Cancer Incidence and Mortality in the Czech Republic

Incidence a mortalita nádorových onemocnění v České republice

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Summary

Backgrounds: The Czech Republic is ranked among those countries with the highest cancer burden in Europe and worldwide. The purpose of this study is to summarize long-term trends in the cancer burden and to provide up-to-date estimates of incidence and mortality rates from 2007. ***Material and Methods:*** The Czech National Cancer Registry (CNCR) was instituted in 1977 and contains information over a 30-year period of standardized registration covering 100% of cancer diagnoses and the entire Czech population. The analysis of CNCR is supported by demographic data of the Czech Republic and by the Death Records Database as civil registration systems. The epidemiology of malignant tumours in the Czech population is available online at www.svod.cz. ***Results:*** All neoplasms, including non-melanoma skin cancer, reached a crude incidence rate of almost 736 cases per 100,000 men and 648 cases per 100,000 women in 2007. The annual mortality rate exceeded 263 deaths per 100,000 population; each year, more than 27,000 persons die of cancer. The overall incidence of malignancies has increased during the last decade with growth index + 26.4% (1997–2007) while the mortality rate has stabilized over this time span (growth index in 1977–2007: –2.5%). Consequently, the prevalence has significantly increased in the registration period and in 2007 it exceeded 400,000 cases. In addition to the demographic ageing of the Czech population, the cancer burden is increased by the growing incidence of multiple primary tumours (recently more than 11% of the total incidence). The most frequent diagnoses include colorectal cancer, lung cancer, breast cancer and prostate cancer. Although some neoplasms are increasingly diagnosed at an early stage (e.g. proportion of stage I + II in female breast cancer: 71.9%, skin melanoma: 81.3%), in general early diagnostics is insufficient in the Czech Republic. This is the case even for highly prevalent colorectal carcinoma (only 43.2% of incident cases recently diagnosed at stage I or II). ***Conclusion:*** The Czech Republic is well equipped with high-quality and functional facilities for collecting and analysing population-based data on malignant tumours. The data survey has enabled the priorities of cancer management in the Czech Republic to be defined. This will undoubtedly lead to a sustained reduction in late diagnosed cases and a reduction in the remarkable regional differences in diagnostic efficiency.

Key words

cancer epidemiology – incidence – mortality – Czech Republic

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Souhrn

Východiska: Česká republika patří mezi onkologicky nejzatíženější státy v evropském i celosvětovém měřítku. Cílem této studie je shrnout dlouhodobé trendy v epidemiologii nádorů, včetně nových odhadů incidence a mortality za rok 2007. ***Materiál a metody:*** Český národní onkologický registr (NOR) byl založen v roce 1977 a zpřístupňuje informace o epidemiologii nádorů za 30 let při 100% pokrytí onkologických diagnóz a české populace. Analýza epidemiologie nádorů se dále opírá o demografická data a o data Registru zemřelých ČR. Epidemiologická data jsou dostupná on-line na portálu www.svod.cz. ***Výsledky.*** Hrubá incidence zhoubných nádorů (včetně jiných nádorů kůže) dosáhla v roce 2007 hodnoty 736/100 000 mužů a 648/100 000 žen. Roční hrubá mortalita přesáhla 263 úmrtí /100 000 obyvatel; každoročně umírá z příčiny zhoubného nádoru více než 27 000 osob. Celková incidence nádorových onemocnění setrvale roste, růstový index dosáhl za období 1997–2007 hodnoty + 26,4 %. Naopak mortalita je ve stejném období stabilizována (růstový index – 2,5 %). Důsledkem rostoucí incidence a stabilizované mortality je růst prevalence, která v roce 2007 přesáhla 400 000 osob. K růstu populační zátěže přispívá kromě demografického stárnutí populace také rostoucí incidence vícečetných primárních nádorů u téhož pacienta (v recentním období více než 11 % z celkové incidence). Mezi nejčastější malignity české populace patří nádory kolorekta, prsu, plic a prostaty. Ačkoli je řada onkologických diagnóz stale častěji zachytávána v méně pokročilých stadiích (např. stadium I + II u nádorů prsu: 71,9 %, u zhoubného melanomu: 81,3 %), celkově je včasná diagnostika zhoubných v ČR nedostatečná. To se týká i velmi častých typů nádorových onemocnění, jako je kolorektální karcinom (pouze 43,2 % nově diagnostikovaných pacientů ve stadiu I + II). ***Závěr:*** Česká republika je vybavena kvalitním a funkčním zázemím pro sběr a analýzu onkologických populačních dat. Dostupná data napomáhají definovat priority organizace onkologické péče, kterými jsou jednoznačně posílení záchytu časných stadií onkologických onemocnění a redukce existujících rozdílů mezi regiony ČR.

Klíčová slova

epidemiologie nádorových onemocnění – incidence – mortalita – Česká republika

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Backgrounds

Cancer epidemiology is of an ever growing importance due to the high incidence rates of malignant tumors [1,2]. In recent years, several comprehensive worldwide and European summaries of cancer incidence and prevalence have been published [3–5]. These reports are unambiguous data-based evidence of a rapid increase of cancer incidence in most of European countries. According to Ferlay et al [5] there were 3,191,000 diagnosed cancer cases (excluding nonmelanoma skin cancer) and 1,703,000 deaths from cancer in Europe in 2006. The same authors concluded that the total number of new cases of cancer in Europe appears to have increased by 300,000 since 2004. Therefore, the cancer is an important public health problem in Europe with only partially effective measures how to diminish the continuous growth of burden. The Czech Republic represents no exception in this respect; quite the opposite, the Czech population ranks among the most burdened countries worldwide [6].

The current role of epidemiology is not purely descriptive. Knowledge on age-specific or stage-specific trends is necessary to evaluate effectiveness of diagnostic processes, to identify weak points in the management of cancer care or to analyze associations with therapeutic outcomes [7]. Among all health care end-points of population-based cancer registries, survival occupies dominant position. Recently, a series of excellent articles summarizing cancer-related survival in European countries has been published [8–11]. Although significant improvement in reached survival rates have been reported for most of the European countries, there are still apparent regional differences, mostly associated with late diagnosis of advanced disease stage and with more o less specific care disparities. Based on current epidemiological trends, it seems that promising modern research technologies and onset of personalized medicine have not yet been effectively translated into cancer control. Epidemiologic data can thus strategically contribute to the management of this field of medicine [12].

Relevant epidemiologic analyses supporting control and planning of cancer prevention, diagnostics and therapy require population data rich in available parameters. Particularly records identifying morphology and clinical stage of tumors are important. Such clinical registries enable monitoring of early detection of cancer which is currently major area of interest in Europe [13], closely related to survival of cancer patients. Cancer population registries form an indispensable component of functional information systems for monitoring of organized screening programmes [14].

However, not all national cancer registries can provide such complex information and therefore many epidemiologic summaries covering large geographic areas cannot address the health care topics adequately. International epidemiologic surveys also often suffer from partially inconsistent data from participating countries or from interruption in time as it was the case of the Europe Against Cancer Programme of the European Commission [15]. Therefore separate processing of national databases leading to extraction of clinically relevant knowledge is still of a great value. That is why we prepared this overview of recent cancer epidemiology in the Czech Republic. This article presents cancer incidence and mortality in the Czech po-

pulation, utilizing more than 30 years experience with nationwide cancer data collection. Up-to-date estimates of incidence and mortality rates from period 2006–2007 are presented in the context of long-term trends. We take not only general descriptive approach, detailed stage-specific trends and regional differences are discussed as well.

Data sources and methods

Demographic data

As a standard part of population monitoring, the Czech Statistical Office administrates data on the demographic structure of the Czech population and makes it available on its website [16,17]. This fully consolidated data source describes the main demographic characteristics of the Czech population, such as the total population, the age structure, life expectancy, as well as predictions up to 2050. Basic demographic characteristics of the Czech population are summarized in Tab. 1.

Czech National Cancer Registry (CNCR)

The CNCR has been maintained since 1977 when it was instituted as a na-

Tab. 1. Demographic and cancer-related characteristics of the Czech population [16,17].

Parameter	Male	Female	Total
Population Size	5,082,934	5,298,196	10,381,130
Fertility rate	–	–	1.438
Age (2007)			
• Mean/median (years)	38.8/37.0	41.8/40.5	40.3/38.6
• 25th–75th percentile (years)	22.1–54.8	23.8–58.9	22.9–56.9
• > 50 years (in %)	31.4%	37.3%	34.4%
Life expectancy at birth (years)	**73.7**	**79.9**	–
Annual overall mortality	**52,719**	**51,917**	**104,636**
Causes of death (%)			
• Diseases of the circulatory system (100–199)	44.7%	55.7%	50.1%
• Neoplasms (C00–D48)	29.1%	23.8%	26.5%
• External causes of morbidity and mortality (V01–Y98)	8.0%	3.6%	5.8%
• Diseases of the respiratory system (J00–J99)	5.9%	5.0%	5.5%
• Diseases of the digestive system (K00–K93)	5.1%	3.9%	4.5%
• Endocrine, nutritional and metabolic diseases (E00–E90)	2.1%	2.9%	2.5%
• Other causes	5.1%	5.1%	5.1%

Tab. 2. Causes of death in the Czech Republic in 2007 according to age [16,17].

	0–14 yrs N = 561	15–29 yrs N = 1,192	30–49 yrs N = 4,702	50–64 yrs N = 19,798	65+ yrs N = 78,383	Total N = 104,636
Neoplasms (C00–D48)	41 (7.3%)	111 (9.3%)	1,185 (25.2%)	8,093 (40.9%)	18,279 (23.3%)	27,709 (26.5%)
Diseases of the circulatory system (I00–I99)	2 (0.4%)	14 (1.2%)	890 (18.9%)	6,259 (31.6%)	45,299 (57.8%)	52,464 (50.1%)
External causes of morbidity and mortality (V01–Y98)	101 (18.0%)	828 (69.5%)	1,464 (31.1%)	1,464 (7.4%)	2,223 (2.8%)	6,080 (5.8%)
Diseases of the respiratory system (J00–J99)	24 (4.3%)	42 (3.5%)	153 (3.3%)	944 (4.8%)	4,552 (5.8%)	5,715 (5.5%)
Diseases of the digestive system (K00–K93)	7 (1.2%)	20 (1.7%)	522 (11.1%)	1,648 (8.3%)	2,550 (3.3%)	4,747 (4.5%)
Endocrine, nutritional and metabolic diseases (E00–E90)	14 (2.5%)	12 (1.0%)	58 (1.2%)	394 (2.0%)	2,145 (2.7%)	2,623 (2.5%)
Diseases of the nervous system (G00–G99)	33 (5.9%)	56 (4.7%)	123 (2.6%)	237 (1.2%)	806 (1.0%)	1,255 (1.2%)
Diseases of the genitourinary system (N00–N99)	1 (0.2%)	3 (0.3%)	28 (0.6%)	164 (0.8%)	1,056 (1.3%)	1,252 (1.2%)
Other diseases, disorders and conditions	338 (60.2%	106 (8.9%)	279 (5.9%)	595 (3.0%)	1,473 (1.9%)	2,791 (2.7%)

Tab. 3. Cancer epidemiology in the Czech Republic (all cancers including skin neoplasms C00–C97, data from 2007) [16–19].

Parameter	Male	Female	Total
Overall incidence			
• Absolute number	37,405	34,352	71,757
• Rate per 100 000	735.9	648.4	691.2
Incidence – ranking of Czech Republic worldwide (ASR, estimate from 2008)[1]	7.	15.	12.
Lifetime cumulative risk of cancer (age 0–75 years)[1]	33.8	24.8	28.9
Overall mortality[2]			
• Absolute number	15,179	12,180	27,359
• Cases per 100,000 population	298.6	229.9	263.5
Mortality – ranking of Czech Republic worldwide (ASR, estimate from 2008)[1]	18.	36.	17.
Mortality/incidence Ratio[2]	0.41	0.35	0.38
Prevalence			
• Absolute number	170,216	230,048	400,264
• Cases per 100,000 population	3,349	4,342	3,856
Growth index (1997–2007)			
• Incidence	27.1%	25.6%	26.4%
• Mortality[2]	–3.4%	–1.6%	–2.5%
• Prevalence	67.9%	59.2%	62.6%

[1] All cancers excluding non-melanoma skin cancer (C00–C97) in age 0–75. Adapted from Ferlay et al [2]; [2] Mortality statistics: Czech Statistical Office [17]

tional database covering 100% of cancer diagnoses and the entire Czech population. The most recent validated outcomes are from 2007 and the CNCR database contains more than 1.6 million records. The registration of malignant neoplasms is stipulated by the legislation and is obligatory. The CNCR is a part of the National Health Information System (NHIS) and is administered by the Institute of Health Information and Statistics of the Czech Republic [18]. The CNCR is accepted as a key database component of the Czech National Cancer Control Programme, designated to report regular and timely estimates of the cancer burden in the Czech population. For the purpose, automated analytic tools with outputs in the final form were developed. The CNCR is equipped with an information system which, among others, provides free accessible an analytical web portal (www.svod.cz) [19].

Incidence data and associated attributes

The CNCR contains personal data on patients, data describing malignant tumors and diagnostic details (including morphology classification and stage), data on patients' treatment, as well as data on post-treatment follow-ups. The registration of a new incident case begins with the cancer diagnosis, its morphological verification and an accurate staging. Subsequently, basic records on primary therapy (employed modalities), reasoning of therapeutic strategy, follow-up data and/or deaths are transferred into the registration forms. The forms are directly linked to the database on the basis of standardized data model and data processing rules [20]. Malignant neoplasms were recorded accor-

Tab. 4. Trends in incidence rates of malignant tumours excluding non-melanoma skin cancer (C00–C97 excluding C44) in the Czech Republic.

	Male		Female		Whole population	
	Number of neoplasms	Rate per 100,000 male	Number of neoplasms	Rate per 100,000 female	Number of neoplasms	Rate per 100,000 persons
1980	16,750	333.9	14,536	273.3	31,286	302.7
1990	19,309	383.4	17,652	331.4	36,961	356.6
2000	23,697	474.0	22,481	426.3	46,178	449.5
2005	27,636	552.4	24,191	460.9	51,827	505.6
2007	27,694	544.8	25,335	478.2	53,029	510.8
Growth index: 1980–1990	114.8%		121.3%		117.8%	
Growth index: 1990–2007	142.1%		144.3%		143.2%	

ding to the International Classification of Diseases for Oncology (ICD-O, tenth revision) [21]. Tumours are staged on the basis of TNM classification system [22]. For the purposes of this article, all cases recorded in the CNCR, including DCO records, were included among incident cases. Identification of multiple cancers in the same person was accurately controlled in the CNCR database, based on strict recognition of individual code of a patient, date of the diagnosis and diagnostic typology of multiple cancers.

Mortality data

The Czech legislation requires all deaths in the Czech Republic to be registered in the Death Records Database, a civil registration system [17]. For this purpose, standardized Death Certificates (internationally recommended by WHO, [23]) are designed to collect precise data on the cause of death in each individual, typically performed and proved by general practitioner. The causes of death are classified according to the International Classification of Diseases (ICD-10), which provides standardized nomenclature in this field [21]. This system ensures comparability of official Czech mortality data [17] with common international reporting. The coding of underlying cause of death can be controlled against independently and timely filled National Cancer Registry. The CNCR serves as another source of mortality data in the Czech Republic. Here, the individual records on the cause of death according to the Death Certificate are directly linked to diagnostic data on decedents, which can be used to code cause-specific mortality with respect to different cancer diagnoses. Death of a given person from malignant tumour is accurately indexed with respect to the main cancer diagnosis in accord with the immediate or the primary cause of death. So the Czech system allows the data managers to code distinct cancer entities and the records on causes of death are finally kept separately in two information systems. The system makes it possible to check the correctness of CNCR data retrospectively, and to verify the validity of mortality data on cancer patients according to internationally accepted rules [24,25], as discussed in [5].

Data analysis

Basic epidemiologic measures as crude incidence and mortality rates, age standardized rates and lifetime cumulative cancer rates were calculated according to widely accepted international guidelines [26,27]. Cumulative risk is expressed as the probability that an individual will develop the given cancer type during age span 0–74 years, in the absence of other competing causes of death. Annual incidence and mortality rates per 100,000 population (crude incidence) were calculated by gender and related to the Czech population structure in 2007 [16]. Age-standardized rates adjusted for the World and European population were calculated using age standards according to Waterhouse et al [28].

Results

Czech Republic belongs to the group of countries with the highest cancer burden, mortality from cancer contributes to the overall population mortality by 26.5% (Tab. 1). The highest relative proportion of mortality from cancer in relation to the other competing causes of death is registered in age group 50–64 years (Tab. 2). Male population is ranked worldwide in the 7th position in cancer incidence and in the 18th position in cancer mortality, women population occupies 15th place in worldwide statistics of incidence and 36th position in mortality ranking (Tab. 3). In 2007, there were 71 757 (691.2 per 100 000 people) new incident cases of all cancers including skin neoplasms (C00–C97). In total, 27 359 cancer deaths were registered in 2007 (263.5 per 100 000 population) (Tab. 3). Crude incidence rate continuously increases with the growth index in the last decade 26.4 % (1997–2007) while the crude mortality rate was stabilized in late 1990s and recently it has become to decrease with

Tab. 5. Incidence and mortality of malignant neoplasms in the Czech Republic according to diagnosis – male population in 2007 [16–19]. Mortality statistics: Czech Statistical Office [17].

Cancer diagnosis		No. of cases		Age-standardized rate		Lifetime cumulative risk (0–74 years)
		Absolute	Per 100,000 male	ASR(W)	ASR(E)	
Oral cavity and pharynx (C00–14)	Incidence	969	19.1	12.4	17.2	1.45
	Mortality	523	10.3	6.7	9.4	
Oesophagus (C15)	Incidence	417	8.2	5.2	7.4	0.66
	Mortality	337	6.6	4.2	6.0	
Stomach (C16)	Incidence	938	18.5	11.2	16.9	1.30
	Mortality	696	13.7	8.3	12.6	
Colorectum (C18–21)	Incidence	4,638	91.2	54.4	81.7	6.44
	Mortality	2,271	44.7	25.7	40.0	
Liver (C22)	Incidence	558	11.0	6.6	9.9	0.80
	Mortality	497	9.8	5.8	8.8	

Tab. 5 (Sequel). Incidence and mortality of malignant neoplasms in the Czech Republic according to diagnosis – male population in 2007 [16–19]. Mortality statistics: Czech Statistical Office [17].

Cancer diagnosis		No. of cases		Age-standardized rate		Lifetime cumulative risk (0–74 years)
		Absolute	Per 100,000 male	ASR(W)	ASR(E)	
Gallbladder etc. (C23–24)	Incidence	312	6.1	3.6	5.6	0.39
	Mortality	255	5.0	2.9	4.6	
Pancreas (C25)	Incidence	964	19.0	11.3	16.9	1.36
	Mortality	897	17.6	10.6	15.8	
Larynx (C32)	Incidence	464	9.1	5.8	8.2	0.72
	Mortality	227	4.5	2.8	4.1	
Trachea, bronchus and lung (C33–34)	Incidence	4,630	91.1	54.8	80.4	6.82
	Mortality	4,032	79.3	47.5	70.3	
Melanoma of skin (C43)	Incidence	993	19.5	12.4	17.6	1.36
	Mortality	201	4.0	2.4	3.6	
Other skin (C44)	Incidence	9,711	191.1	110.5	173.1	7.69
	Mortality	85	1.7	0.9	1.6	
Connective and soft tissue (C47+C49)	Incidence	135	2.7	1.9	2.5	0.19
	Mortality	43	0.8	0.6	0.8	
Prostate (C61)	Incidence	5,094	100.2	58.7	89.8	7.31
	Mortality	1,275	25.1	13.6	23.6	
Testis (C62)	Incidence	482	9.5	7.9	8.5	0.60
	Mortality	35	0.7	0.6	0.6	
Kidney (C64)	Incidence	1,756	34.5	21.4	30.9	2.58
	Mortality	668	13.1	7.8	11.9	
Bladder (C67)	Incidence	1,788	35.2	20.8	31.6	2.26
	Mortality	502	9.9	5.6	9.1	
Brain, nervous system (C70–C72)	Incidence	406	8.0	5.8	7.4	0.59
	Mortality	344	6.8	4.7	6.1	
Thyroid (C73)	Incidence	186	3.7	2.6	3.3	0.27
	Mortality	19	0.4	0.2	0.3	
Hodgkin lymphoma (C81)	Incidence	139	2.7	2.2	2.5	0.19
	Mortality	25	0.5	0.3	0.4	
Non-Hodgkin's Lymphoma (C82–85, C96)	Incidence	611	12.0	7.7	10.8	0.85
	Mortality	262	5.2	3.1	4.8	
Multiple myeloma (C90)	Incidence	209	4.1	2.4	3.7	0.28
	Mortality	155	3.0	1.8	2.8	
Leukaemia (C91–95)	Incidence	650	12.8	8.8	12.0	0.88
	Mortality	415	8.2	5.0	7.6	
All malignant but skin (C00–C97 but C44)	Incidence	27,694	544.8	334.6	488.9	32.59
	Mortality	15,094	297.0	176.8	268.6	
All malignant	Incidence	37,405	735.9	445.1	662.0	39.50
	Mortality	15,179	298.6	177.7	270.1	

growth index –5.4% over time range 1997–2007 (Fig. 1, Tab. 3–4). Growing incidence and stabilized mortality necessarily increase prevalence which exceeded 400,000 of cases in 2007 (Tab. 3).

The age-standardized incidence and mortality rates (World and European age standard) as well as crude incidence and mortality rates are presented in Tab. 5–6 by sex and for all main cancer diagnostic groups. Following types of cancer are most frequent in men population (absolute number in 2007): prostate cancer (5,094), followed by nearly equally incident colorectal can-

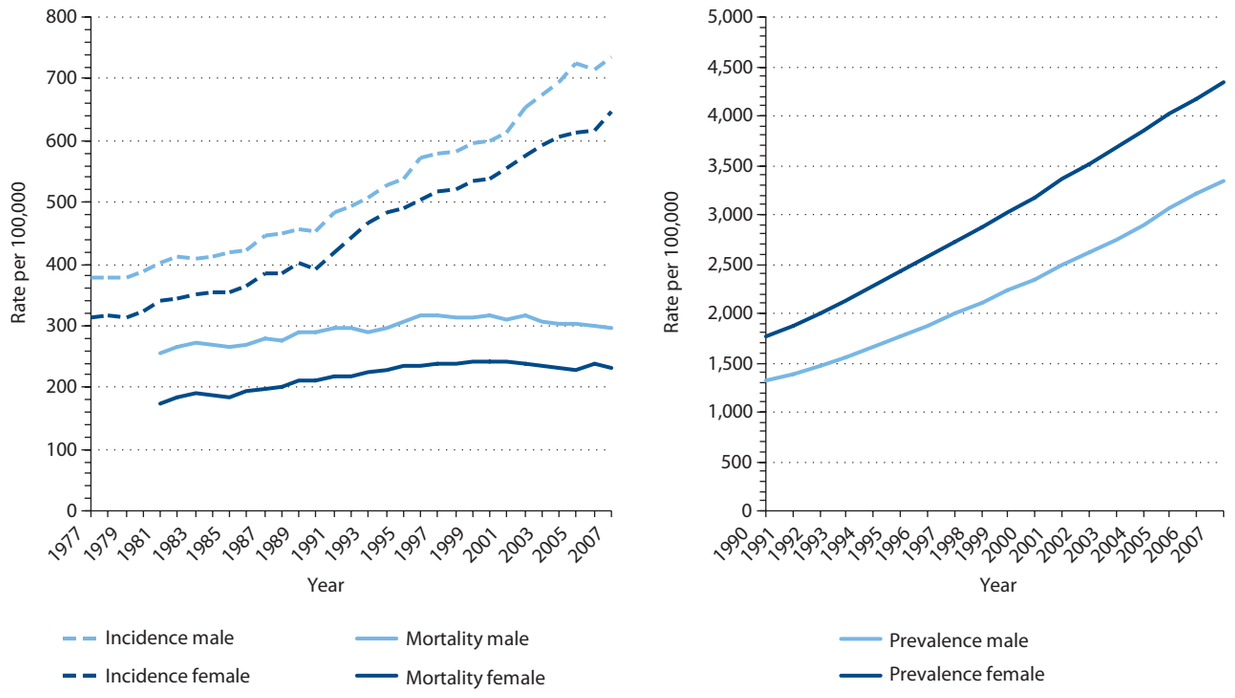

Fig. 1. Overall incidence, mortality and prevalence of all cancer diagnoses (C00–C97) in time trend (National Cancer Registry of the Czech Republic, 1977–2007).

Tab. 6. Incidence and mortality of malignant neoplasms in the Czech Republic according to diagnosis – female population in 2007 [16-19]. Mortality statistics: Czech Statistical Office [17].

Cancer diagnosis		No. of cases		Age-standardized rate		Lifetime cumulative risk (0–74 years)
		Absolute	Per 100,000 female	ASR(W)	ASR(E)	
Oral cavity and pharynx (C00–14)	Incidence	349	6.6	3.6	5.0	0.42
	Mortality	143	2.7	1.4	2.0	
Oesophagus (C15)	Incidence	96	1.8	0.9	1.3	0.10
	Mortality	73	1.4	0.6	0.9	
Stomach (C16)	Incidence	661	12.5	5.5	8.3	0.59
	Mortality	521	9.8	4.0	6.2	
Colorectum (C18–21)	Incidence	3,188	60.2	27.4	40.8	3.13
	Mortality	1,638	30.9	12.2	19.3	
Liver (C22)	Incidence	326	6.2	2.7	4.0	0.30
	Mortality	325	6.1	2.7	4.0	
Gallbladder etc. (C23–24)	Incidence	630	11.9	4.9	7.6	0.58
	Mortality	548	10.3	4.2	6.6	

Tab. 6 (Sequel). Incidence and mortality of malignant neoplasms in the Czech Republic according to diagnosis – female population in 2007 [16–19]. Mortality statistics: Czech Statistical Office [17].

Cancer diagnosis		No. of cases		Age-standardized rate		Lifetime cumulative risk (0–74 years)
		Absolute	Per 100,000 female	ASR(W)	ASR(E)	
Pancreas (C25)	Incidence	962	18.2	7.7	11.8	0.89
	Mortality	884	16.7	6.9	10.7	
Larynx (C32)	Incidence	43	0.8	0.5	0.6	0.05
	Mortality	17	0.3	0.2	0.2	
Trachea, bronchus and lung (C33–34)	Incidence	1,762	33.3	16.6	24.0	2.08
	Mortality	1,444	27.3	12.8	18.9	
Melanoma of skin (C43)	Incidence	1,023	19.3	11.5	15.3	1.18
	Mortality	128	2.4	1.2	1.7	
Other skin (C44)	Incidence	9,017	170.2	77.2	115.1	6.33
	Mortality	51	1.0	0.3	0.6	
Connective and soft tissue (C47+C49)	Incidence	104	2.0	1.3	1.6	0.12
	Mortality	51	1.0	0.6	0.7	
Female breast (C50)	Incidence	6,500	122.7	69.8	96.3	7.75
	Mortality	1,680	31.7	14.7	21.8	
Cervix uteri (C53)	Incidence	990	18.7	12.7	16.1	1.30
	Mortality	314	5.9	3.4	4.7	
Uterus (C54–C55)	Incidence	1,771	33.4	17.6	25.0	2.17
	Mortality	430	8.1	3.5	5.4	
Ovary (C56)	Incidence	1,087	20.5	11.4	15.8	1.31
	Mortality	700	13.2	6.4	9.3	
Kidney (C64)	Incidence	1,039	19.6	9.7	14.1	1.18
	Mortality	398	7.5	3.2	4.9	
Bladder (C67)	Incidence	699	13.2	6.2	9.1	0.63
	Mortality	195	3.7	1.4	2.2	
Brain, nervous system (C70–C72)	Incidence	380	7.2	4.6	5.8	0.47
	Mortality	338	6.4	3.7	4.9	
Thyroid (C73)	Incidence	674	12.7	8.9	11.1	0.90
	Mortality	52	1.0	0.4	0.6	
Hodgkin lymphoma (C81)	Incidence	108	2.0	1.9	1.9	0.14
	Mortality	28	0.5	0.2	0.4	
Non-Hodgkin's Lymphoma (C82–85, C96)	Incidence	619	11.7	6.0	8.5	0.70
	Mortality	249	4.7	2.1	3.1	
Multiple myeloma (C90)	Incidence	234	4.4	1.9	2.9	0.24
	Mortality	177	3.3	1.4	2.2	
Leukaemia (C91–95)	Incidence	507	9.6	5.5	7.1	0.56
	Mortality	379	7.2	3.2	4.7	
All malignant but skin (C00–C97 but C44)	Incidence	25,335	478.2	252.9	354.6	24.88
	Mortality	12,129	228.9	101.5	152.6	
All malignant	Incidence	34,352	648.4	330.2	469.6	30.74
	Mortality	12,180	229.9	101.8	153.2	

Tab. 7. Multiple primary cancers diagnosed in period 1977–2007, documented on records of selected most frequent cancer diagnoses.

		Period 1977–1987	Period 1988–1997	Period 1998–2007
		Annual absolute number (% new cases)		
Colorectal cancer	Primary tumors	4,350 (95.5%)	5,804 (91.6%)	6,761 (86.4%)
	Multiple primary tumors diagnosed in patients already treated for some other type of cancer	204 (4.5%)	536 (8.4%)	1,062 (13.6%)
Breast cancer	Primary tumors	2,900 (95.6%)	3,754 (91.8%)	4,887 (88.4%)
	Multiple primary tumors diagnosed in patients already treated for some other type of cancer	133 (4.4%)	335 (8.2%)	644 (11.6%)
Prostate cancer	Primary tumors	1,256 (94.6%)	1,840 (90.4%)	3,300 (85.9%)
	Multiple primary tumors diagnosed in patients already treated for some other type of cancer	71 (5.4%)	195 (9.6%)	544 (14.1%)

cer (4,638) and lung cancer (4,630). In women, the breast cancer is significantly most frequently diagnosed (6,500 incident cases in 2007), followed by colorectal cancer (3,188), uterus cancer (1,771) and lung cancer (1,762). The highest value of lifetime cumulative risk (0–74 years) was observed in breast cancer (women: 7.75), prostate cancer (men: 7.31), lung cancer (men: 6.82) and colorectal cancer (men: 6.44).

In addition to demographic ageing of the Czech population, the cancer burden is increased by growing incidence of multiple primary tumors. Data in Tab. 7 documents significantly growing contribution of multiple incident cases (both synchronous and metachronous) to the overall incidence. In most prevalent cancers, the rate of multiple diagnoses in the same patients forms more than 11% of the overall incidence (1998–2007).

The database of CNCR offers accurate stratification of newly diagnosed cases according to clinical stage (Fig. 2, Tab. 8). It is evident that early detection of the disease is a weak point of the Czech cancer management, particularly in the following diagnoses: cancer of oesophagus, liver, gallbladder and pancreas. Relatively low proportion of early detected cases can also be observed in highly prevalent cancers like colorectal cancer (stage I + II: 43.2%) and lung cancer (stage I + II: 14.6 %). Furthermore, in all mentioned diagnoses there is no signal of improving situation over a wide time span 1998–2007 (Fig. 2). On the other hand, our survey revealed also prevalent cancers with continuous increase of early diagnosed cases. It is the case of female breast cancer, male testicular and prostate cancer and bladder cancer in both sexes; all these diagnoses have recently exceeded 70 % of incident cases in stage I or II (Tab. 8, Fig. 2).

Problems with accessibility of early diagnostics in cancer management are indicated also in regional survey presented in Tab. 9. Significant regional heterogeneity in early detection rate was found in nearly all listed diagnoses, including most prevalent colorectal cancer (inter regional range in proportion of early diagnosed cases: 37.4%–53.0%), prostate cancer (41.4%–74.3%) or bladder cancer (62.1%–89.6%). It should be emphasized here, that even generally calculated cancer burden significantly differs among regions of the Czech Republic. Crude incidence estimated in 2007 regionally ranges from 444.5 to 604.9 and crude mortality ranges from 236.7 to 301.4 (Tab. 9). Such heterogeneity cannot be explained only by different population structure of the regions. In selected types of cancer the regional distribution of age-standardized incidence rather indicates potential influence of some external, environmental factors (Fig. 3).

Discussion

The cancer burden of the Czech population ranks among the highest worldwide and has been growing continuously [4,6]. During 1990s and 2000s, the incidence of all major cancers was constantly increasing in the Czech population [19] and the growth dynamic was consistent with recently published international data [2–5]. Also relative profile of most prevalent cancer types (breast cancer in women, prostate cancer in men, colorectal and lung cancer in both sexes) corresponds to the outcomes of most recent European epidemiology summaries [5]. In agreement with international reports, lung cancer is the most frequent cause of death from cancer. In the Czech male and female population it means 4,032 and 1,444 deaths.

The growing trend in cancer burden can be generally attributed to widely known risk factors, like apparent demographic ageing of the Czech population, life style factors or more specifically, to changes in reproductive behavior (female breast cancer) [29].

Further growth in cancer incidence can be expected also in future, due to the demographic structure and ageing of the Czech population. In 1995, the average age was 35.6 years for men and 38.9 years for women. Within twelve years, these values shifted to 38.8 years for men and 41.8 years for women (data from 2007). During the period 1995–2007, the proportion of inhabitants aged over 50 years increased by 6.6%.

The increasing trend in incidence is remarkable also in preventable cancers, particularly in breast and colo-

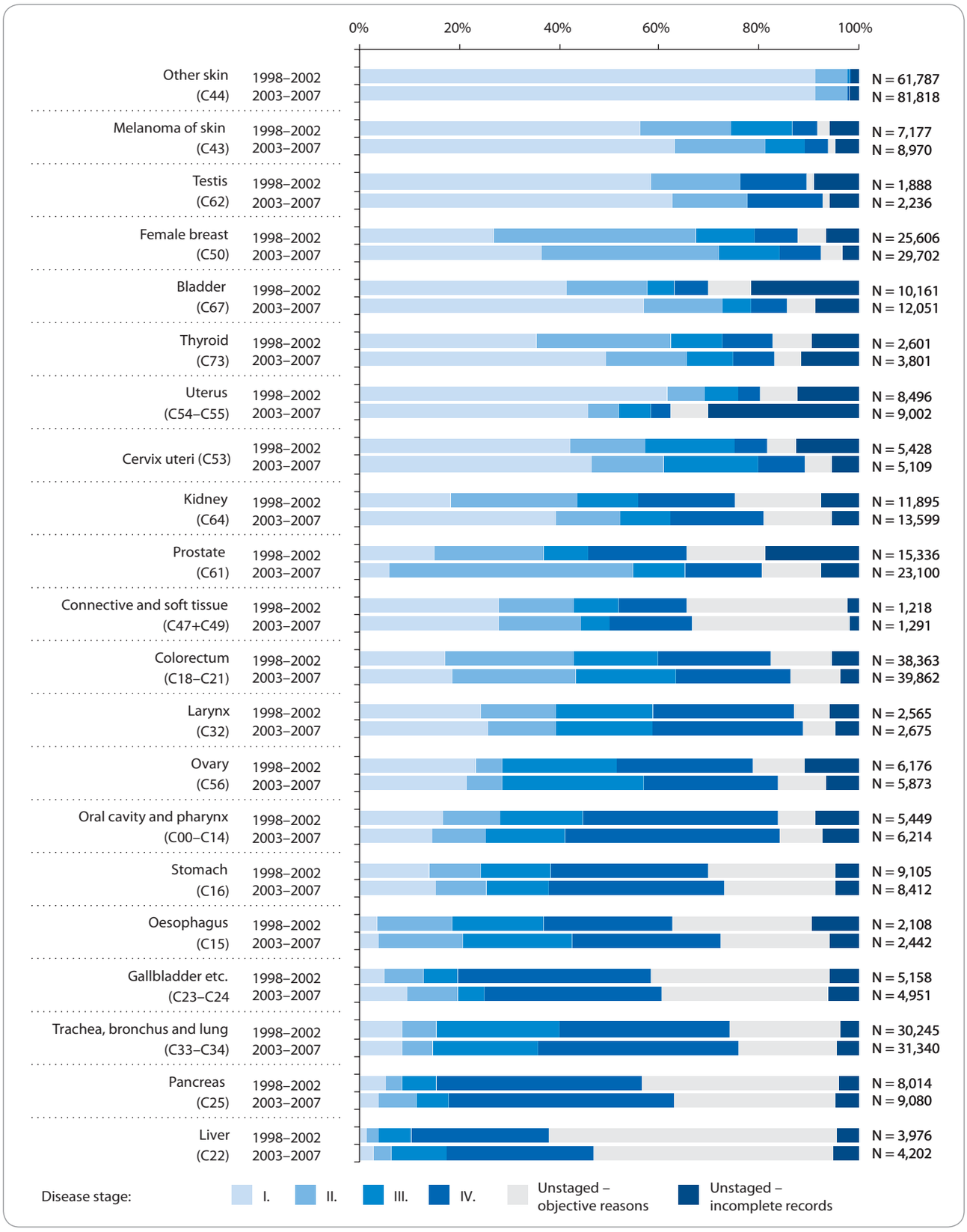

Fig. 2. Proportion of clinical stages in malignant diagnoses (sorted by proportion of stage I + II; National Cancer Registry of the Czech Republic, 1998–2007).

rectal carcinoma. Latest IARC database [2] even shows the Czech Republic to have the highest male colorectal cancer incidence worldwide. The growing incidence of colorectal cancer (growth index 1997–2007: 6.8%) is accompanied with relatively weak early detection of the disease (only 43.2% of incident cases in stage I or II). Furthermore, the relative rate of early detected cases greatly varied among regions (37.4–53.0%) which indicates some disparities in the cancer control. These facts are challengeable for the Czech programme of colorectal screening which has well documented history [30,31].

International trials promise decrease in CRC mortality by more than 30% due to organized screening based on annual guaiac faecal occult blood test (gFOBT) [32,33]. However, recent Czech data indicates only 16% coverage of target adult population by gFOBT screening which is insufficient to initiate population changes.

The recent situation in epidemiology of breast cancer in the Czech women population is better than in colorectal cancer. Although the incidence of breast carcinoma is significantly increasing (growth index 1997–2007: 41.4%), it is accompanied with continuous increase of early diagnosed cases (recently 72% of incident cases diagnosed in stage I or II). These positive changes are due to increasing power of the Czech national screening for breast cancer which already reached more than 50% coverage of target women population (> 45 years). Similarly, as a consequence of widely used PSA test, we can observe growing incidence of early detected prostate cancer (Tab. 8, Fig. 2) although no organized screening for this type of cancer exists in the Czech Republic.

The cancer burden in the Czech Republic has also been increasing due to growing incidence rate of multiple primary malignancies, diagnosed in the same patient. Although the registration of multiple tumors was discussed in literature as rather complicated topic [34], it is not the case of the Czech cancer registry. The CNCR database makes it possible to identify a specific patient; therefore, recurring malignancy in the same person can be accurately identified, whether it is in the same location or another. The chronological order of recurring malignancies can also be measured. Tab. 7 sums up the overall data, showing that multiple malignancies are relatively common, although they differ markedly among diagnoses. If non-melanoma skin cancers (C44) and malignant neoplasms of uncertain behavior (D37–D48) are not taken into account, the relative frequency of recur-

Tab. 8. Classification of malignant neoplasms in the Czech Republic according to trends in incidence rates and clinical stage at the time of diagnosis.

Classification according to trends in incidence rates

Diagnoses of malignant tumours with raising incidence rates	Diagnoses of malignant tumours with stabilised incidence rates	Diagnoses of malignant tumours with decreasing incidence rates
C61 (GI: +88.2%)	C54, C55 (GI: +4.4%)	C81 (GI: –10.8%)
C73 (GI: +85.3%)	C22 (GI: +4.2%)	C56 (GI: –11.2%)
C43 (GI: +63.6%)	C90 (GI: +3.5%)	C16 (GI: –20.9%)
C44 (GI: +62.8%)	C91–C95 (GI: +2.3%)	
C50 (GI: +41.4%)	C32 (GI: –0.8%)	
C67 (GI: +32.6%)	C47, C49 (GI: –4.0%)	
C00–C14 (GI: +32.3%)	C53 (GI: –5.8%)	
C25 (GI: +20.8%)	C23, C24 (GI: –6.0%)	
C62 (GI: +20.2%)		
C82–C85, C96 (GI: +19.9%)		
C64 (GI: +17.4%)		
C70–C72 (GI: +16.3%)		
C15 (GI: +15.0%)		
C33, C34 (GI: +7.5%)		
C18–C21 (GI: +6.8%)		

Classification according to detection rates of less advanced stages of malignant tumours

Low frequency of detection rates at stages (S) I and II	Middle frequency of detection rates at stages (S) I and II	High frequency of detection rates at stages (S) I and II
C15 (S I + II: 20.6%)	C47, C49 (S I + II: 44.6%)	C44 (S I + II: 97.8%)
C23, C24 (S I + II: 19.7%)	C18–C21 (S I + II: 43.2%)	C43 (S I + II: 81.3%)
C33, C34 (S I + II: 14.6%)	C32 (S I + II: 39.5%)	C62 (S I + II: 77.8%)
C25 (S I + II: 11.4%)	C56 (S I + II: 28.5%)	C67 (S I + II: 72.8%)
C22 (S I + II: 6.4%)	C00–C14 (S I + II: 25.5%)	C50 (S I + II: 71.9%)
	C16 (S I + II: 25.4%)	C73 (S I + II: 65.4%)
		C53 (S I + II: 60.9%)
		C61 (S I + II: 54.7%)
		C64 (S I + II: 52.3%)
		C54, C55 (S I + II: 52.0%)

C00–C14: oral cavity and pharynx; C15: oesophagus; C16: stomach; C18–C21: colon and rectum; C22: liver and intrahepatic bile ducts; C23, C24: gallbladder and biliary tract; C25: pancreas; C32: pharynx; C33, C34: trachea, bronchus and lung; C43: skin melanoma; C44: other malignant neoplasm of the skin; C47, C49: connective and soft tissues; C50: breast (women); C53: cervix uteri; C54, C55: uterus; C56: ovary; C61: prostate; C62: testis; C64: kidney; C67: bladder; C70–C72: brain and spinal cord; C73: thyroid gland; C81: Hodgkin's lymphoma; C82–C85, C96: non-Hodgkin's lymphoma; C90: multiple myeloma; C91–C95: leukaemia; GI: growth index related to the period 1997–2007; S I+II: proportion of clinical stages I+II in the overall incidence of the disease, data from period 2003–2007

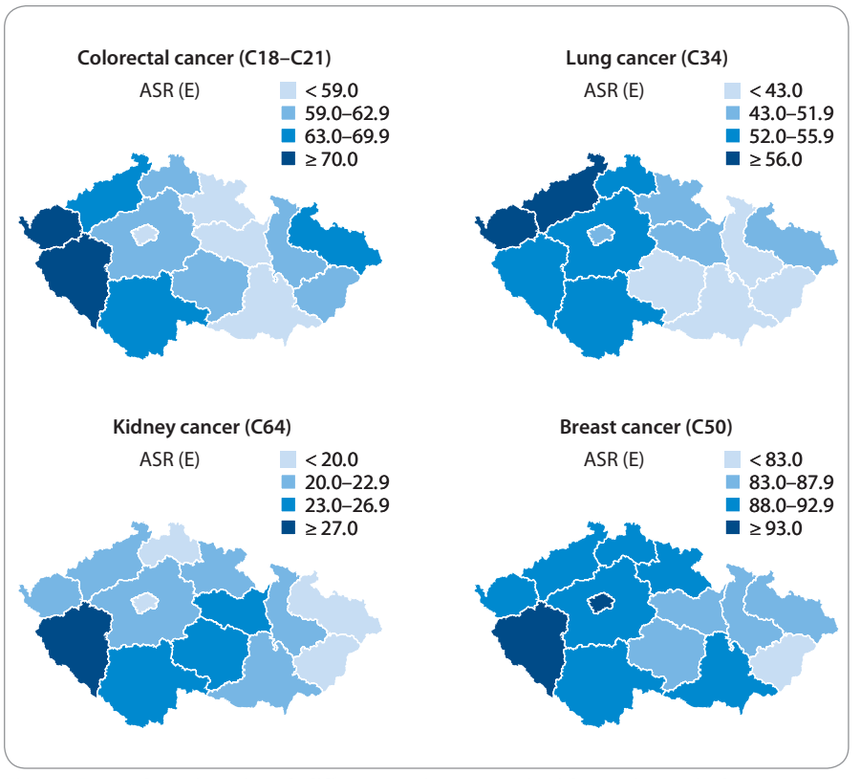

Fig. 3. Examples of regional differences in cancer incidence in period 2003–2007 (National Cancer Registry of the Czech Republic).

ring malignancies ranges from 12 to 14%, the overwhelming majority (96%) of recurring malignancies belonging to other diagnostic group than the primary tumor. Recurring malignancy of the same diagnostic group is more common in breast cancer (C50), bladder cancer (C67) and partly in testicular cancer (C62). This field is very compelling because of it offers a new dimension for cancer burden causation. Additionally, it represents an opportunity for prevention and for better targeting of already diagnosed and treated cancer patients [35,36].

In addition to insufficient early detection of many cancers and related disparity in cancer diagnostics, the Czech cancer care is faced with high regional variability in epidemiologic measures. Although we cannot exclude the influence of under-registration in some regions, its real impact is highly probably limited, particularly in recent period since 2000. This assumption is based on the regional profiles of mortality rates which fully correspond to that observed for the incidence profiles. Mortality estimates are double controlled in the Czech Republic using two independent sources of information on death events, i.e. cancer registry and Death Records Database [17,18]. Furthermore, the CNCR management closely respects the administrative division of the country into 14 regions and is collected with the same operation in each of them. Moreover, observed regional differences in cancer burden are different for various cancers and do not reveal any consistent pattern (Fig. 3).

Therefore, in view of regional differences (Tab. 9, Fig. 3), we cannot neglect influence of environmental factors, although their contribution to aetiology of human cancer is disputably discussed in literature [37,38]. Czech adults who come to risk age categories 50–60 years or older were probably at least partially exposed with environmental pollutants including DDT, PCBs, PAHs and pesticides in 1960s–1970s [6]. This hypothesis however cannot be exactly quantified due to the lack of environmental data from the period of communist government before 1989. Although we cannot address the role of environment in cancer causation, some birth-cohort effects should be studied as indirect population indicator of some unspecified harmful effect in past. This information should be translated into well designed future studies focused on space variability of cancer epidemiology in the Czech Republic.

This work is based on 30-year experience of a nationwide, fully representative cancer registry. It supports the idea that cancer registries can be accepted as one of the main strategies for improving our understanding of cancer and its causation. Representative registries may reveal factors underlying trends in cancer incidence; moreover, they can detect significant changes over time in the main diagnostic measures (such as morphology and staging). This information is necessary to promote prevention which might ultimately lead to better control of the disease. The Czech National Cancer Registry contains complete and comprehensive records on the clinical stage at the time of diagnosis, including detailed records on individual components of TNM classification. The overall CNCR assessment has revealed only 5.8% of records which unfoundedly miss information on both TNM classification and clinical stage (Fig. 2). The completeness of CNCR data increases in time and the most recent period provides high-quality data. The CNCR is equipped by web-based analytic tool which allows the user to perform comprehensive analyses in user-friendly environment [19]. We regard the CNCR database and associated software as one of the most influential product of the Czech National Cancer Control Program. These products also support wider international collaboration which is preferred also by other, similarly equipped cancer control programs [39].

Conclusion

With the epidemiological data accessible, the cancer burden in the Czech Republic can be assessed throughout the population and for individual regions. The proportion of clinical stages as well

Tab. 9. Regional differences in the main epidemiological trends of malignant neoplasms excluding non-melanoma skin cancer (C00–C97 excluding C44) in the Czech Republic [16–19]. Mortality statistics: Czech Statistical Office [17].

Indicator	Data from period	Average value over the whole population	Range of values in regions (Min; Max; n = 14 regions)
Incidence rate per 100,000 population	2003–2007	501.6	(444.5; 604.9)
Age standardized incidence rate, ASR(E)	2003–2007	409.4	(364.3; 480.4)
Incidence growth index related to 1997	1997–2007	17.4%	(7.5%; 32.4%)
Mortality rate per 100,000 population[1]	2003–2007	274.6	(236.7; 301.4)
Age standardized mortality rate, ASR(E)[1]	2003–2007	216.5	(187.2; 250.1)
Mortality growth index related to 1997[1]	1997–2007	–2.6%	(–7.3%; + 3.5%)
Prevalence rate per 100,000 population	2007	2,791	(2,565; 3,071)
Prevalence growth index related to 1997	1997–2007	65.2%	(51.3%; 80.1%)
Mortality/incidence index	2003–2007	0.55	(0.49; 0.60)
Main diagnostic groups – proportion of detection at clinical stages I + II	2003–2007		
Stomach (C16)		25.4%	(17.8%; 35.6%)
Colon and rectum (C18–C21)		43.2%	(37.4%; 53.0%)
Pancreas (C25)		11.4%	(7.3%; 16.6%)
Trachea, bronchus and lung (C33,C34)		14.6%	(11.5%; 18.3%)
Skin melanoma (C43)		81.3%	(74.6%; 88.5%)
Breast – women (C50)		71.9%	(68.9%; 76.6%)
Uterus (C54,C55)		52.0%	(37.4%; 69.0%)
Prostate (C61)		54.7%	(41.4%; 74.3%)
Kidney (C64)		52.3%	(45.6%; 58.1%)
Bladder (C67)		72.8%	(62.1%; 89.6%)
Proportion of detection during autopsy and from DCO	2003–2007	4.9%	(3.2%; 7.2%)

as the success rate of early detection can be analyzed, and the time trends can then be drawn from all assembled data. The most impressive aspect of our study is the accessibility of information over a 30-year period of continuous and standardized registration covering 100% of cancer diagnoses and the entire Czech population; also available in an on-line working, interactive tool [19]. The main challenge for the future is to achieve the unaccomplished objective of lowering cancer mortality, particularly by sustained reduction of late diagnosed cases and of remarkable regional differences in diagnostic efficiency.

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