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Longitudinal trends in major cardiovascular risk factors in the Czech population between 1985 and 2007/8. Czech MONICA and Czech post-MONICA

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ABSTRACT

Objective: The aim of our study was to assess longitudinal trends in major CV risk factors in a representative population sample of the Czech Republic.
Methods: Three cross-sectional surveys of CV risk factors were conducted within the WHO MONICA project in six Czech districts in 1985 ($n = 2570$), 1988 ($n = 2768$), and 1992 ($n = 2343$). In 1997/98, 2000/01, and 2007/08, another three screenings for CV risk factors (a 1% random sample, aged 25–64, mean age 45 years) were conducted in the six original districts ($n = 1990$; 2055; and 2246, respectively).
Results: Over a period of 22/23 years, there was a significant decrease in the prevalence of smoking in males (from 45.0 to 30.5%; $p < 0.001$) and no change in smoking habits in females. BMI increased in males and did not change in females. Both systolic and diastolic blood pressure decreased significantly in both genders, while the prevalence of hypertension declined only in females. Awareness of hypertension also rose as did the proportion of individuals treated by antihypertensive drugs in both genders. Hypertension control improved in either gender. A remarkable drop in total cholesterol was seen in both sexes (males: from 6.21 ± 1.29 to 5.29 ± 1.10 mmol/L; $p < 0.001$; females: from 6.18 ± 1.26 to 5.30 ± 1.06 mmol/L; $p < 0.001$).
Conclusions: The striking improvement in CV risk factors documented between 1985 and 2007/8 most likely contributed to the decrease in CV mortality in the Czech Republic.

1. Introduction

Cardiovascular disease (CVD) is the major cause of death in adults and in the elderly in the majority of developed countries and in many developing countries. At the beginning of the third millennium, CVD causes over 4 million deaths in Europe and over 2 million deaths in the European Union each year [1]. Regional variations in cardiovascular mortality have been observed both between and within European countries [2,3]. Since 1970, substantial decreases occurred in age-specific mortality rates from CVD in West European countries whereas a continuous increase was noted in Central and East European countries up to the early 1990s [2]. In the Czech Republic, the highest standardized mortality rates for CVD, coronary heart disease (CHD), and stroke were achieved around 1985, with a significant continuous decline thereafter. The most significant decrease was achieved by reducing cerebrovascular mortality (>60% for both males and females) [4].

Generally, a decline in CVD mortality can be due to a decrease in the incidence of the disease or a decrease in case fatality, usually associated with the standard of care whereas the incidence is likely to be related to population risk factors. The WHO MONICA (MONItoring trends and determinants in CArdiovascular disease) project was designed to answer this key question arising from the 1978 Bethesda Conference on the decline in CHD mortality. An extensive database was obtained in 37 centers in 21 countries across four continents [5]. Part of the WHO MONICA project was a survey of major cardiovascular risk factors in the Czech Republic. These surveys were carried out in six, mostly rural, districts (Praha-východ, Benešov, Pardubice, Chrudim, Cheb, and Jindřichův Hradec) in 1985, 1988, and 1992.

In 1997/98, 2000/01, and 2007/08, another three surveys were performed in the six original MONICA districts as part of the Czech post-MONICA study. In this paper, we assess longitudinal trends in major cardiovascular risk factors in a representative Czech population sample from 1985 to 2007/08.

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2. Methods

2.1. Study population

A total of six independent cross-sectional surveys for major cardiovascular risk factors were conducted in the Czech Republic. Three (1985, 1988, and 1992) were organized within the WHO MONICA project in six districts. One percent samples stratified by age and sex were randomly selected each year from the National Population Register within an age range of 25–64 years. The response rate varied from 73.2 to 88.4% (Table 1).

In 1997/98, 2000/01, and 2007/08, another three screenings for cardiovascular risk factors were organized in nine districts of the Czech Republic, again involving a 1% percent population random sample aged 25–64 years in each district. Selection was made from the General Health Insurance Company registry keeping, by law, a list of all those insured. Also by law, health insurance is mandatory for all Czech citizens and is paid for by the employer/employee, or by the government (for children, retired and unemployed persons). The overall response rates were 64.5, 63.0, and 62.6%, respectively, without any major regional fluctuations. The response rate never decreased below 60% in any district. Six of the nine districts participated previously in the WHO MONICA project, and it is only these six districts that are included in the current analysis.

2.2. Screening examination

The examination consisted of a physician-completed questionnaire including basic demographic and socioeconomic data, family and personal history, presence/absence of risk factors, questions of whether, at any time in the past, the subjects had received treatment for high blood pressure (BP), or had hypertension diagnosed, and whether they were currently taking antihypertensive medication. The names of currently prescribed medications were recorded and validated against medication containers, whenever possible.

Height and body weight were measured with participants standing without shoes and heavy outer garments. Body mass index (BMI) was calculated, as the weight divided by the height squared (kg/m^2), as a measure of relative weight.

Blood pressure was measured on the right arm with the subject in the sitting position after at least 5-min at rest. Standard mercury sphygmomanometers and correctly sized cuffs were used. The participant's right arm was supported at heart level. The maximum inflation level was determined before the actual measurement. The first and fifth Korotkoff sounds were recorded for systolic BP (SBP) and diastolic BP (DBP) and, for sounds continuing to 0 mmHg, the fourth Korotkoff sound was used. The heart rate was also determined. Blood pressure values were recorded to the nearest 2 mmHg. In 1985, 1998, and 1992, two consecutive BP measurements were performed. The mean value of the two readings was used for the longitudinal trend analysis. In 1997/98, 2000/01, and 2007/08, three consecutive BP measurements were obtained; however, for the purpose of longitudinal trend analysis, only mean of the first two readings was used.

Venous blood samples were obtained from subjects in the sitting position after at least a 12-h fast, ideally with no or gentle tourniquet application on the arm. Venous samples were centrifuged at $1500 \times g$ and subsequently frozen.

2.3. Laboratory analysis

All lipid analyses were performed in the Lipid Laboratory of the Institute for Clinical and Experimental Medicine serving as the WHO Reference Laboratory throughout the WHO MONICA project.

In 1985–1992, total cholesterol was determined using an enzymatic method and CHOD-PAP kits (Boehringer, Mannheim, Germany). HDL-cholesterol was also assessed by enzymatic methods after precipitation of serum apolipoprotein B-containing lipoproteins with sodium phosphotungstate. Beginning 1997, lipid parameters were determined using a fully automated enzymatic method (COBAS MIRA S analyzer) with enzymatic kits by the same manufacturer.

Accuracy of analysis is continuously monitored and tested by the Centers for Disease Control and Prevention (Atlanta, GA, USA); all analyses of total cholesterol and HDL-cholesterol were within the limit ±2%.

2.4. Definition of major risk factors

Smoking was assessed using the WHO definition. A person was considered to be a current smoker if smoking at least one cigarette per day. Obesity was defined as BMI $\geq 30\ kg/m^2$ for both sexes.

Hypertension was defined as a mean SBP ≥ 140 mmHg, and/or a mean DBP ≥ 90 mmHg, or current treatment with antihypertensive drugs. Awareness of hypertension was defined as a subject having reported a previous diagnosis of hypertension or current use of antihypertensive medication. Treatment of hypertension was defined as current use of prescribed medication affecting

Table 1
Survey sample sizes and response rates.

	1985	1988	1992	1997/98	2000/01	2007/08	*p* for trend
Total	2570	2768	2343	1990	2055	2246	
Mean age (years)	44.9 ± 11.38	45.1 ± 11.26	44.7 ± 10.87	45.6 ± 10.64	46.2 ± 11.90	47.1 ± 11.46	<0.001
Men	1253	1357	1134	969	1003	1102	
Mean age (years)	45.0 ± 11.39	45.3 ± 11.29	44.6 ± 10.76	45.8 ± 10.63	46.7 ± 11.07	47.9 ± 11.65	<0.001
Response rate (%)	81.5	85.5	73.2	63.2	62.0	62.1	<0.001
Age group, *n* (%)							
25–34	307 (24.5)	322 (23.7)	246 (21.7)	194 (20.0)	187 (18.6)	208 (18.9)	<0.01
35–44	296 (23.6)	323 (23.8)	350 (30.9)	230 (23.7)	230 (22.9)	251 (22.8)	ns
45–54	334 (26.7)	361 (26.6)	310 (27.3)	332 (34.3)	295 (29.4)	231 (21.0)	ns
55–64	316 (25.2)	351 (25.9)	228 (20.1)	213 (22.0)	291 (29.0)	412 (37.4)	ns
Women	1317	1411	1209	1021	1052	1144	
Mean age (years)	44.9 ± 11.38	44.9 ± 11.24	44.9 ± 10.97	45.3 ± 10.65	45.8 ± 11.10	46.4 ± 11.23	<0.001
Response rate (%)	85.0	88.4	76.7	66.4	63.8	63.1	<0.001
Age group, *n* (%)							
25–34	322 (24.4)	342 (24.2)	266 (22.0)	212 (20.8)	213 (20.2)	235 (20.5)	<0.05
35–44	340 (25.8)	369 (26.2)	356 (29.4)	266 (26.1)	276 (26.2)	284 (24.8)	ns
45–54	343 (26.0)	360 (25.5)	311 (25.7)	326 (31.9)	285 (27.1)	299 (26.1)	ns
55–64	312 (23.7)	340 (24.1)	276 (22.8)	217 (21.3)	278 (26.4)	326 (28.5)	ns

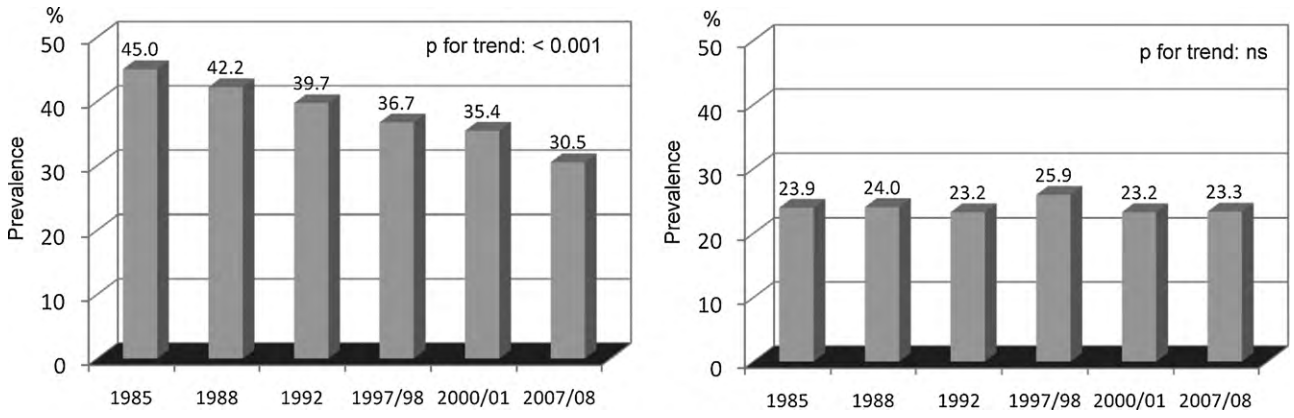

Fig. 1. Prevalence of smoking between 1985 and 2007/08 in six districts of the Czech Republic in males (left panel) and females (right panel).

BP. Hypertension control was defined as a subject receiving drug treatment for hypertension and having an SBP < 140 mmHg and a DBP < 90 mmHg.

Dyslipidemia was defined as total cholesterol ≥ 5 mmol/L (~190 mg/dL) or HDL-cholesterol < 1 mmol/L (~40 mg/dL) in men and < 1.2 mmol/L (~45 mg/dL) in women or use of lipid-lowering drugs [6].

2.5. Statistical analysis

Statistical analyses were performed using BMDP statistical software. Trends for means were tested by linear contrast in analysis of variance and trends for percentage by the chi square test of linear trends of proportions.

3. Results

3.1. Population sample characteristics and response rates

The total number of participants in all six independent cross-sectional surveys was 13,972, with a slightly higher response rate in women (Table 1). There was a significant downward linear trend in the response rate in both sexes; however, it never fell below 60%. The proportion of individuals aged 25–34 years decreased significantly over the period of 22/23 years.

3.2. Trends in anthropometric parameters

There was a significant upward trend in height in both genders, whereas body weight increased only in males between 1985 and 2007/8 (Table 2). The increase in body weight in males is alarming (from 81.7 ± 12.8 to 90.0 ± 15.8 kg; $p < 0.001$). BMI increased significantly only in males (from 27.0 ± 4.0 to 28.5 ± 4.6 kg/m^2; $p < 0.001$).

3.3. Trends in cigarette smoking

Cigarette smoking declined significantly, by 14.5% (from 45.0 to 30.5%), in males between 1985 and 2007/8 whereas there was no change in the proportion of female smokers over the analyzed period (Fig. 1). The overall mean of 23.9% indicates a very high proportion of female smokers.

Interestingly, the mean daily consumption of cigarettes did not change in either gender, and is currently 15.1 ± 9.0 for males, and 9.9 ± 5.9 for females.

3.4. Trends in blood pressure, prevalence, awareness, treatment, and control of hypertension

There was a downward trend in SBP and DBP in both genders with a greater decline in the female population (males: from 135.8 ± 19.2/85.9 ± 11.0 to 132.5 ± 17.2/84.4 ± 10.1 mmHg; $p < 0.001$; females: from 131.6 ± 20.9/82.5 ± 11.3 to 126.6 ± 19.2/80.6 ± 9.6 mmHg; $p < 0.001$) (Table 3).

Over the period of 22/23 years, there was a decline in the prevalence of hypertension in the total population (data not shown in table) and in females (total population: from 47.1 in 1985 to 43.6% in 2007/8; $p < 0.001$; females: from 42.5 in 1985 to 37.3% in 2007/8; $p < 0.001$) while not changing in the male population. Awareness of hypertension increased in both genders and was always higher in females (males: from 41.4 in 1985 to 68.4% in 2007/8; $p < 0.001$; females: from 58.9 in 1985 to 71.4% in 2007/8; $p < 0.001$). The number of individuals on antihypertensive medication increased significantly in both sexes, again showing consistently higher rates among females (males: from 21.1 to 58.2%; $p < 0.001$; females: from 38.9 to 58.9%; $p < 0.001$). Hypertension control increased significantly over the period of 22/23 years (from 3.9 to 24.6%; $p < 0.001$), again showing consistently more effective control of hypertension in females.

Table 2
Anthropometric parameters between 1985 and 2007/08 in six districts of the Czech Republic.

	1985	1988	1992	1997/8	2000/1	2007/8	*p* for trend
Males							
Height (cm)	173.8 ± 6.8	174.3 ± 7.0	174.8 ± 7.1	175.6 ± 7.1	175.3 ± 7.0	177.6 ± 7.0	0.001
Body weight (kg)	81.7 ± 12.8	84.2 ± 12.8	82.8 ± 12.8	84.8 ± 13.1	86.5 ± 14.6	90.0 ± 15.8	0.001
BMI (kg/m^2)	27.0 ± 4.0	27.7 ± 3.8	27.1 ± 3.8	27.5 ± 3.8	28.1 ± 4.4	28.5 ± 4.6	0.001
BMI ≥ 30 (kg/m^2) (%)	246 (19.7)	343 (25.3)	225 (19.9)	244 (25.2)	295 (29.5)	370 (33.6)	0.001
Females							
Height (cm)	161.2 ± 6.3	161.5 ± 6.4	162.2 ± 6.4	162.5 ± 6.4	162.7 ± 6.3	164.6 ± 6.4	0.001
Body weight (kg)	70.8 ± 13.6	72.1 ± 13.8	70.7 ± 13.9	71.5 ± 14.2	72.1 ± 15.0	74.1 ± 16.2	ns
BMI (kg/m^2)	27.3 ± 5.4	27.7 ± 5.4	26.9 ± 5.3	27.1 ± 5.5	27.3 ± 5.7	27.3 ± 5.7	ns
BMI ≥ 30 (kg/m^2) (%)	367 (28.0)	423 (30.0)	308 (25.5)	270 (26.5)	292 (27.8)	344 (30.1)	ns

BMI, body mass index.

Table 3
Blood pressure (mean ± SD), prevalence, awareness, treatment, and control of hypertension between 1985 and 2007/08 in six districts of the Czech Republic.

	1985	1988	1992	1997/8	2000/1	2007/8	*p* for trend
Males							
SBP (mmHg)	135.8 ± 19.2	134.9 ± 19.2	134.2 ± 20.0	132.3 ± 16.9	131.9 ± 16.8	132.5 ± 17.29	0.001
DBP (mmHg)	85.9 ± 11.0	84.4 ± 11.0	86.1 ± 11.4	84.5 ± 10.0	83.7 ± 9.7	84.4 ± 10.1	0.001
Prevalence of HT (%)	650 (51.9)	639 (47.1)	508 (44.8)	408 (42.1)	457 (45.6)	553 (50.2)	ns
Awareness of HT (%)	269 (41.4)	320 (50.1)	232 (45.7)	230 (56.4)	284 (62.1)	378 (68.4)	0.001
Medication for HT (%)	137 (21.1)	197 (30.8)	123 (24.2)	151 (37.0)	191 (41.8)	322 (58.2)	0.001
Control of HT (%)	18 (2.8)	33 (5.2)	14 (2.8)	50 (12.3)	60 (13.1)	135 (24.4)	0.001
Females							
SBP (mmHg)	131.6 ± 20.9	130.7 ± 20.9	130.2 ± 22.0	125.2 ± 18.1	125.9 ± 18.8	126.7 ± 19.2	0.001
DBP (mmHg)	82.5 ± 11.3	81.4 ± 11.2	82.5 ± 12.1	79.3 ± 9.8	79.3 ± 9.8	80.6 ± 9.6	0.001
Prevalence of HT (%)	560 (42.5)	552 (39.1)	460 (38.0)	323 (31.6)	347 (33.0)	426 (37.3)	0.001
Awareness of HT (%)	330 (58.9)	330 (59.8)	255 (55.4)	221 (68.4)	256 (73.8)	304 (71.4)	0.001
Medication for HT (%)	218 (38.9)	233 (42.2)	159 (34.6)	187 (57.9)	205 (59.1)	251 (58.9)	0.001
Control of HT (%)	29 (5.2)	51 (9.2)	28 (6.1)	70 (21.7)	77 (22.2)	106 (24.9)	0.001

p = statistical significance for linear trend; SBP, systolic blood pressure; DBP, diastolic blood pressure; HT, hypertension.

3.5. Trends in lipids

Over the period of 22/23 years, there was a significant downward trend for total cholesterol in both genders (males: from 6.21 ± 1.29 to 5.29 ± 1.10; $p < 0.001$; females: from 6.18 ± 1.26 to 5.30 ± 1.06 mmol/L; $p < 0.001$) (Table 4). Within the same period, there was also a mild decline in HDL-cholesterol in males (from 1.35 ± 0.36 to 1.30 ± 0.34 mmol/L; $p < 0.001$) and no change in females. There was also a significant decrease in non-HDL-cholesterol (males: from 4.86 ± 1.33 to 3.97 ± 1.10; $p < 0.001$; females: 4.61 ± 1.29 to 3.65 ± 1.12 mmol/L; $p < 0.001$) and in the total to HDL-cholesterol ratio (males: from 4.94 ± 1.83 to 4.32 ± 1.39; $p < 0.001$; females: from 4.14 ± 1.32 to 3.42 ± 1.15; $p < 0.001$) in both genders.

Overall, the prevalence of dyslipidemia (for definition, see Methods) was very high in both genders throughout the survey period (total prevalence throughout all six surveys 83.2% in males and 76.7% in females). There was a decrease in the prevalence of dyslipidemia in both genders over the period of 22/23 years (males: from 87.5 to 73.8%; $p < 0.001$; females: from 85.2 to 62.9%; $p < 0.001$).

4. Discussion

4.1. Trends in BMI and obesity

BMI reflects the balance between dietary intake and energy expenditure; in our study, it increased significantly only in males with no change in females. Czech data show a significant decrease in the consumption of meat, sausage, eggs, and milk and dairy products since 1989. Fat of animal origin was largely replaced by vegetable fat and oils. There was also a significant increase in fresh fruit and vegetable consumption [7].

The increase in obesity in Czech males is alarming (from 19.7% in 1985 to 33.6% in 2007/08). The prevalence rates of obesity obtained during the last survey confirm the Czech Republic continues to belong to countries with a high prevalence of obesity [8]. A high prevalence of obesity was also found in Czech females with no significant change over the period of 22/23 years (from 28.0% in 1985 to 30.1% in 2007/08). Our findings are consistent with data from the WHO MONICA Study [8], with an increase in BMI in males basically in all centers whereas the results were much heterogeneous in females (−0.15 ± 0.15 kg/m^2 per year) [9].

In most European countries (except for the Netherlands), Canada, USA, and Australia, obesity is on the increase [10–12]. Obesity is usually more prevalent in females, particularly after the age of 50, in individuals with lower education, and with low physical activity. In females, there is also a linear relationship between BMI and the number of children. Smokers usually have lower BMI, and quitting smoking is associated with a rise in body weight. A significant decrease in the prevalence of smoking in the Czech male population (from 45.0 in 1985 to 30.5 in 2007/08; $p < 0.001$) could partly explain the increase in their BMI. Smoking rates decreased in many countries and are associated with an increase in body weight [13]. On the other hand, an increase in obesity in Australia cannot be explained by smoking habits [14].

Table 4
Lipid parameters between 1985 and 2007/8 in six districts of the Czech Republic.

	1985	1988	1992	1997/8	2000/1	2007/8	*p* for trend
Males							
TC (mmol/L)	6.21 ± 1.29	6.29 ± 1.21	5.98 ± 1.30	5.65 ± 1.15	5.88 ± 1.08	5.29 ± 1.10	0.001
HDL-C (mmol/L)	1.35 ± 0.36	1.33 ± 0.32	1.34 ± 0.49	1.28 ± 0.32	1.25 ± 0.33	1.30 ± 0.34	0.001
Non-HDL-C (mmol/L)	4.86 ± 1.35	4.96 ± 1.26	4.65 ± 1.33	4.36 ± 1.16	4.63 ± 1.11	3.97 ± 1.10	0.001
TC/HDL-C	4.94 ± 1.83	5.01 ± 1.65	4.83 ± 1.66	4.66 ± 1.46	5.01 ± 1.53	4.32 ± 1.39	0.001
Dyslipidemia* (%) (N/T)*	87.5 (1093/1249)	89.3 (1208/1352)	83.5 (945/1132)	77.6 (751/968)	85.0 (853/1003)	73.8 (804/1089)	0.001
Females							
TC (mmol/L)	6.18 ± 1.26	6.22 ± 1.21	5.95 ± 1.29	5.53 ± 1.21	5.82 ± 1.13	5.30 ± 1.06	0.001
HDL-C (mmol/L)	1.57 ± 0.36	1.56 ± 0.34	1.53 ± 0.46	1.50 ± 0.36	1.49 ± 0.38	1.64 ± 0.38	ns
Non-HDL-C (mmol/L)	4.61 ± 1.29	4.66 ± 1.25	4.44 ± 1.32	4.03 ± 1.24	4.33 ± 1.18	3.65 ± 1.12	0.001
TC/HDL-C	4.14 ± 1.32	4.18 ± 1.27	4.16 ± 1.39	3.89 ± 1.30	4.17 ± 1.38	3.42 ± 1.15	0.001
Dyslipidemia* (%) (N/T)	87.7 (1152/1314)	88.0 (1239/1408)	80.6 (974/1209)	70.4 (718/1020)	80.1 (843/1052)	66.0 (737/1117)	0.001

TC, total cholesterol; HDL-C, HDL-cholesterol; N/T, number of individuals with dyslipidemia over the survey population.
Please note the numbers for the survey population may differ slightly from those given in Table 1 as lipid analysis was not available for all individuals.
* Dyslipidemia was defined as total cholesterol ≥ 5 mmol/L (~190 mg/dL) or HDL-cholesterol < 1 mmol/L (~40 mg/dL) in men and < 1.2 mmol/L (~45 mg/dL) in women or use of lipid-lowering drugs.

4.2. Trends in cigarette smoking

The Czech MONICA and post-MONICA studies showed a decline in smoking prevalence only in males (from 45% in 1985 to 30.5% in 2007/8), and no change in females (overall mean, 23.8%). Nevertheless, the latest figures are alarmingly high and no doubt contribute substantially to the high cardiovascular morbidity and mortality in the Czech Republic. The most recent report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee gives a 25% prevalence of smoking in the US population [15]. In Europe, smoking causes 32% of CVD deaths in men aged 35–69 years, and 6% of CVD deaths of women of the same age [16]. The latest data on smoking prevalence in males in Northern and Western Europe are 15–25%. The prevalence of smoking in men is generally higher in East European and former Soviet Union countries (with the highest numbers reported from the Russian Federation and Ukraine, 61 and 62%, respectively). The pattern is reversed for females where smoking rates are very low in former Soviet Union states (6% in Georgia, 2% in Kyrgyzstan, and 1% in Uzbekistan), low in Eastern and Central European countries, but higher in Western and Northern European countries. Notably, the smoking rates of Czech females are close to those of Western and Northern Europe. Over the last 25 years, the prevalence of smoking among men has fallen in many Northern, Southern and Western European countries, and the prevalence of smoking in females has also fallen in some, but not all, of these countries [1].

4.3. Trends in blood pressure, prevalence, awareness, treatment, and control of hypertension

In 2001, about 54% of stroke and 47% of CHD worldwide were attributable to high BP ($\geq$115 mmHg systolic) [17]. In the Czech population, a significant decline in population mean in SBP and DBP over a period of 22/23 years was documented, which undoubtedly contributed to a remarkable decline in CHD and stroke mortality. It is generally accepted a reduction in population mean BP could be achieved by lifestyle modifications, consequently resulting in a reduced prevalence of hypertension, which is only the case of Czech females. Links between BP and diet have been recognized in population studies. In general, lower BP is related to higher dietary fiber and potassium while, in some studies, total or saturated fat intake correlates positively with BP [18]. Lower consumption of total and saturated fat is also documented by Czech data [7]. Due to the high prevalence of hypertension (50.2% in males and 37.3% in females) and the fact 58% of hypertensives receive antihypertensive medication, about 25% of the general population is on antihypertensive medication. This also contributes to the lower population mean BP. Prevalence of hypertension decreased only in females with no change in the male population. Still, the prevalence is extremely high and can be partly explained by the high prevalence of obesity. The increase in male obesity also explains why there was no decline in the prevalence of hypertension in males. Another reason for the high prevalence of hypertension in the Czech Republic is high salt intake [19].

Awareness, treatment, and control of hypertension improved significantly in both genders. The rates for awareness of hypertension are comparable with US data [20]. However, 30% of the population is still unaware of being hypertensive, contributing largely to the poor hypertension control in the population. Our rates of hypertension control are fully comparable with those of Western developed countries [21].

4.4. Trends in lipids

Similar to BP, there was a significant decrease in total and non-HDL-cholesterol in both genders in the Czech population. The mean decrease in total cholesterol by about 0.9 mmol/L in both genders (approx. 14%) is meaningful at the population level. This was mostly induced by non-pharmacologic measures as there are only about 10% of individuals treated by lipid-lowering drugs. The favorable dietary changes at the population level are again supported by the Czech consumption data [7] as mentioned in the first paragraph of Section 4. As a 10% reduction in total cholesterol is followed by a 25% reduction in CHD incidence after 5 years [22], the above changes in lipids presumably contributed to the decreased cardiovascular mortality in the Czech Republic.

Replacing the manual method of lipid determination by a fully automatic enzymatic one did not affect the results as the external quality control provided by the Centers for Disease Control and Prevention in Atlanta (GA, USA) remained within the limit of ±2%.

A potential study limitation is that the decline in the response rate may have resulted in a population sample with a higher proportion of individuals with a higher level of education, who were more health conscious, thus making the results more favorable compared with the entire population. On the other hand, many epidemiological studies conducted nowadays give a response rate below 60%.

In conclusion, there was a favorable trend in most major cardiovascular risk factors in the Czech population between 1985 and 2007/8. Decreases in population mean BP, total cholesterol, and smoking rates in males most likely contributed to the significant decrease in cardiovascular mortality.

The results, obtained in a representative population sample, provide important information about the population health status, allowing for extrapolation to the entire Czech population. Longitudinal trends of major cardiovascular risk factors may help in analyzing the trends in cardiovascular morbidity and mortality, and in planning health care services and drug consumption.

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