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CZECH MORTALITY PATTERNS: THE PAST, THE PRESENT, AND REGIONAL DISSIMILARITIES

J. Rychtaříková: *Czech mortality patterns: the past, the present, and regional dissimilarities.* – Geografie – Sborník ČGS, 107, 2, pp. 156 – 170 (2002). In the interwar period, life expectancy at birth in the Czech Republic was close to the levels observed in France. After the World War II, three dissimilar stages in the development of life expectancy at birth became apparent in the Czech Republic: 1. between World War II and the mid-1960s characterized by mortality decrease; 2. from the mid-1960s to the mid-1980s, showing the deterioration of the survival rate; and 3) from the mid-1980s or the beginning of the 1990s to the present with a reappearance of a new decline in mortality. The recent improvements in the survival rate have been primarily due to the reduction of mortality from circulatory diseases and at older ages. Significantly diverse cause-of-death profiles were found in the Ostrava, Zlín, Karlovy Vary and the Central Bohemia regions, with similar deviations for both sexes in 1994 – 1997.
KEY WORDS: Mortality – Czech Republic – regional differences by cause.

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Introduction

The theory of epidemiological transition provides a basic framework for investigating patterns of mortality decline during the last two centuries (Omram 1971). With the use of this theory, three stages of transition can be distinguished: from a high to low infant mortality rate; communicable to non-communicable diseases; and from a small to a larger excess male mortality. However, since the beginning of the 1970s new phenomena in mortality change have appeared: mortality decline at advanced ages and a decrease in cardiovascular mortality (formerly considered as impossible to reduce), a lowering of the life expectancy differential between men and women, and the emergence of new communicable diseases including AIDS. As a result, recent structural changes in low mortality countries were named the Fourth Phase of the epidemiological transition in mortality and related health issues.

Historical perspective of mortality change in the Czech Republic

The Czech Republic followed, with a delay compared to northern and western Europe, the stages identified by the theory of epidemiological transition. However, from the beginning of the 20th century and including the interwar period, mean length of life increased and male and female survival in the Czech Republic was close to the levels observed in France (Fig. 1). At

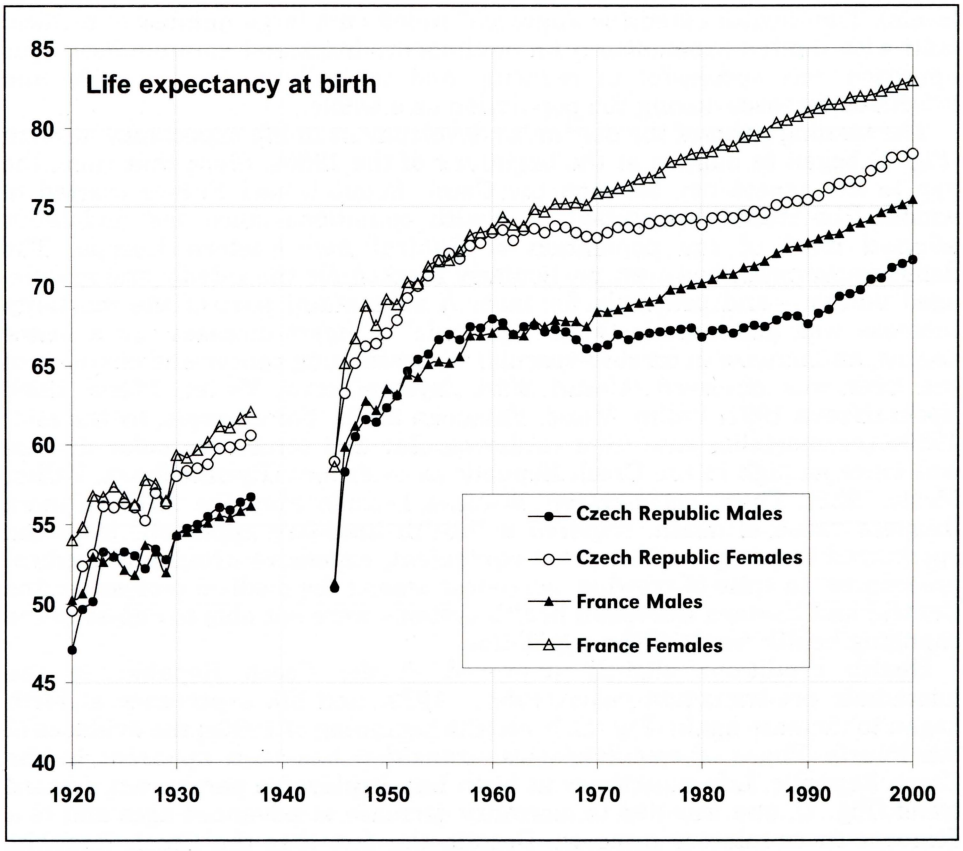

Fig. 1 – Development of life expectancy at birth in the Czech Republic and France since 1920. Life expectancy at birth.

that time the Czech lands of Bohemia, Moravia and part of Silesia (the current Czech Republic) belonged among the more economically advanced countries. In 1930, GNP/capita (in 1960 US dollars and prices: actual boundaries) was 720 (Bairoch 1981) and productivity in agriculture (Kirk 1946) was 145 (France: 890 and 176 respectively; Austria 715 and 134; Hungary 430 and 78; Poland 420 and 49; and Italy 525 and 73).

In the 1950s the mean length of life increased more rapidly in the Czech Republic than in France. Until the early1960s life expectancy at birth for Czech females was the same as their French counterparts, but Czech males had a longer mean length of life than French males (Fig. 1). This significant decrease in Czech mortality was due to the capability of a socialist country to develop rapid coverage of the entire population with basic but comprehensive health services. Immunization contributed to a marked decrease in infant mortality rate. Socialism also managed to eliminate extreme poverty. In 1948 under the communist regime the centralization process began in the Czech Republic. The Czech government nationalized the health care system with Act 185/1948 and in 1952 the Ministry of Public Health assumed control of all medical services. A hierarchical structure of medical services was established and based on a rigorous three-tier system (regional, district and community

levels). The "health-extensive approach" relied on a large number of medical staff with limited expenditures for equipment, drugs and maintenance. This approach was successful in reducing and controlling communicable and infectious diseases among the population as a whole.

The turning point of the dissimilar development in life expectancy at birth (Fig. 1) began to happen at the beginning of the 1960s. Since that time, the gap in life expectancy between the Czech Republic and France started to widen. The decline/stagnation in health conditions since the mid-1960s affected most of the population of Central and Eastern Europe. The deterioration was, however, particularly marked for the elderly and middle-aged adults – and primarily for men. A substantial part of the mortality increase was attributable to an "epidemic" of heart diseases. To a lesser degree, an increase in cerebro-vascular diseases, lung cancer and cirrhosis of the liver was observed (Unicef 2001; Rychtaříková, Vallin, Meslé 1989; Rychtaříková 1997; Vallin, Meslé, Valkonen 2001). For example, by the mid-1980s the mortality rate from cardiovascular and cerebro-vascular disease was twice as high in the Czech Republic as in France (Rychtaříková, Vallin, Meslé 1989). These degenerative diseases became from the 1970s a more frequent cause of death, required a "health intensive approach" involving specialized training, sophisticated equipment, expensive drugs and medical procedures. In spite of growing awareness among the medical profession, the Central and Eastern European health systems were not able to adjust to the changing health needs of the population.

Health conditions slightly improved in the Czech Republic in the immediate pre-transition years (1985 – 1989) and life expectancy at birth began to increase again (Fig. 1). Since the beginning of 1990s, the evidence of the Fourth Phase of epidemiological transition has been apparent in the Czech Republic. Life expectancy at birth has displayed a permanent upward trend (Fig. 1), and was due to mortality decrease at advanced ages and to a decrease in circulatory diseases. Despite the fact that the Czech Republic escaped a dramatic increase in the number of deaths (labeled the mortality crisis of the 1990s) observed in most post-communist countries (UNICEF 1994), the time delay of the Czech Republic in the reduction of mortality rate compared to France has not been reduced and life expectancy at birth has followed an almost parallel trend (Fig. 1).

In summary, three dissimilar stages in the development of life expectancy at birth became apparent in the Czech Republic during the post-war period: 1. between World War II and the mid-1960s characterized by mortality decrease; 2. from the mid-1960s to the mid-1980s, showing the deterioration of the survival rate; and 3. from the mid-1980s or the beginning of the 1990s to the present with a reappearance of a new decline in mortality. The period of transition after 1989 accompanied by political, economic, social and behavioral transformations has not - unlike other post-communist countries – negatively influenced the process of mortality decline which had already been initiated in the Czech Republic prior to the transition period. The recent improvements in the survival rate have been primarily due to the reduction of mortality from circulatory diseases and at older ages (Rychtaříková 1998a; Rychtaříková 1998b). In 2000 life expectancy at birth was 71.65 years for men and 78.35 for women (France 75.41 and 82.92). The increase in life expectancy at birth has currently brought the Czech Republic a little closer to the European average. However, the country is still, like all the other former socialistic countries of Central and Eastern Europe, lagging behind Western norms.

Diversity of trends by age

Before World War II, infant mortality rate was substantially higher in the former Czech lands than in France (Fig. 2). The difference is not easy to explain and it might suggest there were a weaker social organization and less efficient health care system of mother/child protection. Contrary to the health situation prior to World War II, the infant mortality rate was lower in the Czech territory than in France during the 1950s. This rapid decrease in infant mortality rate at that time (Fig. 2) contributed the most to the increase in life expectancy at birth. A particularly active maternity and welfare policy, immunization, and universal access to health care resulted in rapid improvement of infant survival in the Czech Republic. From 1961, on the contrary, the reduction in infant mortality lessened, but an abrupt increase in IMR in 1965 was due to a legal change in the definitions of live birth and stillbirth. A downward trend reappeared in the 1980s, and has continued through the 1990s. In 2000 the Czech Republic and France displayed the same levels: 4.1 infant deaths per 1000 live births (Fig. 2). Therefore, the infant survival in the Czech Republic is among the highest in Europe (Vallin, Meslé, Valkonen 2001).

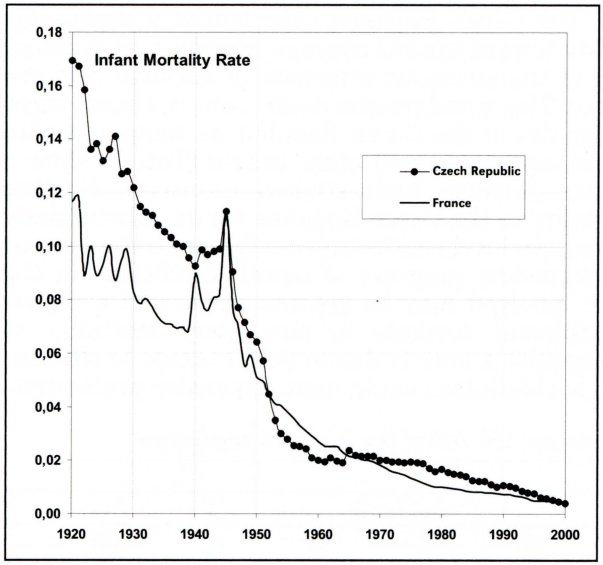

Fig. 2 – Development of infant mortality rate in the Czech Republic and France since 1920. Infant Mortality Rate.

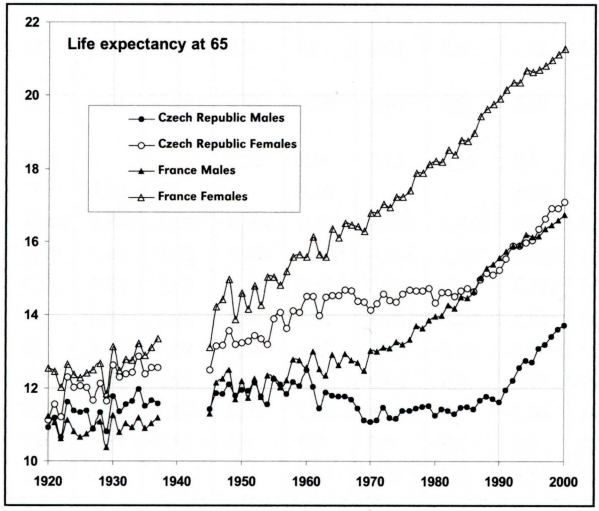

Fig. 3 – Development of life expectancy at 65 in the Czech Republic and France since 1920. Life expectancy at 65.

Older age groups show different time trends in mortality than infants. Prior to World War II life expectancy at age 65 was longer for males in the former Czech lands than in France and only slightly shorter for women. The higher Czech survival rate at 65+ persisted until the beginning of the 1960s. However, the trend reversed and an increase in mortality of 65+ was observed between 1960 and 1970

in the Czech Republic (Fig. 3). The reduction in life expectancy at 65 primarily influenced a shortened life expectancy at birth. A substantial part of the mortality increase of adults and the elderly was attributable to a very high frequency of cardiovascular diseases. Psychosocial stress, underdeveloped health care services (as compared to the West), and unhealthy lifestyles were responsible factors.

During the 1990s a decrease in mortality was observed in the Czech Republic and was primarily due to the reduction of mortality from circulatory diseases at older ages (Rychtaříková 1998a). Deaths from circulatory diseases have apparently been sensitive to the transition process in the Central and Eastern European countries. The Czech Republic experienced a decreasing risk and converged more quickly toward the EU average. However, circulatory mortality still represents one of the strongest contrasts in survival between the Czech Republic and France. The standardized death rate is almost three times higher for males and females in the Czech Republic as compared with France (Tab. 1). But malignant neoplasms and other causes (Tab. 1) show a significantly smaller difference between both studied countries. Further diminution of circulatory mortality in the Czech Republic would substantially advance the country toward western levels and patterns. Dietary habits are no doubt partly responsible for impeding progress of health conditions in the Czech Republic. Other factors involved may be greater stress and a higher smoking rate. The recent profound decrease in circulatory mortality at advanced ages in the Czech Republic is mainly due to better access to efficient health care, more modern and sophisticated equipment, expensive procedures,

Tab. 1 – Age-standardized death rate per 100 000 of the standard population (new standard)

Country and year	Czech Republic						France		
	1996			1998			1996		
Sex	Total	Males	Females	Total	Males	Females	Total	Males	Females
All causes	744,8	977,9	570,7	706,6	926,6	541,6	489,3	671,7	345,2
Malignant neoplasms	187	257,6	138,2	182,9	250,9	136,5	147,2	213,4	96,8
Malignant neoplasm of stomach	12	18,1	8,2	10,2	15	7,1	5,3	8,3	3,1
Malignant neoplasm of trachea, bronchus and lung	38,4	72,5	12,9	36,2	67,7	12,9	27,3	51,8	7,2
Malignant neoplasm of female breast	13	0,2	22,4	12,8	0,2	22,2	..	..	21,7
Malignant neoplasm of prostate	..	20,8	..	..	21,8	..	..	20,1	..
Diseases of the circulatory system	394,8	499,7	318,4	368,9	461,5	300,8	134,4	178,5	100,8
Ischaemic heart diseases	176,1	239,6	129,1	148,6	206,7	106,3	39,8	60,4	23,9
Cerebro-vascular disease	104	121,7	92	100,2	111,9	91,3	33,1	39,9	27,9
Diseases of the respiratory system	30	42,7	21,8	26,2	39,7	17,4	32,1	48,3	21,8
Diseases of the digestive system	29	40,5	19,2	28,5	39,8	18,6	25,5	34,5	18
Chronic liver disease and cirrhosis	12,7	19,7	6,6	13,9	21	7,5	12,1	17,8	7,2
External causes	61	88,3	35	54,8	81,7	29,4	53,4	77	31,6
Motor vehicle traffic accidents	6,3	9,8	2,9	5,7	9,1	2,4	12,5	18,6	6,5
Suicide and self-inflicted injury	12,9	21,6	5,1	13,2	22,2	5	16	24,5	8,3

Source: http://www3.who.int/whosis/whsa/whsa_table4.cfm?path=whosis,whsa, whsa_table4&language=english

better drugs, and improved emergency services. In spite of a favorable turnover of mortality at advanced ages observed since the beginning of 1990s in the Czech Republic, the lag behind France has continued (Fig. 3).

Current patterns of mortality by cause in regions of the Czech Republic

In studies dealing with regional dissimilarities within a country the general level of mortality as well as age and cause-of-death rates are usually shown. The approach used in this paper extends the above-mentioned concepts by studying *relative cause-of-death profiles*. Regions may achieve the same levels of total mortality (i.e. life expectancy) but at a radically different age or cause pattern.

A relative structure can reflect the underlying behavioral and environmental risk factors. Therefore, groups of regions with similar cause-of-death patterns may represent the same mortality structures although the differences in the level of total mortality can be observed. The structures tend to remain more stable as mortality declines over time.

The section uses the correspondence analysis method, to identify typical cause/causes of death in individual regions of the Czech Republic from 1994 to 1997. Row profiles (regions) and column profiles (death frequency by cause based on standardized rates) can be displayed as a two-dimensional plot with condensed information. Correspondence analysis (CA) is a multidimensional scaling technique (MDS) where the interest is primarily in joint plots of objects and variables. A basic concept is that of distance related to the issue of similarity or dissimilarity (between an object and a variable). The frequency table of data (contingency table) is converted into graphical displays in which rows and columns are depicted as points. Mathematically, CA decomposes the χ^2 measure of association of the table into components in a manner similar to the decomposition of variance in principal components analysis. In CA the coordinates are computed so that each successive coordinate axis accounts for a decreasing portion of the total association (χ^2) between the rows and columns. Regional differences in relative cause profiles (relative structure of mortality by cause) were analyzed using the method of simple correspondence analysis (based on two-way contingency table). The entry data consist of regions (rows) and selected groups of causes of death for males and for females are in columns. Relative frequencies of standardized death rate by cause add up to 100 % for each region. Each cell of the table contains the relative frequency of cause of death by region (Tab. 3). In this analysis only the first two dimensions are considered.

Regional dissimilarities in cause-of-death profiles are analyzed for six main groups of causes: malignant neoplasms, circulatory diseases, diseases of the respiratory system, diseases of the digestive system, external causes of death, and other causes. (See Tab. 7) The regions under study correspond to the administrative division that came into force in the Czech Republic since the 1st January 2000 (see Fig. 5). The data covering the period of 1994 – 1997 were converted according to this new administrative division. Standardized death rates by cause were computed for the 14 regions by using the method of direct standardization for the age groups of 15-19, 20-24,....80-84, 85+, for males and females in the four-year period of 1994 – 1997.

Tab. 2 – Age-standardizèd death rate by cause per 100 000 of the standard population Regions of the Czech Republic; years 1994-1997; Ages 15-19, 20-24,..85+; European standard

Region	Medical cause of death						
	1.	2.	3.	4.	5.	6.	Total
	Males						
Praha	3994	7553	550	662	1238	726	14723
Central Bohemia	4612	9824	495	654	1287	713	17584
Ceske Budejovice	4607	8700	687	523	1206	649	16372
Plzen	4742	8778	894	483	1252	671	16820
Karlovy Vary	5167	8790	1019	706	1572	723	17977
Usti n L	5165	9697	767	825	1410	786	18649
Liberec	4612	8872	506	687	1359	669	16705
Hradec Kralove	3988	8021	696	510	1181	637	15034
Pardubice	3874	8673	927	616	1265	572	15927
Jihlava	4125	8882	735	505	1073	597	15917
Brno	4016	8740	637	696	1196	530	15816
Zlin	3970	9420	580	772	1390	517	16648
Olomouc	4093	8730	700	680	1349	671	16223
Ostrava	4561	9178	1292	782	1391	628	17831
Czechia	**4354**	**8838**	**732**	**664**	**1288**	**652**	**16529**
	Females						
Praha	2520	4943	271	371	624	503	9232
Central Bohemia	2281	6336	250	300	554	517	10238
Ceske Budejovice	2401	5542	350	304	500	495	9592
Plzen	2563	5927	505	283	628	557	10463
Karlovy Vary	2745	5923	550	347	619	569	10753
Usti n L	2722	6319	366	388	598	628	11019
Liberec	2459	5780	265	346	625	462	9937
Hradec Kralove	2262	5323	393	275	533	476	9262
Pardubice	2186	5663	489	297	617	498	9751
Jihlava	2163	5624	400	252	452	411	9301
Brno	2198	5462	330	312	472	362	9135
Zlin	2022	6006	264	338	477	367	9473
Olomouc	2189	5650	308	342	534	586	9608
Ostrava	2344	5801	608	395	519	445	10112
Czechia	**2353**	**5696**	**366**	**332**	**551**	**486**	**9784**
Correlation coefficient between standardized death rates of an individual cause and total mortality							
Males	0,838	0,814	0,401	0,548	0,697	0,417	
Females	0,731	0,763	0,398	0,381	0,559	0,700	

Note: 1. Malignant Neoplasms; 2. Circulatory diseases; 3. Diseases of the respiratory systém; 4. Diseases of the digestive systém; 5. External causes of death; 6. Other causes.

Descriptive perspective

The region of Úsli n. L. shows the highest standardized death rate for males (18 649 p.100 000) and for females (11 019 p.100 000), see Tab. 2. On the contrary, Prague is the most favorable place to live for males (14 723 p.100 000) and the second for females (9 232 p.100 000). Brno has the lowest standardized death rate for females (9 135 p.100 000). The regions with the best (Prague) and the worst (Ústí n. L.) survival indices suffer from a high

level of air pollution but they substantially differ in population structures, especially regarding educational level. A higher proportion of people with a university degree live in Prague and they have the highest survival rate. The highest relative number of university graduates in Prague decreases the average mortality indicators. The region of Ústí n. L is disadvantageous due to a higher proportion of people with only a basic education and increased mortality risk. In addition, Ústí n. L has a high unemployment rate, unlike Prague which has the lowest unemployment rate in the Czech Republic. The unemployed experience worse health conditions (Unicef 2001, Unicef 1994). Regions showing a mortality level below the national average are mostly in the south-east and those with excess mortality are situated in the north and west. West-east polarization is very pronounced regarding malignant neoplasms and the standardized rate decreases from the west to the east. The highest rate is observed in Karlovy Vary and Ústí n. L. (western regions) while Zlín (east) displays the lowest level. Surprisingly, women in Prague experience a rather high mortality from malignant neoplasms, while male cancer mortality is below the national level (Tab. 2).

Circulatory diseases are the most frequent causes of mortality in the developed world. However the high percentage of deaths due to circulatory diseases (computed from the distribution of standardized rates by cause) can be related either to low mortality where these diseases are the primary cause of death or to a high mortality level due to less developed health services combined with an unhealthy life style common in Central and East European countries during the communist era. In the Czech Republic, the strong correlation (0.8) is observed between the standardized rate of total mortality and the standardized rate of mortality from circulatory diseases (low total mortality rates corresponds to low mortality rates from circulatory diseases; Tab. 2). Unlike neoplasms, regional patterns of mortality from circulatory diseases are not apparent and the increased risk is scattered throughout the Czech Republic. The highest levels are in Central Bohemia, Ústí n. L. (west) and Zlín (east). This observation likely reflects the social and health conditions – Including life style – of regional populations. However, relative frequency of deaths from circulatory diseases does not correlate with the total mortality rate (–0.3; Tab. 3). The lowest frequency due to circulatory deaths is observed in the region of Karlovy Vary (Tab. 3) but experiences a high total mortality rate, but Prague has a low standardized rate and a low frequency of circulatory deaths. Zlín and Central Bohemia show a positive correlation (high total mortality level correlating to a high proportion of circulatory deaths) while Hradec Kralové shows a higher proportion combined with a lower level.

Diseases of the respiratory system show the "highest" positive correlation coefficient between level and proportion (0.2; Tab. 3). Although this mortality accounts for less than 5 % in the total number of standardized deaths, different regions show large variations. A particularly high rate of mortality from respiratory diseases is observed in Ostrava (males: 1 292; females: 608 p. 100 000) and Karlovy Vary (males: 1 019; females: 550) compared with Central Bohemia (495 for males and 250 for females). The increased risk of mortality from respiratory disease appears primarily in long-term industrialized regions (Ostrava, Karlovy Vary, Pardubice, Plzeň, Ústí n. L.). While mortality from respiratory diseases can be related, to some extent, to the influence of the physical environment (climate, air pollution), mortality from digestive diseases is strongly connected to dietary habits and stress. However, the industrialized

Tab. 3 – Percentage of standardized deaths by cause
Regions of the Czech Republic; years 1994-1997; Ages 15-19, 20-24,..85+;

Region	Medical cause of death						
	1.	2.	3.	4.	5.	6.	Total
	Males						
Praha	27,1	51,3	3,7	4,5	8,4	4,9	100,0
Central Bohemia	26,2	55,9	2,8	3,7	7,3	4,1	100,0
Ceske Budejovice	28,1	53,1	4,2	3,2	7,4	4,0	100,0
Plzen	28,2	52,2	5,3	2,9	7,4	4,0	100,0
Karlovy Vary	28,7	48,9	5,7	3,9	8,7	4,0	100,0
Usti n L	27,7	52,0	4,1	4,4	7,6	4,2	100,0
Liberec	27,6	53,1	3,0	4,1	8,1	4,0	100,0
Hradec Kralove	26,5	53,4	4,6	3,4	7,9	4,2	100,0
Pardubice	24,3	54,5	5,8	3,9	7,9	3,6	100,0
Jihlava	25,9	55,8	4,6	3,2	6,7	3,8	100,0
Brno	25,4	55,3	4,0	4,4	7,6	3,4	100,0
Zlin	23,8	56,6	3,5	4,6	8,3	3,1	100,0
Olomouc	25,2	53,8	4,3	4,2	8,3	4,1	100,0
Ostrava	25,6	51,5	7,2	4,4	7,8	3,5	100,0
Czech Republic	26,3	53,5	4,4	4,0	7,8	3,9	100,0
	Females						
Praha	27,3	53,5	2,9	4,0	6,8	5,4	100,0
Central Bohemia	22,3	61,9	2,4	2,9	5,4	5,1	100,0
Ceske Budejovice	25,0	57,8	3,7	3,2	5,2	5,2	100,0
Plzen	24,5	56,7	4,8	2,7	6,0	5,3	100,0
Karlovy Vary	25,5	55,1	5,1	3,2	5,8	5,3	100,0
Usti n L	24,7	57,3	3,3	3,5	5,4	5,7	100,0
Liberec	24,7	58,2	2,7	3,5	6,3	4,6	100,0
Hradec Kralove	24,4	57,5	4,2	3,0	5,7	5,1	100,0
Pardubice	22,4	58,1	5,0	3,0	6,3	5,1	100,0
Jihlava	23,3	60,5	4,3	2,7	4,9	4,4	100,0
Brno	24,1	59,8	3,6	3,4	5,2	4,0	100,0
Zlin	21,3	63,4	2,8	3,6	5,0	3,9	100,0
Olomouc	22,8	58,8	3,2	3,6	5,6	6,1	100,0
Ostrava	23,2	57,4	6,0	3,9	5,1	4,4	100,0
Czech Republic	24,1	58,2	3,7	3,4	5,6	5,0	100,0
Correlation coefficient between standardized death rates of an individual cause and total mortality							
Males	0,278	–0,292	0,189	0,148	–0,025	–0,207	
Females	0,080	–0,234	0,215	–0,083	0,050	0,389	

Note: 1. Malignant Neoplasms; 2. Circulatory diseases; 3. Diseases of the respiratory systém; 4. Diseases of the digestive systém; 5. External causes of death; 6. Other causes.

and mining regions of Ostrava and Ústí n. L. possess the highest level. On the contrary, low risk is seen in Plzeň, Jihlava, and Hradec Králové. External causes are a heterogeneous mix that includes traffic accidents, suicides, homicide and other external causes. The Czech Republic, (the former Czech lands) was known as a country with a high suicide rate, primarily in the north and west. Current regional differences of standardized death rates from external causes are very small and do not show a special geographical configuration. The rates ranked by sex do not display the same regional pattern.

Descriptive perspective used for presenting Czech regional patterns showed several particular anomalies in the spatial distribution of mortality

Tab. 4 – Inertia and Chi-Square decomposition

Singular Value	Principal Inertia	Chi-Square	Percent	Cumulative Percent
0.05362	0.00287	8.6241	48.94	48.94
0.04057	0.00165	4.9371	28.02	76.95
0.02626	0.00069	2.0681	11.74	88.69
0.01728	0.00030	0.8955	5.08	93.77
0.01323	0.00018	0.5253	2.98	96.75
0.01066	0.00011	0.3407	1.93	98.68
0.00579	0.00003	0.1005	0.57	99.25
0.00489	0.00002	0.0718	0.41	99.66
0.00441	0.00002	0.0582	0.33	99.99
0.00071	0.00000	0.0015	0.01	100.00
Total	0.00587	17.6228	100.00	

Degrees of freedom = 154

by cause. Malignant neoplasms follow a more or less West-East axis while circulatory diseases are scattered throughout the entire territory. Some regions have a specific cause-of-death profile, while others display a non-specific structure. High standardized rates are found for several causes of deaths in Ústí n. L. (malignant neoplasms, circulatory and digestive diseases) while an unusually high mortality from respiratory diseases is very typical in Ostrava.

Correspondence analysis perspective

Dissimilarities in proportions (relative frequencies by cause), irrespective of mortality level, were investigated in order to depict the most important regional anomalies. The results of correspondence analysis illustrate in a compact manner the differences in cause-death profiles of regions in the Czech Republic. Analyzed data are in Table 3. Males (6 variables) and females (6 variables) were joined in one model assuming that the behaviors and the impact of environment (physical and social) would contribute similarly to a risk of death for both sexes. The list of causes and their abbreviations are in the Table 7. The first coordinate axis accounts for the largest part of the total association between the rows and columns represented by χ^2 statistic. (The coordinates in correspondence analysis are based on the generalized singular value decomposition of the matrix of relative frequencies; χ^2/N is referred to as the total inertia having similar meaning as variance and its decomposition in principal components analysis). Table 4 displays an inertia and chi-square decomposition table that includes total inertia, principal inertias of each dimension (eigenvalues), singular values (square roots of the eigenvalues), each dimension's percentage of inertia, and the total chi-square with its degrees of freedom and decomposition. The first coordinate (first dimension) accounted for 49 % and the second for 28 % of the total association (Fig. 4, Tab. 4). Therefore, the two first axes account for 77 % of the association, indicating that the association between the row and column categories is essentially two-dimensional. The total chi-square statistic is 17.62. The plot (Fig. 4) shows how regions are associated with medical causes of death. Table

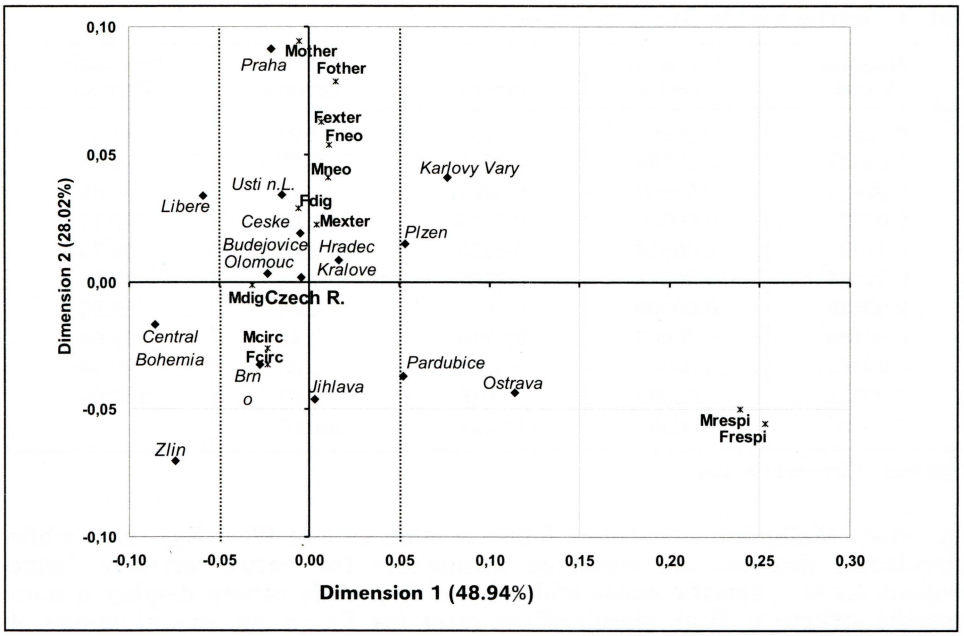

Fig. 4 – Plot of Simple Correspondence Analysis of regional dissimilarities in cause-of-death profiles

Tab. 5 – Observed minus Expected values (total = 0)

	1.	2.	3.	4.	5.	6.	1.	2.	3.	4.	5.	6.
Region	Mneo	Mcirc	Mrespi	Mdig	Mexter	Mother	Fneo	Fcirc	Frespi	Fdig	Fexter	Fother
Praha	0,02240	***-0,06925***	-0,02541	0,01911	0,01947	0,03368	**0,11064**	***-0,15742***	-0,03086	0,02389	0,03805	0,01570
Central Bohemia	-0,00776	**0,08289**	***-0,05601***	-0,00673	-0,01683	0,00444	***-0,05644***	**0,12068**	-0,04723	-0,01268	-0,00698	0,00265
Ceske Budejovice	**0,05604**	-0,00804	-0,00991	-0,02423	-0,01522	0,00135	0,03531	-0,01644	-0,00691	-0,00463	-0,01367	0,00635
Plzen	**0,05781**	-0,03969	0,02728	-0,03496	-0,01265	0,00221	0,01732	***-0,05398***	0,03237	-0,02017	0,01270	0,01177
Karlovy Vary	**0,07608**	***-0,14946***	0,03900	0,00030	0,03066	0,00343	**0,05188**	***-0,10622***	0,04190	-0,00276	0,00463	0,01059
Usti n L	0,04119	-0,04610	-0,01282	0,01669	-0,00870	0,00973	0,02433	-0,03096	-0,01797	0,00703	-0,00656	0,02414
Liberec	0,03825	-0,00905	-0,04880	0,00643	0,01042	0,00275	0,02567	-0,00341	-0,03973	0,00587	0,02233	-0,01074
Hradec Kralove	0,00223	-0,00096	0,00450	-0,01758	0,00120	0,01060	0,01508	-0,02659	0,01288	-0,01130	0,00428	0,00565
Pardubice	***-0,07119***	0,03583	0,04407	-0,00182	0,00409	-0,01098	***-0,05170***	-0,00642	0,03842	-0,00868	0,02372	0,00466
Jihlava	-0,01819	**0,08064**	0,00411	-0,02495	-0,03603	-0,00559	-0,02389	**0,07329**	0,01471	-0,02006	-0,02543	-0,01862
Brno	-0,03553	**0,06255**	-0,01560	0,01610	-0,00859	-0,01893	0,00288	**0,05066**	-0,00819	0,00350	-0,01522	-0,03363
Zlin	***-0,08713***	**0,10677**	-0,03380	0,02380	0,01757	-0,02720	***-0,08756***	**0,17098**	-0,03576	0,00862	-0,01968	-0,03660
Olomouc	-0,04089	0,01441	-0,00607	0,00907	0,01639	0,00710	-0,03979	0,01771	-0,02173	0,00857	-0,00216	0,03740
Ostrava	-0,02939	***-0,06364***	**0,09163**	0,01547	-0,00075	-0,01333	-0,02639	-0,03003	**0,07195**	0,01985	-0,01634	-0,01903
Czech Republic	-0,00390	0,00308	-0,00218	0,00331	-0,00103	0,00073	0,00267	-0,00184	-0,00383	0,00295	0,00033	-0,00029

Note: 1. Malignant Neoplasms; 2. Circulatory diseases; 3. Diseases of the respiratory systém; 4. Diseases of the digestive system; 5. External causes of death; 6. Other causes.
M males; F females
Values: eq or less than -0.05 in bold and italic
Values: eq or more than 0.05 in bold
Values: eq or less than -0.1 in bold, italic, and underlined
Values: eq or more than 0.1 in bold and underlined

Tab. 6 – Contributions to the Total Chi-Square Statistic

Percents	1.	2.	3.	4.	5.	6.	1.	2.	3.	4.	5.	6.	
region	Mneo	Mcirc	Mrespi	Mdig	Mexter	Mother	Fneo	Fcirc	Frespi	Fdig	Fexter	Fother	Sum
Praha	0.097	0.459	0.733	0.475	0.248	**1.478**	**2.608**	***2.172***	***1.261***	0.882	**1.315**	0.253	***11.980***
Central Bohemia	0.012	0.657	***3.564***	0.059	0.185	0.026	0.679	**1.276**	***2.953***	0.249	0.044	0.007	***9.711***
Ceske Budejovice	0.606	0.006	0.111	0.765	0.151	0.002	0.266	0.024	0.063	0.033	0.170	0.041	***2.239***
Plzen	0.645	0.151	0.845	***1.592***	0.104	0.006	0.064	0.255	**1.387**	0.628	0.147	0.142	***5.967***
Karlovy Vary	**1.117**	***2.137***	**1.728**	0.000	0.614	0.015	0.573	0.989	**2.324**	0.012	0.019	0.115	***9.643***
Usti n L	0.327	0.203	0.187	0.363	0.049	0.123	0.126	0.084	0.428	0.076	0.039	0.598	***2.604***
Liberec	0.282	0.008	***2.705***	0.054	0.071	0.010	0.140	0.001	***2.089***	0.053	0.453	0.119	***5.985***
Hradec Kralove	0.001	0.000	0.023	0.402	0.001	0.146	0.048	0.062	0.220	0.197	0.017	0.033	***1.151***
Pardubice	0.978	0.123	**2.206**	0.004	0.011	0.157	0.569	0.004	**1.954**	0.116	0.511	0.022	***6.656***
Jihlava	0.064	0.622	0.019	0.811	0.847	0.041	0.122	0.471	0.286	0.622	0.588	0.356	***4.848***
Brno	0.244	0.374	0.276	0.338	0.048	0.466	0.002	0.225	0.089	0.019	0.210	***1.162***	***3.454***
Zlin	***1.465***	**1.091**	***1.298***	0.738	0.201	0.964	***1.633***	**2.562**	***1.693***	0.115	0.352	***1.376***	***13.487***
Olomouc	0.323	0.020	0.042	0.107	0.175	0.066	0.337	0.027	0.625	0.113	0.004	**1.437**	***3.277***
Ostrava	0.167	0.387	**9.538**	0.312	0.000	0.231	0.148	0.079	**6.852**	0.609	0.243	0.372	***18.938***
Czech Republic	0.003	0.001	0.005	0.014	0.001	0.001	0.002	0.000	0.019	0.013	0.000	0.000	***0.060***
Sum	***6.331***	***6.239***	***23.281***	***6.034***	***2.707***	***3.732***	***7.317***	***8.232***	***22.242***	***3.738***	***4.112***	***6.034***	100.000

Note: 1. Malignant Neoplasms; 2. Circulatory diseases; 3. Diseases of the respiratory system; 4. Diseases of the digestive system; 5. External causes of death; 6. Other causes.
M – males; F – females
Values: eq or more than 1.0 and negative in table 5 are in bold and italic
Values: eq or more than 1.0 and positive in table 5 are in bold
Values: eq or more than 5.0 and positive in table 5 are in bold and underlined

5 (observed minus expected values) and Table 6 (contributions to the Total Chi-square statistic) help to understand the plot (Fig. 4). Table 6 shows that 19 % of the total chi-square statistic is contributed by the Ostrava region, which is followed by Zlín at over 13 %, and Prague (12 %). Similarly, the combined respiratory mortality for males and females contribute over 45 % to the total chi-square, whereas the causes and regions nearer the origin of the plot contribute significantly less. The Ostrava region is farther from the origin than all other regions following the first dimension. Central Bohemia and Zlín are the extreme regions in the opposite direction. The cause-of-death profile of Ostrava is associated with strong excess mortality from respiratory diseases and Tables 5 and 6 show that respiratory problems are the only anomaly in that region and contribute over 16 % to the total chi-square. Both excess respiratory mortality and the Ostrava region are farther from the origin than all other active points and thus emphasize their marked specificity. The Central Bohemia region on the opposite side of the first dimension is characterized by the extremely low frequency of deaths due to respiratory problems. While Ostrava and Central Bohemia show one anomaly of their cause of death profile, the Zlín region experiences three marked anomalies: low frequency of neoplasms and respiratory problems (males and females), but very frequent circulatory diseases (Tab. 5 and 6, Fig. 4). Prague displays a particular pattern, but for females only. The capital city is characterized by a very high frequency of malignant neoplasms, a significantly below-average frequency of circulatory and respiratory deaths, and a high proportion of external causes. The Karlovy Vary region differs with a high frequency of neoplasms and respiratory diseases, and less significant circulatory problems.

Tab. 7 – Selected groups of causes of death with their ICD-9 codes and ICD-10 codes

Cause of death	Abbreviation	ICD - 9	ICD - 10
1. Malignant Neoplasms	(neo)	140-208	C00-C48
2. Circulatory diseases	(circ)	390-459	I00-I99
3. Diseases of the respiratory system	(respi)	460-519	J00-J99
4. Diseases of the digestive system	(dig)	520-579	K00-K93
5. External causes of death	(exter)	E800-E999	V01-Y89
6. Other causes	(other)	Remainder	

The regions listed above (Ostrava, Zlín, Prague, Karlovy Vary, and Central Bohemia) deviate the most from the origin and therefore show a particular cause-of-death profile (Fig. 4). These uncommon structures can reflect special underlying behavioral and environmental risk factors. Those findings would therefore require more detailed and complex statistical research. However, the hypothesis – different risk factors reflecting different social, economic, cultural, and health conditions in regions also generate different cause-of-death profiles irrespective of mortality intensity – was confirmed. Despite the apparent similarity of some regions regarding mortality levels, it was found that mortality profiles in these regions form distinctive configurations.

Fig. 5

Conclusion

In the Czech Republic from the beginning of the 20th century and during the interwar period, mean length of life increased and was close to the levels observed in France. During the post-war period, three dissimilar stages in the

development of life expectancy at birth became apparent in the Czech Republic: between World War II and the mid-1960s and characterized by mortality decrease; from the mid-1960s to the mid-1980s and showing the deterioration of the survival rate; and from the mid-1980s or the beginning of the 1990s to the present with a reappearance of a new decline in mortality. The recent favourable development has currently brought the Czech Republic a little closer to the European average. Regional analysis of cause-of-death patterns shows a persistence of regional peculiarities very likely reflecting different underlying behavioral and environmental risk factors. Significantly diverse cause-of-death profiles were found in the Ostrava, Zlín, Karlovy Vary and the Central Bohemia regions, with similar deviations for both sexes. Interestingly enough, the capital city of Prague shows a distinctive pattern for women only.

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Summary

ÚMRTNOST V ČESKÉ REPUBLICE: MINULOST, SOUČASNOST A REGIONÁLNÍ ROZDÍLY

Úroveň úmrtnosti v českých zemích (současná Česká republika) byla v období mezi dvěma světovými válkami stejná jako ve Francii. Tato situace odpovídala tehdejšímu ekonomickému postavení českých zemí, kde hrubý domácí produkt na hlavu nebo produktivita zemědělství dosahovaly „západoevropských" standardů. Velmi příznivé úmrtnostní poměry byly zejména u osob starších čtyřiceti let. Po druhé světové válce lze rozlišit tři etapy ve vývoji úmrtnostních ukazatelů: 1. od poloviny čtyřicátých let do poloviny let šedesátých charakterizované snižováním míry kojenecké úmrtnosti a prodlužováním střední délky života při narození; 2. období mezi polovinou šedesátých a koncem osmdesátých let, které se vyznačovalo zejména zhoršováním úmrtnosti mužů a stagnací úmrtnosti žen; 3. prodlužování průměrné délky života v devadesátých letech v důsledku

zlepšení úmrtnostních ukazatelů starších osob (40+) a poklesu úmrtnosti na nemoci oběhové soustavy představující nový kvalitativní obrat. Tyto nové trendy přiblížily opět Českou republiku evropskému průměru. Regionální diferenciace úmrtnosti nebyla v rámci České republiky v porovnání s jinými evropskými zeměmi výrazná. Vyšší úroveň úmrtnosti je tradičně pozorovaná v kraji Ústeckém a naopak nejpříznivější ukazatele přežití vykazují kraje Pražský, resp. Brněnský. Snižující se úroveň úmrtnosti je dlouhodobě pozorována ve směru severozápad – jihovýchod. Cílem práce bylo ověřit zda pozorované regionální odlišnosti v úrovni úmrtnosti odrážejí také stejné typické struktury podle příčin. Studium relativních profilů struktur úmrtnosti podle příčin může korelovat se specifickými behaviorálními, environmentálními či dalšími faktory a tyto struktury nemusí být závislé na celkové výši úmrtnosti. I když v regionech České republiky v období 1994 – 1997 vysoká celková úmrtnost výrazně korelovala s vysokou intenzitou úmrtnosti na nemoci oběhové soustavy (0,8), tak procentuelní zastoupení nemocí oběhové systému ve struktuře příčin již s celkovou úmrtností nekorelovalo (-0,3). Nejnižší zastoupení bylo pozorováno v Karlovarském kraji, který se současně vyznačuje vysokou úmrtností. Hlubší pohled na specifičnost profilů úmrtnosti podle příčin byl proveden metodou korespondenční analýzy. Regionální anomálie – odlišnosti od průměrného relativního profilu úmrtnosti podle příčin byly zejména v Ostravském, Zlínském a Pražském regionu. Z hlediska příčin vykazovaly nejvíce atypičností nemoci respiračního systému, které byly vysoce nadprůměrné v Ostravském regionu. Zatímco odchylky od průměru byly v dotyčných regionech podobné pro obě pohlaví a potvrzovaly takto hypotézu o specifických faktorech sociálního prostředí tak Praha byla specifická pouze pro ženy. Tyto výsledky naznačují přítomnost specifických faktorů ovlivňujících délku života.

Obr.1 – Vývoj střední délky života při narození v České republice a Francii v letech 1920 – 2000
Obr. 2 – Vývoj míry kojenecké úmrtnosti v České republice a Francii v letech 1920 – 2000
Obr. 3 – Vývoj střední délky života ve věku 65 let v České republice a Francii v letech 1920 – 2000
Obr. 4 – Regionální rozdíly úmrtnostních profilů podle příčin metodou jednoduché korespondenční analýzy
Obr. 5 – Administrativní členění České republiky

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