406.92	428.30	452.24	420.90	349.84	500.07	1.16*	-0.64	0.9458
	CI95%	348.03	314.81	358.01	375.81	396.08	419.55	389.14	320.97	464.81			
Varaždin	CI5%	408.05	372.04	418.26	438.02	460.53	484.94	452.65	378.71	535.33	1.05	8.73	0.2875
	CI95%	298.90	290.36	298.27	262.55	278.84	302.03	202.25	354.08	389.05			
Koprivnica-Križevci	CI5%	275.51	266.91	275.24	240.32	256.64	279.23	183.53	328.33	362.04	1.43*	0.19	0.8855
	CI95%	322.28	313.80	321.30	284.77	301.05	324.82	220.97	379.84	416.06			
Bjelovar-Bilogora	CI5%	239.56	297.45	317.40	312.43	349.14	343.38	50.18	477.13	375.07	1.28*	-0.68	0.757
	CI95%	216.98	271.95	292.01	286.93	322.03	316.28	39.25	444.12	347.10			
Primorje-Gorski Kotar	CI5%	262.14	322.95	342.78	337.93	376.24	370.49	61.12	510.13	403.04	0.86*	2.52	0.1087
	CI95%	361.60	91.09	117.70	397.76	424.72	448.53	314.53	264.54	338.74			
Bjelovar-Bilogora	CI5%	334.92	77.93	102.04	369.93	395.96	418.89	289.80	242.45	312.98	1.05	8.73	0.2875
	CI95%	388.27	104.24	133.37	425.59	453.47	478.16	339.27	286.63	364.49			
Bjelovar-Bilogora	CI5%	412.55	393.05	427.97	478.43	492.57	434.14	383.91	388.45	463.28	1.43*	0.19	0.8855
	CI95%	378.35	360.52	394.02	442.64	456.25	399.80	351.98	356.05	427.46			
Bjelovar-Bilogora	CI5%	446.75	425.59	461.91	514.22	528.89	468.48	415.84	420.85	499.11	1.28*	-0.68	0.757
	CI95%	426.22	421.01	403.06	393.62	409.25	471.38	533.88	298.41	413.52			
Primorje-Gorski Kotar	CI5%	393.33	388.71	371.16	362.65	376.77	437.43	497.28	270.65	380.69	0.86*	2.52	0.1087
	CI95%	459.11	453.31	434.97	424.58	441.72	505.33	570.47	326.16	446.35			
Primorje-Gorski Kotar	CI5%	219.54	222.85	227.50	179.42	236.33	210.62	244.00	242.32	277.89	0.86*	2.52	0.1087
	CI95%	204.39	207.52	211.94	165.60	220.69	195.9	228.18	226.32	260.23			
Primorje-Gorski Kotar	CI5%	234.69	238.17	243.06	193.23	251.97	225.34	259.81	258.31	295.55			
	CI95%												

Lika-Senj		185.99	223.75	202.18	158.18	276.98	280.17	261.17	208.73	258.78	0.80*	3.73	0.1619
	CI5%	154.38	188.71	169.96	129.21	240.03	243.28	225.63	176.67	219.44			
	CI95%	217.61	258.80	234.40	187.15	313.93	317.05	296.70	240.80	298.12			
Virovitica-Podravina		390.62	359.20	46.04	366.99	107.23	82.24	347.14	358.11	416.46	1.29*	4.76	0.696
	CI5%	351.97	321.41	32.58	329.07	86.28	64.02	310.09	321.69	374.94			
	CI95%	429.27	396.99	59.51	404.92	128.18	100.47	384.18	394.52	457.97			
Požega-Slavonija		415.65	390.19	423.02	432.62	409.72	395.17	102.99	199.14	419.57	1.30*	-7.84	0.2228
	CI5%	371.96	349.13	380.59	390.26	367.91	353.89	81.61	169.58	376.74			
	CI95%	459.34	431.25	465.45	474.98	451.52	436.45	124.37	228.69	462.40			
Brod-Posavina		385.22	385.65	308.18	374.79	404.32	74.90	23.75	444.28	520.38	1.61*	-8.16	0.5622
	CI5%	356.80	356.68	282.13	346.78	374.84	62.26	16.34	413.17	487.16			
	CI95%	413.64	414.62	334.23	402.80	433.79	87.54	31.16	475.38	553.61			
Zadar		248.31	242.12	242.00	227.44	224.38	196.09	231.82	207.14	214.29	0.66*	-2.13	0.0201
	CI5%	226.07	219.98	219.97	206.11	203.47	176.53	210.31	187.03	193.36			
	CI95%	270.56	264.27	264.03	248.76	245.30	215.65	253.32	227.25	235.22			
Osijek-Baranja		246.75	230.37	258.82	302.71	306.28	230.04	197.77	301.89	378.48	1.17*	2.89	0.293
	CI5%	230.17	214.59	241.80	284.40	287.78	213.87	182.19	282.92	357.58			
	CI95%	263.33	246.15	275.83	321.01	324.79	246.21	213.35	320.87	399.37			
Šibenik-Knin		241.85	326.29	235.48	283.23	236.66	301.12	98.65	366.60	297.71	0.92	-0.83	0.8792
	CI5%	216.05	296.34	210.73	256.14	211.51	272.98	82.70	307.34	268.29			
	CI95%	267.64	356.24	260.24	310.32	261.80	329.27	114.61	365.87	327.13			
Vukovar-Srijem		340.09	317.61	262.94	369.64	373.19	321.20	205.76	230.68	376.84	1.16*	-1.95	0.529
	CI5%	314.47	292.68	240.03	342.99	346.39	296.46	185.98	209.10	349.77			
	CI95%	365.71	342.54	285.85	396.30	399.98	345.93	225.53	252.26	403.90			
Split-Dalmatija		225.49	223.83	240.42	261.48	200.02	227.47	208.04	288.89	229.94	0.71*	0.69	0.6631
	CI5%	212.16	210.52	226.66	247.33	187.57	214.40	195.46	273.92	216.53			
	CI95%	238.81	237.14	254.18	275.63	212.46	240.55	220.62	303.87	243.35			
Istria		201.81	249.99	220.62	233.39	244.35	238.96	288.39	337.55	366.96	1.13*	6.63	0.0013
	CI5%	183.92	230.13	201.98	214.23	224.59	219.91	267.12	314.48	342.68			
	CI95%	219.71	269.84	239.26	252.56	264.11	258.01	309.65	360.62	391.24			
Dubrovnik-Neretva		220.15	223.48	149.56	217.89	193.40	223.44	212.87	242.50	275.42	0.85*	3.17	0.1585
	CI5%	195.33	198.67	129.36	193.56	170.80	199.06	189.25	217.08	247.86			
	CI95%	244.96	248.30	169.77	242.21	216.00	247.82	236.49	267.93	302.98			
Međimurje		361.56	370.93	407.27	398.18	435.82	382.92	254.03	240.84	172.55	0.53*	-8.36	0.0167
	CI5%	327.39	336.53	372.32	362.69	398.52	347.56	224.89	212.13	148.48			
	CI95%	395.72	405.33	442.21	433.68	473.12	418.28	283.18	269.56	196.62			
City of Zagreb		356.07	318.41	329.10	332.24	299.09	259.58	224.80	235.26	272.22	0.84*	-4.86	0.0045
	CI5%	343.49	306.47	317.12	320.17	287.64	248.90	214.82	225.03	261.28			
	CI95%	368.66	330.34	341.07	344.32	310.54	270.26	234.77	245.49	283.15			

* significant difference

from Mediterranean part) had lower CVD mortality rates than rate for Croatia: Primorje-Gorski Kotar, Zadar, Split-Dalmatia, Istria, Dubrovnik-Neretva and City of Zagreb. In remaining 4 counties CVD mortality rates did not differ from rate for entire Croatia (Table 3).

Between 1997 and 2006, the age- and sex-adjusted rates of CVD mortality significantly increased in four counties: Sisak-Moslavina, Karlovac, Brod-Posavina and Vukovar-Srijem, while significant decrease was recorded in 11 counties: Zagreb, Krapina-Zagorje, Varaždin, Primorje-Gorski Kotar, Virovitica-Podravina, Požega-Slavonija, Šibenik-Knin, Istria, Dubrovnik-Neretva, Međimurje and City of Zagreb as well as in both Continental and Mediterranean part and entire Croatia. No significant change was recorded in remaining 6 counties (Table 3, Figure 3).

Rates of hospitalization due to CVD for Mediterranean part have been significantly lower than rates for Croatia in entire period 1997–2006, except 2004 and 2005 when no significant difference was recorded, while rates of hospitalization due to CVD for Continental part have been significantly higher than rates for Croatia in entire period, except in 2004 and 2005 when no significant difference was recorded (Table 4).

In 2006, 11 counties had higher rates of hospitalization due to CVD than rate for Croatia: Krapina-Zagorje, Sisak-Moslavina, Karlovac, Koprivnica-Križevci, Bjelovar-Bilogora, Virovitica-Podravina, Požega-Slavonija, Brod-Posavina, Osijek-Baranja, Vukovar-Srijem and Istria, while 8 counties had lower rates than rate for Croatia: Zagreb, Primorje-Gorski Kotar, Lika-Senj, Zadar, Split-Dalmatia, Dubrovnik-Neretva, Međimurje and City of Zagreb. In remaining 2 counties CVD hospitalization rates did not differ from rate for entire Croatia (Table 4).

The age- and sex-adjusted rates of CVD hospitalizations significantly increased between 1998 and 2006 only in Istria county, while significant decrease in the number of hospitalizations was recorded in three counties: Zadar, Međimurje and City of Zagreb. No significant change was recorded in remaining counties, in Continental and Mediterranean parts and in Croatia as a whole (Table 4, Figure 4).

Discussion

Our analysis has showed that ischemic heart disease and cerebrovascular disease are still the leading cause of death in Croatia and all of its regions in the period 1997–2006. Croatian age adjusted mortality from IHD are 160.3 and from CVD 126.1 per 100 000 (year 2006). The rates of IHD mortality for nearby countries are higher only for Hungary (261.3) but lower for Slovenia (67.2) and Italy (64.1). The rates of CVD mortality for Hungary (108.2), Slovenia (56.5) and Italy (49.1) are lower than the rates for Croatia³³. The mortality from ischemic heart disease for Croatia decreased from 1997 to 2002, raised sharply in 2003 and fell again afterwards. In 2003 total number of deaths for entire Croatia increased by 3,000 (from around 49,500 to around 52,500) compared to 2002 and majority of previous and following

years. No changes in legislative or coding practices occurred in 2003, therefore the cause of this increase in 2003 should be further investigated. The mortality from cerebrovascular disease (stroke) decreasing over the period studied. Regional differences for CVD morbidity and mortality are more prominent than IHD differences. An increment in IHD rates was registered in 7 counties. No countries, however, registered reductions. The increase was most commonly registered in the counties which were most affected by the Homeland War and had poor economic indicators, but also in continental counties with more dominant risk factors in comparison with other, primarily Mediterranean southern parts of Croatia. The rates of IHD mortality for the Mediterranean region are significantly lower than the average rates for Croatia during entire period. The rates are higher in some continental and 3 northern coastal counties. The reason could be that the three counties, Istria, Primorsko-Goranska and Ličko-Senjska Counties, include parts not typically Mediterranean (Lika, Gorski Kotar and the inland Istria). In terms of IHD morbidity, it should be pointed out that there is no compatibility with IHD mortality rates, whether positive or inverse. Trends of increase are less prominent and are present in only two counties, Koprivnica-Križevci and Osijek-Baranja, with a higher mortality than is the mean rate for Croatia. This was a descriptive study and the validity of the study depends on the accuracy of the primary cause of death or the primary diagnosis at discharge. In hospital admissions of IHD it is important to recognize that multiple admissions of the same patient cannot be determined. An additional factor in the rise of the number of admissions for IHD could be the introducing or intensive use of diagnostic and therapeutic procedures. The results should be taken with caution due to a possible variability and differences in quality of hospital data and related rates. The mortality from CVD has not, however, increased significantly, except in 4 war-affected counties: Sisačko-Moslavačka, Karlovačka, Brodsko-Posavska and Vukovarsko-Srijemska. Rate reduction was, however, noted in 11 counties, and both regions (Mediterranean and continental), if analyzed as a whole. With respect to the geographic distribution of mortality, the results indicate that continental-Mediterranean differences still exist, with higher mortality rates for CVD in the continental part. Hospital morbidity rates are more congruent with mortality rates than is the case with IHD, and higher in the continental than Mediterranean area. Morbidity trends, both CVD and IHD-related, are less prominent, when compared with mortality. The possible causes of such inconsistencies, both for CVD and IHD, are possible variability and differences in the quality of hospital discharge data. City of Zagreb has significantly lower mortality and hospital morbidity rates, both for IHD and CVD, than is the average for Croatia. Consequently, if the data on hospital treatment are complete and authentic, it may be due to the influence of a better socioeconomic status and education in the Croatian capital. Trends in mortality and the geographic distribution of IHD and CVD can be explained by various factors including geographical differences and environment, differences in

the prevalence of cardiovascular risk factors, differences in demographic characteristics and socio-economic level, as well as differences in the quality of health care. It has been suggested that general health and economic conditions, even in early life, can be partially responsible for variable rates attributable to cardiovascular diseases^{34–37}. An inadequate control of classic cardiovascular risk factors may contribute to an unnecessary number of deaths attributable to IHD and CVD that is control of hypertension and hypercholesterolemia. The same happens with overweight/obesity and diabetes, as well as unhealthy habits (smoking, nutrition, physical inactivity). Cross-population differences in genetic susceptibility to CVD and CVD risk factors have also been suggested^{38–40}. All present analyses have shown differences in the geographical distribution of cardiovascular mortality, as well as certain risk factors for the same diseases in Croatia^{30,41–43}. One of the cardiovascular disease mortality analyses for ages 35–64 in 2003 produced the highest male and female rate for Central Croatia. The lowest rates were discovered in the Zadarska County³¹. IHD and CVD were, however, not separately analyzed. It has been shown in the Croatian adult household health survey (HHS) in 2003 that the prevalence of cardiovascular risk factors is high in Croatia, with regional and gender differences. The southern (Mediterranean) region had a low prevalence of inadequate nutrition, while Zagreb a very prevalent physical inactivity. The eastern part led in unhealthy nutrition, the south in high alcohol consumption⁴⁴. Overweight and obesity was more prevalent in the continental and western part of the country. The most serious risks for men in general are high arterial blood pressure, smoking, physical inactivity, alcohol consumption, inadequate nutrition and weight. For women, it is high arterial blood pressure, physical inactivity, weight, smoking, inadequate nutrition and alcohol consumption^{45–50}. Overall prevalence of hypertension in Croatia in HHS was 45.5% and there was no difference between the continental and Mediterranean regions⁵¹. The data from the LIBS-5 study for 15 EU countries have ranked Croatia first according to the prevalence of hypertension and smoking among hospitalized IHD patients, fourth according to the presence of hypercholesterolemia, and second according to the number of diabetics. The prevalence of all analyzed risk factors was higher than the EU average. Only one (Rijeka) of 4 regions (Split, Zagreb, Osijek and Rijeka) had lower rates than was the EU average, according to hypercholesterolemia prevalence⁵². The results showed that the lowest prevalence of the X syndrome was the lowest in the Adriatic Croatia, when compared with the continental Croatia and the City of Zagreb. The present study was carried out using official statistics. In the absence of data on incidence and hospital mortality, data from death certificates and hospital discharges were used. In terms of limitations, the present study experienced problems in obtaining quality data from death certificates for elderly people, especially for

over 65 year of age with multiple cause of death, although death certificates in Croatia have been shown to be of good quality.

Death certificates in Croatia are fulfilled by certified or medical doctors who treated patient; they are validated in Croatian National Institute of Public Health and may be sent back for corrections if not fulfilled according to WHO criteria. Fulfilling of hospital discharge diagnoses data does not require any certificate and the data are much more numerous compared to mortality data (more than 600,000 hospitalizations vs. around 50,000 deaths), therefore such a detailed control of hospital discharge data is not possible. This is the reason why variability and differences in quality are considered to be greater for hospital data than for mortality data. Both for mortality and hospital morbidity data ICD-10 was used for coding during the entire study period (1997–2006) and no legal changes or changes in coding practice which would influence observed rates occurred during that time.

In conclusion, this study has shown that the increase in mortality from IHD and the decrease in mortality from CVD, observed in Croatia as a whole, are not homogenous across the country. In some counties, there is very little variation over the study period, a result which hints at a possible stabilization of mortality rates. In a small number of counties, a non-statistically significant increase in mortality rates was observed, though this result needs to be confirmed over time. The high prevalence of CV risk factors provides a good opportunity for action and improvement. The results should be useful in prioritizing between counties when deciding on where health care interventions should be focused. Trends in IHD and CVD hospital morbidity and mortality rates result from a combination of risk factors that affect the rates of incidence events (first event), recurrent events, disease severity and case-fatality. Measures of these components can lead to the strategies that may lower mortality from cardiovascular diseases. There is a need of evaluation of existing national and regional activities for the promotion of cardiovascular health, particularly regarding deployment of promotional measures and creation of new, modern, improved national public health intervention model based on regional peculiarities and needs, focusing on changeable behaviour (lifestyles) risk factors, such as tobacco smoking, unhealthy dietary habits, physical inactivity and alcohol consumption, in order to improve cardiovascular health of Croatian population. This new national public health intervention model need to be based on key messages structured around a four-pronged approach of healthy eating, physical activity, non smoking and moderate alcohol consumption. Furthermore, this new, national public health intervention model need to be adaptable to specific environment of certain region to be used in conjunction with existing related regional cardiovascular health promotion programs for reduction of cardiovascular morbidity.

REFERENCES

1. WORLD HEALTH ORGANIZATION (WHO): Population ageing: a public health challenge. (Fact Sheet N 135. Revised September 1998).
2. WORLD HEALTH ORGANIZATION (WHO): Keep Fit for Life: Meeting the Nutritional Needs of Older Persons. (Geneva, 2002).
3. THOM TJ, EPSTEIN FH, FELDMAN JJ, LEAVERTON PE, *Int J Epidemiol*, 14 (1985) 510.
4. KIMM SY, ORNSTEIN SM, DELONG ER, GRUFFERMAN S, *Circulation*, 63 (1983) 3.
5. WORLD HEALTH ORGANIZATION (WHO): World Health Statistics Annual 1988. (Geneva, 1988).
6. HOWSON CP, REDDY KS, RYAN TJ: Control of Cardiovascular Disease in Developing Countries: Research, Development, and Institutional Strengthening. (National Academy Press, Washington DC, 1998).
7. RYWIK S, WAGROWSKA H, BRODA G, KUZMINSKA A, POLAKOWSKA M, KULESZA W, KUPSC W, KURJATA P, *Int J Epidemiol*, 18 (1989), S129.
8. THOM TJ, *Ann Epidemiol*, 3 (1993) 509.
9. FEINLEIB M, INGSTER L, ROSENBERG H, MAURER J, SINGH G, KOCHANEK K, *Ann Epidemiol*, 3 (1993), 458.
10. SANS S, KESTELOOT H, KROMHOUT D, *Eur Heart J*, 18 (1997) 1231.
11. RYGLEWICZ D, POLAKOWSKA M, LECHOWICZ W, BRODA G, ROSZKIEWICZ M, JASINSKI B, HIER DB, *Stroke*, 28 (1997) 752.
12. MARMOT MG, *Postgrad Med J*, 60 (1984) 3.
13. ROSE G, *Int J Epidemiol*, 18 (1989) S174.
14. STEWART AW, *Int J Epidemiol*, 23 (1994) 505.
15. SYTKOWSKI PA, KANNEL WB, D'AGOSTINO RB, *N Engl J Med*, 322 (1990) 1635.
16. FOLSOM AR, GOMEZ-MARIN O, SPRAFKA JM, PRINEAS RJ, EDLAVITCH SA, GILLUM RF, *Am Heart J*, 114 (1987) 1199.
17. ROCELLA EJ, BURT V, HORAN RJ, CUTLER J, *Ann Epidemiol*, 3 (1993) 547.
18. HIGGINS M, THOM T, *Ann Epidemiol*, 3 (1993) 550.
19. WING S, CASPER M, RIGGAN W, HAYES C, TYROLER HA, *Am J Public Health*, 78 (1988) 923.
20. RADISHAUSKAS R, BERNOTENE G, SHOPAGENE D, RASTENITE D, Ter Arkh, 77 (2005) 34.
21. SARTI C, RASTENYTE D, CEPAITIS Z, TUOMILEHTO J, *Stroke*, 31 (2000) 1588.
22. KESTELOOT H, SANS S, KROMHOUT, *Eur Heart J*, 27 (2006) 107.
23. BABUŠ V, *Liječ Vjesn*, 116 (1994) 235.
24. BARAC B, *Med Vjesn*, 31 (1999) 121.
25. HRABAK-ŽERJAVIĆ V, *Acta Clin Croat*, 38 (1999) 12.
26. HRABAK-ŽERJAVIĆ V, KRALJ V, SILOBRČIĆ-RADIĆ M, *Medicus*, 12 (2003) 9.
27. HRABAK-ŽERJAVIĆ V, ŠERIĆ V, KRALJ V, SILOBRČIĆ-RADIĆ M, *Medicus*, 10 (2001) 7.
28. KRALJ V, HRABAK-ŽERJAVIĆ V, ERCEG M, TOMIĆ B: Kardiovaskularne bolesti u Republici Hrvatskoj. (Hrvatski zavod za javno zdravstvo, Zagreb, 2004).
29. LUKOVIĆ G, IVANKOVIĆ D, *Liječ Vjesn*, 116 (1994) 175.
30. PAVLOVIĆ M, ŠARIĆ M, ČOROVIĆ N, *Acta Med Croatica*, 61 (2007) 329.
31. STRNAD M, ČORIĆ T, KERN J, POLAŠEK O, Knjiga sažetaka simpozija: Prostorna distribucija populacijskih kardiovaskularnih rizika u Hrvatskoj. (Akademija medicinskih znanosti Hrvatske, Zagreb, 2005).
32. CROATIAN NATIONAL INSTITUTE OF PUBLIC HEALTH: Croatian Health Service Yearbook 2006. (Zagreb, 2007).
33. WORLD HEALTH ORGANIZATION (WHO): Health for all database. (Geneva, 2007).
34. RICH-EDWARDS JW, STAMPFER MJ, MANSON JE, ROSNER B, HANKINSON SE, COLDITZ GA, WILLETT WC, HENNEKENS CH, *BMJ*, 315 (1997) 396.
35. KUNST AE, DEL RIOS M, GROENHOF F, MACKENBACH JP, *Stroke*, 29 (1998) 2285.
36. VAN ROSSUM CTM, VAN DE MHEEN H, BRETTELER MMB, GROBBEE DE, MACKENBACH JP, *Stroke*, 30 (1999) 357.
37. POWER C, HYPONEN E, SMITH GD, *Am J Public Health*, 95 (2005) 1396.
38. HAVLIK RJ, FEINLEIB M, Hypertension, 4 (suppl III) (1982) 121.
39. UBBINK JB, VERMAAK WJH, DELPORT R, VAN DER MERWE A, BECKER PJ, POTGIETER H, *Am J Clin Nutr*, 62 (1995) 802.
40. VERMAAK WJ, UBBINK JB, DELPORT R, BECKER PJ, BISSBORT SH, UNGERER JP, *Atherosclerosis*, 89 (1991) 155.
41. KERN J, IVANKOVIĆ D, SOGORIĆ S, VULETIĆ S, *Med Arh*, 58 (2004) 351.
42. BUZINA R, KEYS A, MOHACEK I, MARINKOVIĆ M, HAHN A, BLACKBURN H, *Circulation*, 41, suppl 4 (1970) 140.
43. BUZINA R, MOHACEK I, MENOTTI A I SUR, *Eur J Epidemiol*, 11 (1995) 259.
44. KERN J, STRNAD M, ČORIĆ T, VULETIĆ S, *BMJ*, 331 (2005) 208.
45. ERCEG M, HRABAK-ŽERJAVIĆ V, IVIČEVIĆ UHERNIK A, KNJIGA SAŽETAKA SIMPOZIJA: PROSTORNA DISTRIBUCIJA POPULACIJSKIH KARDIOVASKULARNIH RIZIKA U HRVATSKOJ. (AKADEMIJA MEDICINSKIH ZNANOSTI HRVATSKE, ZAGREB, 2005).
46. MIŠIČIĆ DUŠKOVIĆ M, HEIMER S, GREDELJ M, HEIMER Ž, Knjiga sažetaka simpozija: Prostorna distribucija populacijskih kardiovaskularnih rizika u Hrvatskoj. (Akademija medicinskih znanosti Hrvatske, Zagreb, 2005).
47. HEIM I, KRUIHEK LEONTIĆ D, Knjiga sažetaka simpozija: Prostorna distribucija populacijskih kardiovaskularnih rizika u Hrvatskoj. (Akademija medicinskih znanosti Hrvatske, Zagreb, 2005).
48. KOVAČIĆ L, GAZDEK D, SAMARDŽIĆ S, Knjiga sažetaka simpozija: Prostorna distribucija populacijskih kardiovaskularnih rizika u Hrvatskoj. (Akademija medicinskih znanosti Hrvatske, Zagreb, 2005).
49. KAIĆ-RAK A, KULIER I, PUCARIN-CVETKOVIĆ J, Knjiga sažetaka simpozija: Prostorna distribucija populacijskih kardiovaskularnih rizika u Hrvatskoj. (Akademija medicinskih znanosti Hrvatske, Zagreb, 2005).
50. MUSTAJBEGOVIĆ J, DOKO JELINIĆ J, PUCARIN-CVETKOVIĆ J, MILOŠEVIĆ M, ŽUŠKIN E, Knjiga sažetaka simpozija: Prostorna distribucija populacijskih kardiovaskularnih rizika u Hrvatskoj. (Akademija medicinskih znanosti Hrvatske, Zagreb, 2005).
51. IVIČEVIĆ UHERNIK A, ERCEG M, MUSIĆ MILANOVIĆ S, *Public Health Nutr In press*, (Accepted January 20, 2008).
52. BERGOVAC M, MILIČIĆ D, REINER Z, MIHATOV S, *Liječ Vjesn*, 127 (suppl 3) (2005) 40.

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TRENDOVI I REGIONALNE RAZLIKE U ISHEMIJSKIM BOLESTIMA SRCA I CEREBROVASKULARNIM BOLESTIMA U HRVATSKOJ, 1997–2006

SAŽETAK

Cilj rada je analiza stope smrtnosti i bolničkog pobola od ishemijskih bolesti srca i cerebrovaskularnih bolesti odrasle populacije Hrvatske tijekom 10-godišnjeg razdoblja, od 1997. do 2006. godine. Podaci o umrlima dobiveni su iz Državnog zavoda za statistiku, a podaci o hospitaliziranima iz baze podataka o bolničkim otpustima pri Hrvatskom zavodu za javno zdravstvo. Stope umrlih od ishemijskih bolesti srca tijekom promatranog perioda niže su u mediteranskom dijelu Hrvatske, a ne razlikuju se u kontinentalnoj Hrvatskoj u odnosu na hrvatski prosjek. Stopa hospitalizacija od ishemijskih bolesti srca viša je na Mediteranu, a niža na kontinentalnom dijelu u odnosu na prosjek za Hrvatsku. Stope umrlih, kao i stope bolničkog pobola od cerebrovaskularnih bolesti niže su u mediteranskoj, a više u kontinentalnoj Hrvatskoj u odnosu na prosjek za Hrvatsku tijekom promatranog perioda. Ova analiza identificira dijelove, županije ili regije, Hrvatske u kojima postoje značajna negativna odstupanja i ukazuju na potrebu za javnozdravstvenom intervencijom.