AVOIDABLE MORTALITY IN THE CZECH REPUBLIC IN 1990–2006*)

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Abstract: This article discusses avoidable mortality as a methodological instrument for measuring the efficiency of the health care system from the perspective of the reduction of mortality intensity and the practical application of this instrument in the Czech Republic. The first part of the article contains an introduction to and a discussion of this concept. The second part focuses on quantifying the contribution of the transforming Czech health care system to the significant extension of life expectancy in the Czech Republic in the period between 1990 and 2006.

During the period of the transition from a totalitarian society with a centrally planned economy to a democratic society with a market economy the Czech Republic has experienced fundamental changes in the state of public health and the mortality rate of its population. Since 1990 – which marks the start of the period of deep socio-economic changes and is also the year of the last more pronounced rise in mortality in the country – until 2005 male life expectancy at birth rose by 5.3 years and female life expectancy at birth rose by 3.9 years. By 2006 the change was 5.9 and 4.6 years, respectively. The period between 1990 and 2005, for which we have comparable international data, the annual increase in life expectancy at birth rose by 0.36 years for males and 0.25 for females. The figures rank the Czech Republic among the countries with the fastest declines in total mortality intensity, as the average value of the total increase in life expectancy of males and females for the most advanced European countries in this period was 'just' 4.0 and 3.1 years, respectively, which in annual terms is an increase of 0.27 and 0.20 years, respectively. This development brought the Czech Republic significantly closer to the average life expectancy at birth exhibited by the most advanced countries – among males the gap narrowed from 5.3 years in 1990 to 4.0 years in 2005 and among females from 3.0 years to 2.3 years.

It is clear that the positive development in the state of the population's health and the mortality rate in the Czech Republic since 1990 are connected with the ongoing processes of deep social transformation, but it is also apparent that the recorded changes are the result of the interactive effect of numerous factors. These include:

– an increase in funding of health care in a demonopolised and liberalised economy;
– the emergence of private care, the opportunity for people to freely choose their doctor, access to very effective medicines (beta-blockers, statins, ACE inhibitors, calcium channel blockers) and to modern health technology (diagnostic and therapeutic), rescue services with much greater mobility and better technical equipment;
– an increase in the output of health services (e.g. the number of cardiosurgery operations increased sixfold between 1991 and 2005);
– the introduction of various preventive programmes targeting risk population groups (e.g. breast cancer screenings, colorectal screenings, etc.);
– strengthening the awareness of the benefits of caring for one's health, partly motivated by new concerns people have about losing income from time off work or losing their job;

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Table 1 Comparison of the dynamics of the increase in life expectancy at birth in selected European countries 1990–2005

Country	Males		Difference	Country	Females		Difference
	1990	2005	2005–1990		1990	2005	2005–1990
Czech Republic	**67.57**	**72.92**	**5.35**	Ireland	77.67	81.72	4.05
Ireland	72.09	77.29	5.20	Poland	75.50	79.33	3.83
Switzerland	73.99	78.74	4.75	Portugal	77.53	81.33	3.80
Germany[1)]	71.99	76.71	4.72	**Czech Republic**	**75.48**	**79.25**	**3.77**
Finland	70.96	75.59	4.63	Finland	79.01	82.51	3.50
Austria	72.28	76.69	4.41	Germany[1)]	78.54	82.03	3.49
Norway	73.45	77.82	4.37	Hungary	73.79	77.17	3.38
Portugal	70.61	74.90	4.29	Austria	78.99	82.27	3.28
United Kingdom	72.80	77.08	4.28	Spain	80.59	83.66	3.07
Poland	66.50	70.75	4.25	Slovenia	77.83	80.86	3.03
Slovenia	69.82	73.94	4.12	Switzerland	80.93	83.96	3.03
France	72.80	76.80	4.00	France	80.90	83.80	2.90
Denmark	72.01	75.96	3.95	Norway	79.92	82.75	2.83
Italy	73.92	77.60	3.68	Italy	80.43	83.20	2.77
Sweden	74.83	78.49	3.66	United Kingdom	78.40	81.12	2.72
Spain	73.39	76.98	3.59	Denmark	77.83	80.50	2.67
Hungary	65.15	68.69	3.54	Romania	73.14	75.70	2.56
Belgium	72.73	76.18	3.45	Sweden	80.50	82.90	2.40
Slovakia	66.72	70.17	3.45	Slovakia	75.70	78.07	2.37
Netherlands	73.83	77.25	3.42	Belgium	79.54	81.85	2.31
Greece	74.66	76.82	2.16	Greece	79.48	81.63	2.15
Romania	66.69	68.68	1.99	Bulgaria	74.71	76.24	1.53
Bulgaria	67.97	68.99	1.02	Netherlands	80.25	81.72	1.47
Mean[2)]	72.90	76.93	4.04	Mean[2)]	78.53	81.58	3.05

Notes: [1)] Former Federal Republic of Germany in 1990; [2)] The average value does not include post-communist countries.
Source: Eurostat, INSEE.

– positive lifestyle changes among most of the population, especially in the area of nutrition (increased consumption of healthy foods partly owing to more diverse choices);
– improvement in the quality of the environment;
– a change in the structure of the economic activity of the population (a decrease in the share of the population working in industry, an increase in the share working in services) and the related improvement in the quality of the work environment;
– the social effects of the transition were tolerable.

Unfortunately with the current level of knowledge there is no way of ranking the amount of impact each of these factors has had, but the generally accepted claim is that the changes in the area of medical care are the main source of the observed decline in total mortality (*Rychtaříková* 2002, 2004). The trend in the main innovations in health care and selected services indicates that these changes were not inconsequential. The cited causal relationship is most often presented through the decline in the intensity in mortality from circulatory diseases, which in recent years clearly contributed most to the increase in life expectancy of the Czech population, as experts have do doubt that in this cause-of-death category extensive investments have had a direct effect on the observed positive development.

Although on a general level the causality of this positive development is clear, it is not possible from existing data to directly determine the share of individual and not always clearly defined factors on the trend in total mortality. Therefore, in the following text we will attempt at least indirectly to assess the role that progressive changes in the Czech health care system

Table 2 Trends in selected indicators of changes in the health care system, CR, 1990–2006

Year	Public expenditure on health		Consumption of drugs		Transplantation					Cardiosurgery operations
	CZK billions	Per capita (CZK)	CZK billions	Per capita (CZK)	Heart	Renal	Liver	Pancreas	Lung	
1990	30.1	–	6.27	605	–	–	–	–	–	–
1991	38.2	–	6.96	675	9	178	2	0	0	1 657
1992	43.6	4 221	9.33	904	–	–	–	–	–	–
1993	69.3	6 705	13.96	1 351	–	–	–	–	–	–
1994	81.1	7 850	21.19	2 050	–	–	–	–	–	–
1995	93.3	9 032	25.64	2 482	60	389	31	13	0	4 008
1996	102.4	9 927	28.18	2 732	75	393	42	19	0	5 042
1997	109.0	10 582	30.06	2 917	96	445	49	21	1	5 943
1998	119.3	11 585	33.31	3 236	55	366	66	21	8	6 464
1999	123.5	12 006	36.44	3 544	64	316	67	24	14	6 869
2000	133.0	12 943	38.39	3 737	58	353	61	23	7	8 438
2001	145.2	14 202	44.23	4 326	49	330	58	25	10	9 082
2002	162.3	15 910	48.03	4 709	54	326	62	23	9	10 817
2003	175.6	17 212	52.22	5 118	52	400	65	23	11	11 163
2004	184.8	18 108	56.99	5 583	48	442	83	25	7	11 621
2005	191.4	18 698	64.57	6 309	62	411	82	18	11	10 515
2006	199.2[1)]	19 402[1)]	58.97	5 744	57[1)]	395[1)]	99[1)]	25[1)]	15[1)]	9 938[1)]

Note: [1)] Preliminary estimates.
Sources: VÚPSV, ÚZIS, Národní kardiochirurgický registr.

have played in the development of mortality and we will do so in relation to selected causes of death and using the concept of avoidable mortality.

'Avoidable mortality' is a concept that provides both a theoretical foundation and a methodological framework for identifying how much the health care system influences the health of the population (*Andreev et al*. 2003). The concept of avoidable mortality was introduced as a tool for evaluating the quality of medical care by *Rutstein* and his colleagues, who more than thirty years ago came up with the idea of indirectly measuring the impact of changes in the quality of health care on mortality. As an indicator of the quality of the health system they used the differences in the share of deaths from selected causes of death or groups of causes (*Nolte et al*. 2002).

Despite the fact that the concept is not used too frequently, it has considerable informative value. The concept focuses on the primary function of the health care system, that is, on the reduction of mortality. With the available data it is possible not just to operationalise this concept for the Czech Republic but also to make an international comparison. We can thus compare the different national health care systems and from the differences in the level and dynamics of selected indicators we can then judge where the weaknesses and strengths of individual health care systems lie.

The concept of avoidable mortality

The concept of avoidable mortality as a tool for measuring the quality of health care emerged out of research conducted under the American Working Group on Preventable and Manageable Diseases by a team headed by *David R. Rutstein* (1976). The approach this concept represents is based on the assumption that the effectiveness of health care in the sense of its quality can be expressed in terms of the rate of mortality from different causes of death that can be completely or at least partly eliminated through timely and appropriate medical intervention. With the help of specialists from numerous medical fields, the research identi-

fied around eighty different causes of death that lead to premature death and yet could be eliminated with the help of preventive or treatment procedures. The causes include diseases that can be cured (e.g. appendicitis), can to some extent be avoided through prevention (e.g. lung cancer), or fall into both categories (e.g. diphtheria). The occurrence of death or increased mortality from these causes constitutes a warning signal indicating the need to improve the quality of prevention or the quality of health care provided (*Niti and Ng* 2001; *Westerling* 2001; *Korda and Butler* 2004).

Rutstein's original list was drawn up with a view to the imperatives of international comparison. The list therefore includes a wide spectrum of causes of death, some of which are almost entirely absent from advanced countries or, conversely, are rare or uncommon in developing countries. As a result, the causes of death selected for studies in different countries usually differ significantly, even though the authors draw on the same list of causes of deaths drawn up by Rutstein (*Mackenbach, Bouvier-Colle and Jougla* 1990).

Rutstein himself pointed out in a later work (*Rutstein et al*. 1980) that it is necessary to continuously observe the diseases on the list in relation to advances in medical knowledge and practises and to changes in society and the environment. The lists are therefore continuously revised and elaborated. Rutstein's list was substantially modified in connection with the creation of the European Community Atlas of Avoidable Death, which was prepared by a working group headed by W. W. Holland (*Holland (ed.)* 1991; *Holland (ed.)* 1993). The original, considerably longer list of avoidable diseases was as a result shortened to seventeen groups of diseases and some diseases were newly added to the list, such as breast cancer and testicular cancer, with the aim of obtaining a complete overview of the occurrence of these diseases in individual European countries.

However, authors of earlier works published mainly in the 1980s, who were the first to apply the concept of avoidable mortality on data from selected countries, also contributed to perfecting the selection of causes of deaths and groups of causes of deaths in Rutstein's original list (*e.g. Charlton et al*. 1983; *Bauer and Charlton* 1986; *Charlton and Velez* 1986). They not only helped perfect the selection of diseases on Rutstein's original list, but also helped to determine the age limits for each cause of death, with their upper age limit in most cases set at 65. Many studies from the 1980s and 1990s (*e.g. Charlton and Velez* 1986; *Poikolainen and Eskola* 1986; *Mackenback et al*. 1988; *Holand (ed.)* 1991; *Westerling* 1992; *Holland (ed.)* 1993) revealed a faster decrease in avoidable mortality in economically advanced countries than what was recorded in the case of mortality as a whole. This finding was also confirmed in later studies examining the trend in avoidable mortality in countries outside Europe, for instance, in New Zealand, Singapore, and Australia (*Tobias and Jackson* 2001; *Niti and Ng* 2001; *Korda and Butler* 2004). In the case of many avoidable causes of death it was found that mortality declined faster following the introduction of certain forms of health care, such as primary care programmes aimed at monitoring hypertension and serving to prevent cerebrovascular diseases, or regular pap smears (*Westerling* 2001).

Studies of avoidable mortality only began emerging in the eastern European region in the 1990s and were usually fashioned as comparisons between the West and the East (*e.g. Boys, Forster and Józan* 1991; *Velkova, Wolleswinkel-van den Bosch, and Mackenbach* 1997; *Andreev et al*. 2003; *Nolte et al*. 2002; *Newey et al*. 2004). One classic study is a comparative analysis of avoidable mortality in Lithuania and Sweden in 1971–1990 (*Gaizauskiené and Westerling* 1995).

With regard to the application of the concept of avoidable mortality in Czech research, it is necessary to mention the division of avoidable mortality into two basic categories – treatable mortality and preventable mortality (see *Newey et al*. 2004). Treatable mortality refers to causes of death that respond to health intervention in the form of secondary prevention and treatment. These include cervical cancer, hypertension, or appendicitis, and these causes are viewed as indicators of the quality of health care. Conversely, preventable mortality refers to causes that

usually lie outside the control of health services and are mainly affected by primary prevention. These include in particular lung cancer, which can be avoided by not smoking, or liver cirrhosis, which can be avoided by limiting alcohol consumption. Diseases in this category and their prevalence are logically regarded as an indicator of the quality of preventive care.

Data

Using available data sources, especially those published in a publication of the Czech Statistical Office called 'Deaths by a Detailed List of Causes of Death, Sex and Age in the Czech Republic (1919-2005)', for each year between 1990 and 2005 we obtained data on mortality by age, sex, and cause of death and the numbers of deceased were aggregated into the age groups 0, 1-4, 5-9,…, 75+ years. The data refer to the numbers of deaths by cause for each calendar year in the period 1990-1993 and 1994-2006 categorised with the help of the 9th or 10th revised International Statistical Classification of Diseases and Associated Health Problems. We took structurally analogical and temporally corresponding age structures of the population for 1990-2005 from the *Demographic Handbook 2006*. Data relating to deaths and the age structure for 2006 are taken from a publication of the Czech Statistical Office titled *The Demographic Yearbook of the Czech Republic 2006*.

Selected Avoidable Causes of Mortality

In the analysis we used 37 individual causes or cause-of-death categories (Tab. 3) regarded as avoidable according to *Newey et al*. (2004). In conformity with their specifications avoidable causes can be divided into three groups:

1. treatable diseases
2. preventable diseases
3. ischemic heart disease.

With regard to the third category, *Newey et al*. (2004) argue that ischemic heart disease must be studied separately because:

1. the effect of health care on limiting death from this disease is unclear,
2. ischemic heart disease can be viewed as an indicator of health care but also of health policy,
3. many deaths from this disease conceal the effects of health care for diseases other than ischemic heart disease.

For some causes of death (e.g. measles, whooping cough) not a single death was recorded in the statistics for the entire observed period. Nevertheless, we kept these causes in the list in order to preserve the ability to use the results of our analysis in international comparison with countries where deaths from these causes are still recorded.

An important part of applying the avoidable mortality concept involves setting the upper age limit to which it is still possible to think in terms of avoidable mortality. In conformity with most studies on this issue we set the upper age limit at 75 because whether or not a death was avoidable and what exactly the cause of death was become very questionable matters at an older age (*Mackenbach et al*. 1988). In the case of selected causes of deaths and cause-of-death categories Newey and his colleagues selected a different age limit. For example, in the case of intestinal infections, whooping cough, measles, and children's respiratory diseases deaths before the age of 15 were recorded and in the case of leukaemia they analysed deaths of people only up to the age of 45. These causes thus include a different group of diseases for children and for adults, and those deaths from the listed cause that occur at a time other than childhood then reflect the presence of some other disease. A different age limit was also set for diabetes (to age 50), because avoidable mortality from this disease at an older age, and especially the effectiveness of diabetic tests to limit vascular complications remains debatable (*Newey et al*. 2004).

Table 3 List of causes of death/cause-of-death categories by basic avoidable mortality categories, ages 0–74

Cause/group of causes of death	ICD9	ICD10
Treatable diseases		
Intestinal infections	001–009	A00–A09
Tuberculosis	010–018, 137	A15–A19, B90
Other infections (Diphtheria, Tetanus, Poliomyelitis)	032, 037, 045	A36, A35, A80
Whooping cough	033	A37
Septicaemia	038	A40–A41
Measles	055	B05
Malignant neoplasm of colon and rectum	153–154	C18–C21
Malignant neoplasm of skin	173	C44
Malignant neoplasm of breast	174	C50
Malignant neoplasm of cervix uteri	180	C53
Malignant neoplasm of cervix uteri and body of the uterus	179, 182	C54, C55
Malignant neoplasm of testis	186	C62
Hodgkin's disease	201	C81
Leukaemia	204–208	C91–C95
Diseases of the thyroid	240–246	E00–E07
Diabetes mellitus	250	E10–E14
Epilepsy	345	G40–G41
Chronic rheumatic heart disease	393–398	I05–I09
Hypertensive disease	401–405	I10–I13, I15
Cerebrovascular disease	430–438	I60–I69
All respiratory diseases (excl. pneumonia/influenza)	460–479, 488–519	J00–J09, J20–J99
Influenza	487	J10–J11
Pneumonia	480–486	J12–J18
Peptic ulcer	531–533	K25–K27
Appendicitis	540–543	K35–K38
Abdominal hernia	550–553	K40–K46
Cholelithiasis & cholecystitis	574–575.1	K80–K81
Nephritis and nephrosis	580–589	N00–N07, N17–N19, N25–N27
Benign prostatic hyperplasia	600	N40
Maternal deaths	630–676	O00–O99
Congenital cardiovascular anomalies	745–747	Q20–Q28
Perinatal deaths, all causes excluding stillbirths	760–779	P00–P96
Misadventures to patients during surgical and medical care	E870–E876, E878–E879	Y60–Y69, Y83–Y84
Preventable diseases		
Malignant neoplasm of trachea, bronchus, and lung	162	C33–C34
Cirrhosis of liver	571	K70, K73–K74
Motor vehicle accidents	E810–825	V02–V04, V09, V12–V14, V20–V79, V82–V87, V89
Ischemic heart disease		
Ischemic heart disease	410–414	I20–I25

Notes: Causes/groups of causes which we register the definition of different ages (see text):
Intestinal infectious diseases – 0–14
Pertussis – 0–14
Measles – 0–14
Malignant tumor of the uterine body and uterine – 0–44
Diabetes – 0–49
Leukemia – 0–44
Respiratory system diseases (excluding pneumonia and influenza) – 1–14.
Source: Newey et al., 2004.

With regard to the practice of setting age intervals for the study of avoidable mortality it is interesting that no author has yet taken into account the differences in mortality or specifically in the life expectancy at birth of females and males. In this context the logical thing would be to raise the age limit for females in the analysis of avoidable mortality by five years, that is, around the number of years that make up the difference between male and female life expectancy at birth in advanced countries. However, in the study at hand we deliberately chose not to make this innovation in order to preserve the comparability of the results with results from other, similar studies. Nevertheless, we do plan to make this adjustment in future research.

Indicators

We observed the trend in avoidable mortality in each of the three above-mentioned cause-of-death categories separately for males and females, and did so using standardised mortality rates. We chose the European Standard Population for this purpose (*Doll and Cook* 1966).

Given the mentioned need to limit the analysis of avoidable mortality to the 0–74 age interval we constructed abridged life tables for the exact ages between 0 and 75. Total mortality intensity in this and generally in analogically defined age intervals is characterised by an indicator that Anglo-Saxon literature calls 'temporary life expectancy' and often also 'partial life expectancy', specifically from birth to age 75 (ie_{0-75}). As with other table functions this one is calculated separately for males and females and it is defined as the average number of person-years lived in the given age interval per person just born, assuming that throughout the duration of that person's life the mortality schedule of the given life table remains unchanged. According to this definition then:

$$ie_{0-75} = (T_0 - T_{75}) / 1_0$$

where T_0 and T_{75} is the total number of person-years lived after the exact age of 0 or 75 years, and 1_0 represents the radix of the table.

Using the method of two-dimensional composition (*Arriaga* 1984) we drew on the calculated values of the relevant temporary life expectancies to describe the contribution of the listed avoidable cause-of-death categories to the differences of ie_{0-75} between 1990 and 2006 separately for males and females.

Based on the values calculated for the noted indicators, the temporary life expectancies and the contribution (shares) of individual cause-of-death categories we can fulfil two basic objectives of this study:

– to describe the trend in mortality (distinguishing between unavoidable and avoidable mortality, subsequently broken down into treatable mortality, preventable mortality, and ischemic heart disease) by sex and age in the period between 1990 and 2006,
– to estimate the contribution of the listed categories to the change in temporary life expectancy between 1990 and 2006.

Findings

Between 1990 and 2006 among males there was a decline in the number of deaths that constituted avoidable mortality by roughly 10 200, which signifies a decrease in the share of this component in total mortality from 63.0% in 1990 to 52.2% in 2006. A similar trend was observed among females: the number of deaths in the observed period decreased by approximately 5400. This led to a decrease in the share of avoidable mortality from the original 60.0% to 51.3%, which means that, like in the case of males, the share of avoidable and unavoidable mortality in the total number of deaths almost evened out.

In terms of the internal structure of avoidable mortality, the reduction in the number of deaths from ischemic heart disease, which contributed to approximately one-half (5600

Table 4 Deaths according to basic cause-of-death categories, by sex (ages 0–74), CR, 1990–2006

Category	Number of deaths			Proportion of total deaths (%)		
	1990	1998	2006	1990	1998	2006
	Males					
Treatable mortality	8 578	6 425	5 403	20.9	18.5	17.9
Preventable mortality	6 354	5 203	4 896	15.5	15.0	16.3
Ischemic heart disease	10 969	7 572	5 409	26.7	21.9	18.0
Avoidable mortality	25 901	19 200	15 708	63.0	55.4	52.2
Unavoidable mortality	15 213	15 448	14 402	37.0	44.6	47.8
Total mortality	41 114	34 648	30 110	100.0	100.0	100.0
	Females					
Treatable mortality	7 840	6 206	4 681	33.8	30.6	28.3
Preventable mortality	1 260	1 406	1 614	5.4	6.9	9.8
Ischemic heart disease	4 835	3 590	2 193	20.8	17.7	13.2
Avoidable mortality	13 935	11 202	8 488	60.0	55.2	51.3
Unavoidable mortality	9 272	9 109	8 063	40.0	44.8	48.7
Total mortality	23 207	20 311	16 551	100.0	100.0	100.0

deaths) of the decrease in the number of deaths, contributed most to the decline in the number and share of avoidable deaths among males. The observed trend led to a decrease in the share of deaths from this cause out of the total number of deaths by 8.7 percentage points, from 26.7% in 1990 to 18.0% in 2006. There was also a significant reduction in the number of deaths from treatable diseases, primarily owing to the decrease in cerebrovascular diseases. The decrease in the number of deaths in this category by 3200 also represented a decrease in its share in total mortality from 20.9% in 1990 to 17.9% in 2006. There was a smaller reduction in the number of deaths from preventable causes (1500 cases), while a full two-thirds of this figure was ascribable to the decrease in the number of deaths from malignant neoplasm of trachea, bronchus, and lung. As a result there occurred a slight increase in the share of deaths in this category of causes out of total mortality, when it increased from 15.5% in 1990 to 16.3% in 2006. The shifts in the structure of avoidable mortality that occurred during the observed period signalise that the effectiveness of prevention is somewhat lagging behind the effectiveness of the treatment process, and this trend is somewhat more apparent among females than males.

Unlike males, among females treatable diseases contributed most to the overall decrease in their number of deaths from avoidable causes. In 2006, 3200 fewer people died from these diseases than in 1990, which, considering the trend in mortality connected with other groups of diseases, signified a reduction in the share of treatable mortality out of total mortality by 5.5 percentage points (from 33.8% to 28.3%). Out of the absolute decrease, a full two thousand fewer deaths were due to cerebrovascular diseases. Ischemic heart disease, which is a separate category in our research, showed a decline of approximately 2600 deaths during the observed period, which ultimately led to a substantial decrease in the share of this cause in total mortality by 7.6 percentage points from 20.8% in 1990 to 13.2% in 2006. The only divergence from this in every respect clearly positive trend in mortality among females was causes of death in the category of preventable mortality. The number of deaths that were in the preventable category in the population of females did not decrease in the observed people but rather increased by 350 cases. This occurred mainly owing to the rise in the number of deaths from malignant neoplasm of trachea, bronchus, and lung in connection with the growing number of females smokers. However, given the significant decrease in the number of deaths in the other categories this increase of 350 deaths signified then an increase in the

Table 5 Standardised mortality rate by sex and cause-of-death category (ages 0–74); per 100 thous. inhabitants; European Standard Population, CR, 1990–2006

Year	Treatable mortality		Preventable mortality		Ischemic heart disease		Avoidable mortality		Unavoidable mortality		Total mortality
	Intensity	Share[1] (%)	Intensity	Share[1] (%)	Intensity	Share[1] (%)	Intensity	Share[2] (%)	Intensity	Share[2] (%)	Intensity
	Males										
1990	197.8	33.6	140.5	23.9	250.7	42.6	589.0	63.5	339.2	36.5	928.2
1991	182.1	33.1	136.1	24.7	232.3	42.2	550.5	63.3	319.1	36.7	869.5
1992	171.6	32.2	135.1	25.4	226.2	42.4	532.9	62.8	316.3	37.2	849.2
1993	161.5	32.2	127.8	25.5	212.4	42.3	501.7	62.6	300.2	37.4	802.0
1994	155.1	32.9	113.5	24.1	203.3	43.1	471.9	59.7	318.5	40.3	790.4
1995	150.7	32.8	114.0	24.8	195.0	42.4	459.6	59.1	317.9	40.9	777.5
1996	142.6	33.0	109.3	25.3	180.3	41.7	432.1	57.8	315.0	42.2	747.1
1997	132.7	32.8	109.1	27.0	163.1	40.3	404.9	55.1	330.1	44.9	735.0
1998	130.4	33.8	104.2	27.0	151.7	39.3	386.4	55.7	307.0	44.3	693.4
1999	128.3	33.0	113.5	29.2	146.9	37.8	388.7	57.5	287.4	42.5	676.1
2000	128.8	34.3	111.0	29.6	135.7	36.1	375.5	56.6	287.9	43.4	663.4
2001	118.9	33.6	106.7	30.1	128.5	36.3	354.1	55.6	282.5	44.4	636.6
2002	120.7	35.2	103.3	30.1	119.3	34.7	343.3	54.2	289.7	45.8	633.0
2003	119.3	35.7	102.2	30.6	113.0	33.8	334.5	52.9	298.2	47.1	632.7
2004	112.9	35.5	99.5	31.3	106.0	33.3	318.4	52.4	289.1	47.6	607.5
2005	107.3	34.9	97.0	31.6	103.2	33.6	307.6	52.4	279.6	47.6	587.2
2006	102.3	35.0	89.9	30.8	100.1	34.2	292.3	52.2	267.2	47.8	559.4
	Females										
1990	144.1	57.1	23.3	9.2	85.1	33.7	252.5	59.9	169.2	40.1	421.7
1991	137.8	56.1	25.3	10.3	82.5	33.6	245.5	60.5	160.0	39.5	405.5
1992	129.3	56.1	26.3	11.4	74.8	32.5	230.4	59.5	156.9	40.5	387.3
1993	126.6	56.1	23.8	10.6	75.0	33.3	225.4	59.6	153.0	40.4	378.4
1994	118.7	55.7	22.0	10.3	72.3	33.9	213.0	57.5	157.5	42.5	370.5
1995	117.0	55.2	23.5	11.1	71.4	33.7	211.9	57.3	158.0	42.7	369.9
1996	106.7	54.4	22.9	11.7	66.5	33.9	196.0	56.6	150.4	43.4	346.5
1997	103.9	55.3	23.3	12.4	60.5	32.2	187.7	54.7	155.7	45.3	343.4
1998	100.0	56.6	23.8	13.5	52.9	29.9	176.7	54.6	146.8	45.4	323.6
1999	97.9	55.6	26.4	15.0	51.8	29.4	176.0	55.3	142.3	44.7	318.3
2000	94.9	55.8	27.7	16.3	47.6	28.0	170.2	55.1	138.6	44.9	308.8
2001	92.8	56.3	27.1	16.4	45.1	27.3	165.0	54.2	139.2	45.8	304.2
2002	90.8	56.3	27.4	17.0	43.2	26.8	161.3	54.4	135.0	45.6	296.3
2003	88.2	56.4	27.8	17.8	40.4	25.8	156.4	52.7	140.3	47.3	296.7
2004	82.6	56.6	26.8	18.4	36.5	25.0	145.9	52.1	134.1	47.9	280.0
2005	79.2	55.5	26.9	18.8	36.6	25.7	142.7	51.3	135.2	48.7	277.9
2006	74.9	55.8	26.3	19.6	33.0	24.6	134.2	51.0	129.0	49.0	263.3

Note: [1] Proportion of avoidable mortality.
[2] Proportion of total mortality.

share of deaths caused by preventable diseases out of the total number of deaths from 5.4% in 1990 to 9.8% in 2006.

If we look at the trend in mortality using standardised mortality rates we find that the overall mortality intensity of males in the period between 1990 and 2006 decreased from 928.2 to 559.4 deaths per 100 000 average male population, which represents a decline to a level equal to 60.3% of the initial level in 1990. Among females, the same indicator fell during the ob-

served period to 62.4% of its original level in 1990, when the standardised mortality rate decreased from 421.7 to 263.3 deaths per 100 000 average female population. The positive trend in overall mortality was mainly the result of a decrease in the intensity of mortality from avoidable causes of death. Avoidable mortality among males decreased from 589.0 to 292.3 deaths per 100 000 average male population and thus fell to a level equal to just 49.6% of the original level. Among females a comparable change occurred, when the standardised mortality rate decreased from 252.5 to 134.2 deaths per 100 000 average female population, which signifies a decrease to 53.2% of the original intensity of mortality from avoidable diseases.

In the case of unavoidable mortality, among males a decrease in intensity of 21.3% (from 339.2 to 267.2 deaths per 100 000 males) was recorded, which is a somewhat lower decrease than what was recorded among females. In the case of females unavoidable mortality decreased by 23.7% (from 169.2 to 129.0 deaths per 100 000 females).

The result of the differentiated trend in mortality in both categories of mortality was a significant change in the share of avoidable and unavoidable mortality causes out of the overall mortality intensity – among males the ratio changed from approximately 64 : 36 in 1990 to 52 : 48 in 2006 and among females from 60 : 40 to 51 : 49.

With regard to the intensity of mortality in individual categories of avoidable mortality (treatable mortality, preventable mortality, ischemic heart disease) by sex we find that it was even during the observed period. Yet from the perspective of the total reduction in avoidable mortality the biggest influence for both males and females was the decline in mortality from ischemic heart disease, the intensity of which in 2006 was approximately 40% of the initial intensity in 1990. The standardised mortality rate from this cause decreased in the observed period among males from 250.7 deaths per 100 000 average male population in 1990 to 100.1 deaths in 2006 and among females an analogical decrease was observed in this indicator from 85.1 to 33.0 deaths.

Mortality in the relatively broadly defined cause-of-death category encompassing treatable diseases also decreased in the observed period by around the same rate for both males and females. The initial standardised mortality rate decreased by around 50%, which was a decrease from 197.8 to 102.3 deaths per 100 000 males and from 144.1 to 74.9 deaths per 100 000 females. In this cause-of-death category mortality became strongly concentrated in the top three most significant causes of death for both males and females. For example, among males the top three most common diseases causing death (cerebrovascular diseases, colorectal neoplasms, and pneumonias accounted for three-quarters of overall mortality in 2006. Among females the concentration of mortality in the top three causes of death was just slightly milder, with cerebrovascular diseases, colorectal neoplasms, and pneumonias accounting for almost 70% of the total intensity of treatable causes of death in 2006.

The cause-of-death category that can be influenced by primary prevention (malignant neoplasm of trachea, bronchus, and lung, cirrhosis of liver, and motor vehicle accidents) exhibited some significantly specific features compared to the observed trend. In the case of males we observed the least dynamic but still very significant decrease in overall mortality intensity in the case of these diseases, where the standardised mortality rate decreased between 1990 and 2006 from 140.5 to 89.9 deaths per 100 000 males, that is, to 64% of the level in 1990. Conversely, among females, under the same conditions and in the same time frame it increased by a full 13%, as the standardised mortality rate rose from 23.3 to 26.3 deaths per 100 000 average female population. Even if we take into account the relatively low initial rate of this indicator and the greater tendency towards randomness in the trend, this is unquestionably a significant shift and especially a significant trend. The most likely reason for this shift is the unhealthy lifestyle that is still prevalent among a large part of the Czech population (the large number of smokers and heavy alcohol consumption), which under the influence of socio-cultural behavioural patterns still widespread in the recent past females avoided more of-

Table 6 Standardised mortality rate by sex and cause of death/category of avoidable cause of death (ages 0–74; per 100 thous. inhabitants; European Standard Population), CR, 1990–2006 (selected years)

Cause/group of causes of death	Males			Females		
	1990	1998	2006	1990	1998	2006
Intestinal infections	0.1	0.0	0.0	0.2	0.0	0.0
Tuberculosis	2.0	1.1	0.5	0.5	0.3	0.2
Other infections (Diphtheria. Tetanus. Poliomyelitis)	0.0	0.0	0.0	0.0	0.0	0.0
Whooping cough	0.0	0.0	0.0	0.0	0.0	0.0
Septicaemia	0.5	0.4	1.6	0.6	0.3	0.8
Measles	0.0	0.0	0.0	0.0	0.0	0.0
Malignant neoplasm of colon and rectum	33.3	33.3	27.8	16.6	15.5	12.5
Malignant neoplasm of skin	0.6	0.5	0.6	0.4	0.2	0.2
Malignant neoplasm of breast	x	x	x	23.7	21.5	17.9
Malignant neoplasm of cervix uteri	x	x	x	5.6	5.2	4.6
Malignant neoplasm of cervix uteri and body of the uterus	x	x	x	0.4	0.2	0.2
Malignant neoplasm of testis	1.1	1.0	0.5	x	x	x
Hodgkin's disease	1.6	0.9	0.4	0.9	0.5	0.3
Leukaemia	1.8	1.0	0.6	1.3	0.7	0.4
Diseases of the thyroid	0.0	0.0	0.0	0.1	0.0	0.1
Diabetes mellitus	1.1	0.5	0.5	0.6	0.3	0.2
Epilepsy	1.9	1.6	1.7	1.1	0.7	0.7
Chronic rheumatic heart disease	5.6	1.8	0.5	5.6	1.8	0.4
Hypertensive disease	4.3	4.6	5.3	2.8	2.5	2.9
Cerebrovascular disease	100.0	57.0	37.1	59.6	34.7	20.3
All respiratory diseases (excl. pneumonia/influenza)	0.1	0.1	0.1	0.1	0.1	0.1
Influenza	0.4	0.1	0.1	0.2	0.1	0.0
Pneumonia	10.3	10.5	10.8	4.4	4.7	4.5
Peptic ulcer	6.6	3.7	3.5	1.6	1.1	1.4
Appendicitis	0.5	0.2	0.1	0.2	0.1	0.1
Abdominal hernia	0.5	0.4	0.3	0.8	0.1	0.3
Cholelithiasis & cholecystitis	1.9	0.6	0.5	1.9	0.7	0.4
Nephritis and nephrosis	7.4	4.6	5.0	4.8	3.6	3.1
Benign prostatic hyperplasia	1.9	0.1	0.2	0.0	0.0	0.0
Maternal deaths	x	x	x	0.2	0.1	0.2
Congenital cardiovascular anomalies	2.7	1.5	0.8	1.9	1.4	0.4
Perinatal deaths. all causes excluding stillbirths	11.5	4.8	3.5	7.8	3.6	2.8
Misadventures to patients during surgical and medical care	0.0	0.0	0.2	0.0	0.0	0.0
Treatable mortality	**197.8**	**130.4**	**102.3**	**144.1**	**100.0**	**74.9**
Malignant neoplasm of trachea. bronchus. and lung	91.8	70.7	55.7	10.5	13.0	15.2
Cirrhosis of liver	31.1	23.4	22.2	7.9	7.9	7.7
Motor vehicle accidents	17.6	10.2	11.9	4.9	2.9	3.4
Preventable mortality	**140.5**	**104.2**	**89.9**	**23.3**	**23.8**	**26.3**
Ischemic heart disease	**250.7**	**151.7**	**100.1**	**85.1**	**52.9**	**33.0**
Avoidable mortality	**589.0**	**386.4**	**292.3**	**252.5**	**176.7**	**134.2**

ten than they do today. Changes in the structure of the intensity of avoidable mortality in the case of males resulted in relatively equal rates of mortality in the individual cause-of-death categories in the avoidable mortality category. In 2006, treatable diseases accounted for 35.0%, preventable diseases for 30.8%, and ischemic hearth disease for 34.2% of the total intensity of mortality from avoidable causes of death. Among females, despite a decline treatable diseases still accounted for more than one-half the total intensity of mortality from

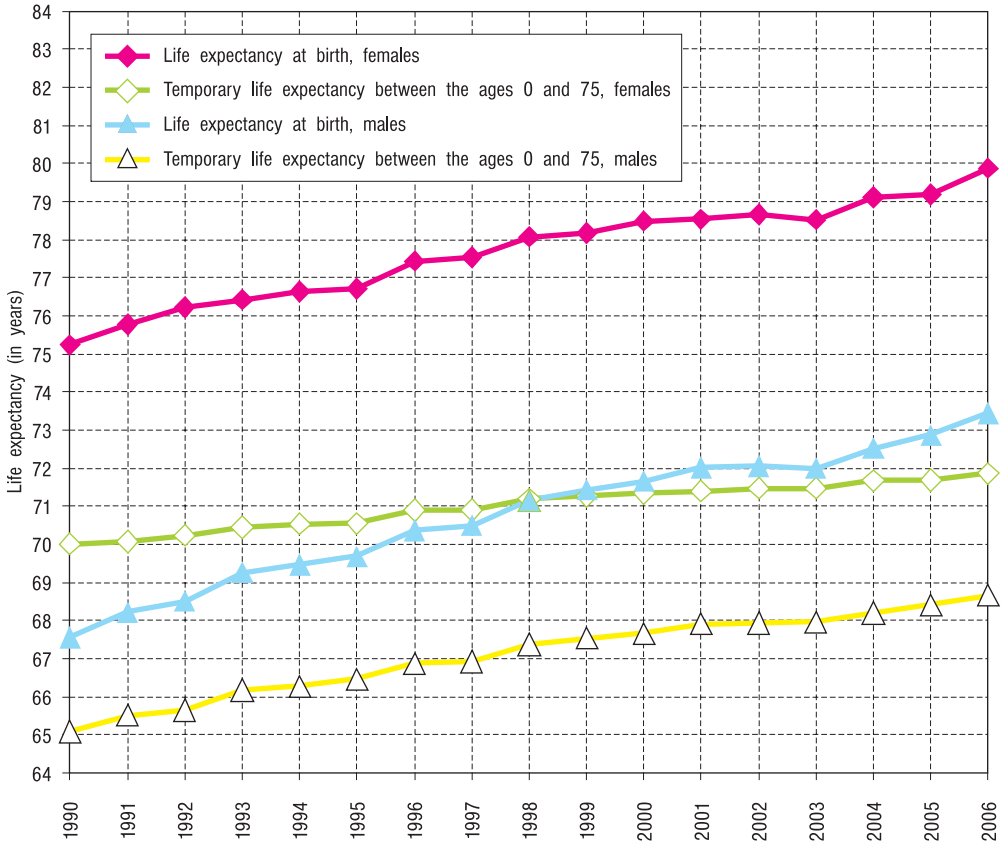
Table 7 Contributions of age groups and cause-of-death categories of the change in temporary life expectancy (ages 0–74) between 1990 and 2006, CR

Year	Treatable mortality		Preventable mortality		Ischemic heart disease		Avoidable mortality		Unavoidable mortality		**Total mortality**	
	Numbers	Per cent	Numbers	Per cent	Numbers	Per cent	Numbers	Per cent	Numbers	**Per cent**	**Numbers**	Per cent
	Males											
0	0.42	11.7	0.00	0.1	0.00	0.0	0.42	11.8	0.16	**4.5**	**0.58**	16.3
1–4	0.02	0.5	0.00	0.1	0.00	0.0	0.02	0.7	0.04	**1.0**	**0.06**	1.7
5–9	0.01	0.2	0.01	0.3	0.00	0.0	0.02	0.5	0.02	**0.5**	**0.04**	1.0
10–14	0.01	0.3	0.00	0.0	0.00	0.0	0.01	0.2	0.01	**0.4**	**0.02**	0.6
15–19	0.02	0.4	0.01	0.3	0.00	0.0	0.03	0.7	0.02	**0.4**	**0.04**	1.2
20–24	0.01	0.2	0.01	0.3	0.00	0.0	0.02	0.6	0.06	**1.7**	**0.08**	2.2
25–29	0.02	0.5	0.02	0.5	0.00	0.1	0.04	1.0	0.05	**1.5**	**0.09**	2.5
30–34	0.02	0.5	0.01	0.4	0.02	0.5	0.05	1.4	0.07	**1.8**	**0.12**	3.3
35–39	0.03	0.9	0.03	0.9	0.04	1.0	0.10	2.8	0.09	**2.6**	**0.19**	5.3
40–44	0.05	1.3	0.07	1.8	0.08	2.2	0.19	5.3	0.07	**2.0**	**0.26**	7.4
45–49	0.07	1.9	0.08	2.2	0.13	3.5	0.27	7.6	0.06	**1.8**	**0.34**	9.4
50–54	0.08	2.1	0.10	2.7	0.17	4.7	0.34	9.6	0.04	**1.1**	**0.38**	10.6
55–59	0.09	2.5	0.09	2.5	0.20	5.5	0.38	10.5	0.06	**1.6**	**0.43**	12.1
60–64	0.11	3.0	0.06	1.5	0.22	6.1	0.38	10.7	0.06	**1.7**	**0.44**	12.4
65–69	0.09	2.5	0.04	1.2	0.18	4.9	0.31	8.6	0.07	**2.0**	**0.38**	10.5
70–74	0.04	1.1	0.01	0.2	0.06	1.5	0.10	2.9	0.03	**0.7**	**0.13**	3.6
Total	1.06	29.7	0.53	14.9	1.08	30.2	2.68	74.9	0.90	**25.1**	**3.58**	100.0
	Females											
0	0.30	16.3	0.00	–0.1	0.00	0.0	0.30	16.3	0.16	**8.7**	**0.46**	25.0
1–4	0.02	1.0	0.00	0.2	0.00	0.0	0.02	1.2	0.03	**1.6**	**0.05**	2.8
5–9	0.01	0.7	0.01	0.3	0.00	0.0	0.02	1.0	0.01	**0.6**	**0.03**	1.6
10–14	0.01	0.7	0.00	0.0	0.00	0.0	0.01	0.7	0.02	**0.8**	**0.03**	1.5
15–19	0.01	0.5	0.02	1.0	0.00	0.0	0.03	1.6	0.03	**1.5**	**0.06**	3.1
20–24	0.01	0.6	0.00	0.2	0.00	0.0	0.02	0.8	0.01	**0.5**	**0.02**	1.3
25–29	0.01	0.8	0.00	–0.2	0.00	0.0	0.01	0.7	0.02	**1.0**	**0.03**	1.7
30–34	0.02	1.1	0.00	0.0	0.00	0.0	0.02	1.2	0.04	**2.0**	**0.06**	3.2
35–39	0.02	1.3	0.00	0.0	0.00	0.2	0.03	1.5	0.03	**1.5**	**0.06**	3.0
40–44	0.03	1.8	0.01	0.3	0.01	0.5	0.05	2.6	0.03	**1.4**	**0.07**	4.0
45–49	0.05	2.7	0.00	0.1	0.02	1.1	0.07	3.9	0.03	**1.8**	**0.11**	5.7
50–54	0.07	3.6	–0.01	–0.7	0.04	2.0	0.09	4.9	0.03	**1.5**	**0.12**	6.4
55–59	0.08	4.3	–0.01	–0.7	0.07	3.8	0.14	7.4	0.04	**2.3**	**0.18**	9.7
60–64	0.09	5.1	–0.01	–0.6	0.09	4.9	0.17	9.3	0.04	**2.3**	**0.21**	11.6
65–69	0.10	5.5	–0.01	–0.4	0.10	5.2	0.19	10.4	0.07	**3.6**	**0.26**	13.9
70–74	0.04	2.1	0.00	0.0	0.04	2.2	0.08	4.3	0.02	**1.0**	**0.10**	5.3
Total	0.89	48.3	–0.01	–0.5	0.37	20.1	1.26	67.9	0.59	**32.1**	**1.85**	100.0

avoidable causes of death, but the share of preventable diseases increased. Thus treatable diseases accounted for 55.8% of the total intensity of avoidable mortality, preventable diseases for 19.6%, and ischemic heart disease for 24.6%.

To assess the role of analysed cause-of-death categories in the change in life expectancy in the 0–74 age interval we first calculated temporary life expectancy between the exact ages of 0 and 75 for the period 1990-2006 and then using the method of two-dimensional decomposition we determined the specific contribution of each category to the change in temporary life expectancy between the years 1990 and 2006. Life expectancy in the 0–74 age interval increased significantly for both males and females: it reached 68.7 years for males in 2006

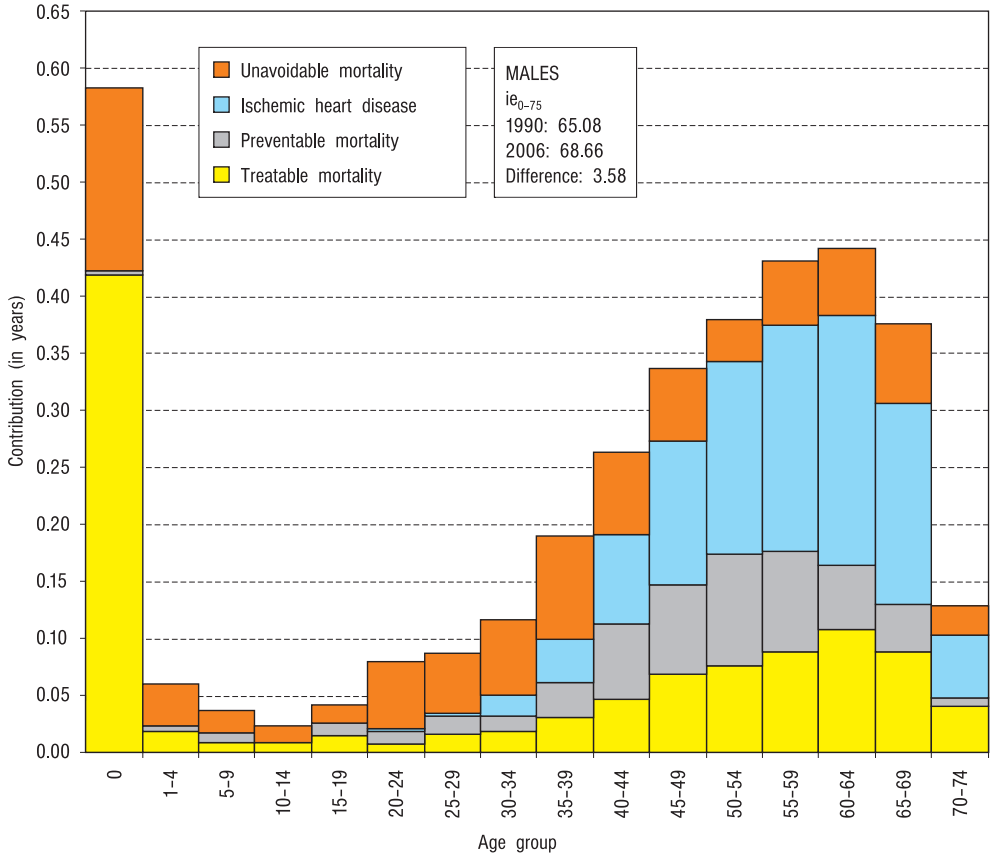
Figure 1 Life expectancy at birth and temporary life expectancy between the ages of 0 and 75, by sex, CR, 1990–2006



compared to 65.1 years in 1990 and grew gradually from 70.0 to 71.9 years for females. The increase in temporary life expectancy compared to life expectancy at birth was proportionally slower for females than males (1.9 : 4.6 and 3.6 : 5.9, respectively) owing to the above-mentioned higher modal age of deceased females. The disproportion observed in the dynamics of development would undoubtedly experience a significant decrease if we were to use a higher upper interval limit for females to calculate temporary life expectancy (see the discussion on this issue above).

Avoidable mortality contributed to the rise in average life expectancy in the 0–74 age interval in 1990–2006, which was 3.6 years for males and 1.9 years for females, by 2.7 years for males and 1.3 years for females, which in relative terms represents shares of 75% and 68%, respectively. Among both males and females this contribution occurred in the category of infants and people over the age of 35, which corresponds to the distribution of the intensity of mortality from causes belonging to the given category by age. In avoidable mortality approximately 40% of the increase in period life expectancy between the ages of 0 and 75 among males stemmed from treatable mortality and ischemic hearth disease (both contributed around 1.1 years in absolute terms) and 20% stemmed from the category of preventable causes (0.5 years). Among females, mortality from treatable causes contributed 0.9 years to the total decrease in the 0–74 age interval, which represents approximately 70% of the total change, and

Figure 2a Contributions of mortality category and age group to the change in temporary life expectancy (ages 0–74) between 1990 and 2006, CR, males



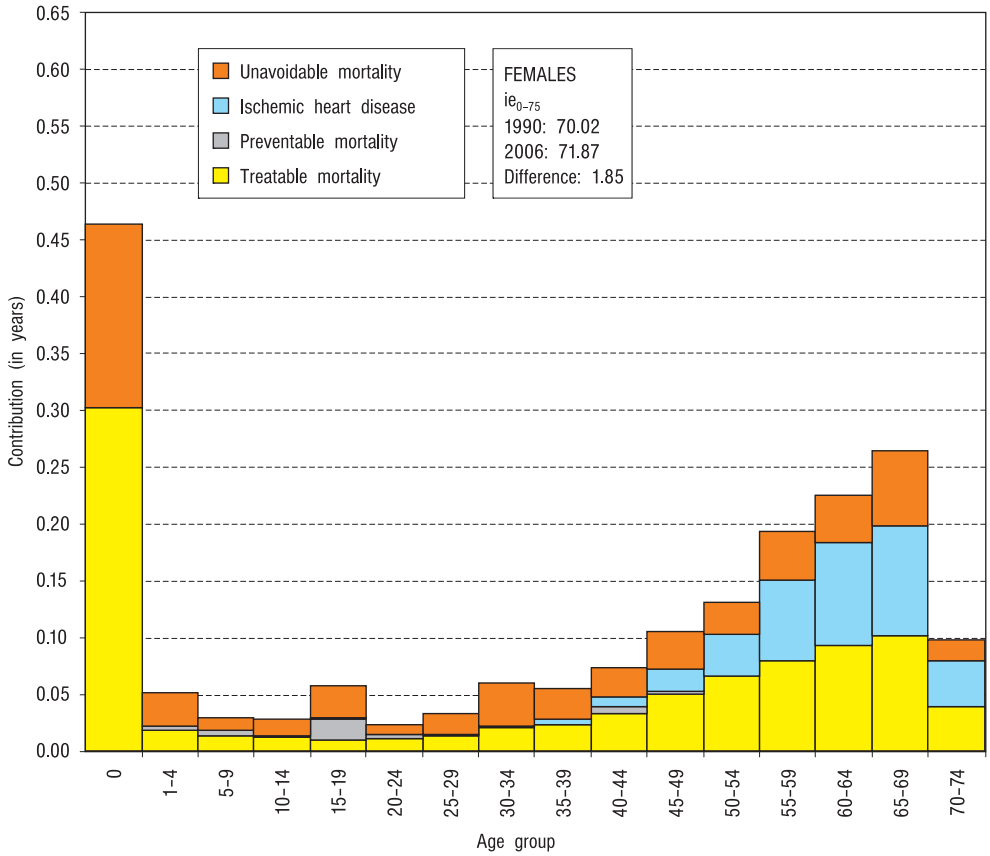
ischemic heart disease contributed 0.4 years representing around 30% of the change. In the case of treatable diseases the contribution was concentrated in the age groups of infants and people aged 40 and over (90% of the contribution to this group of causes). Conversely, the decline in mortality from ischemic heart disease among females occurred almost entirely in the age group over 40. Mortality influenced by prevention did not contribute to the increase in life expectancy of females in the Czech Republic, mainly owing to the increase in the intensity of mortality from malignant neoplasm of trachea, bronchus, and lung.

Conclusion

Between 1990 and 2006 we observed a decline in the intensity of avoidably mortality among males in the Czech Republic by almost 40% and among females by almost 38% and a decrease in the intensity of unavoidable mortality by 21% and 24%, respectively.

Given that in 1990 avoidable mortality accounted for 63.5% of the total mortality intensity among males and 59.9% among females, the decrease in avoidable mortality can be regarded as significant. The observed decline in this intensity moreover contributed very significantly (among males 75% and among females 68%) to the total increase in average life expectancy expressed as temporary life expectancy between the ages of 0 and 75. The rates confirm be-

Figure 2b Contributions of mortality category and age group to the change in temporary life expectancy (ages 0–74) between 1990 and 2006, CR, females



yond any doubt the fundamental role of the transforming health system in the improvement of the health and the decline in mortality of the population of the Czech Republic.

Our study of the issue does not end with these findings. In the current stage of research[1)] we are focusing attention on determining where the Czech Republic stands in terms of how effective its medical care is compared to other transition countries and compared to those countries with the best mortality indicators. Currently we are preparing to apply the concept of avoidable mortality to identify possible regional disproportions in the effectiveness of its health care.

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