

Years of life lost due to malignant neoplasms characterized by the highest mortality rate

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Abstract

Introduction: The analysis of premature deaths measured with years of life lost between the studied and referential populations helps to emphasize the social and economic aspect of a loss caused by deaths due to malignant neoplasms. The aim of the study was to analyze years of life lost by inhabitants of the Lodz province due to malignant neoplasms.

Material and methods: The study material included a database which contained information gathered from 313,144 death certificates (including 66,899 people who died of malignant neoplasms) of inhabitants of the Lodz province who died between 1999 and 2008. The SEYLLp (Standard Expected Years of Life Lost per living person) method was used to determine years of life lost. Jointpoint models were used to analyze time trends.

Results: In males the diseases which mostly contributed to death were tracheal, bronchial and lung malignant neoplasms (SEYLLp = 170.7) and cancer of the large intestine, rectum and anus (SEYLLp = 47.5). In females the principal diseases were tracheal, bronchial and lung malignant neoplasms (SEYLLp = 61.6), breast cancer (SEYLLp = 60.4) and cancer of the large intestine, rectum and anus (SEYLLp = 42.3). The years of life lost were growing in the period under study.

Conclusions: The number of years lost due to malignant neoplasms in the Lodz province between 1999 and 2008 was growing. The main reasons for deaths in females were tracheal, bronchial and lung malignant neoplasms as well as breast cancer and in males – cancer of the large intestine, rectum and anus as well as prostate cancer.

Key words: malignant neoplasms, years of life lost, trends, the Lodz province.

Introduction

The Lodz province is situated in central Poland. It is inhabited by over 2.5 million people, which constitutes approximately 7% of the population of Poland. The province, and especially its capital Lodz were famous for the dominance of textile and apparel industries. It was a source of a deep economic crisis after the systemic transition in 1989, when Poland adopted the mechanisms of a free-market economy. Nowadays Lodz is the biggest producer of household appliances in Poland. There is also a dynamic growth of the pharmaceutical industry and manufacturing of construction materials.

The population of the Lodz province is characterized by the lowest natural growth (–2.7%) in Poland, the highest feminization rate (110 females per 100 males), the lowest share of people in the pre-productive age (17.4%)

and the highest of those in the post-productive age (18.8%) as well as the highest mortality rates (125.9 for males and 63.6 for females) and the shortest life expectancy (70.1 for males and 79.4 for females) (data for 2010) [1, 2]. These long-lasting unfavorable indicators justify the need to monitor the epidemiological situation of the province.

Certain methods are becoming more and more useful in the evaluation of the state of health. Thanks to these it is possible to calculate premature death in years of time lost. Time lost due to premature death is a function of the death rate and expected life span. Researchers use a few methods of measuring the gap between the real death age in a particular population and the ideal death age and the main difference between them is the point of reference, i.e. the death age considered as "ideal".

Murray and Lopez in *Global Burden of Disease* [3] suggest using the SEYLL method (*Standard Expected Years of Life Lost*) to measure the burden of disease due to premature mortality. The method is used to calculate the number of years of life lost by the studied population in comparison to the years lost by the referential (standard) population. The researchers suggest adopting the expected years of life in Japan as the standard life span because just there it is the highest. According to the statistics from 2009 further life expectancy was 86.5 for females and 79.6 for males [4]. For Europe the authors of „Health statistics – Atlas on mortality in the European Union” [5] suggest adopting life tables of 15 old European Union member states, separately for males and females. The application of life tables for all the 27 member states might be an alternative. Differences in the life span in the particular countries are still very high. For example, in 2009 the average life span for males from the 15 old member states was 78.2 years but in 12 countries of Central and Eastern Europe, which belong to the group of the 27 EU states, the life span was only 72 years [6]. Adopting this alternative way of calculation might result in underestimating the number of years of life lost in most European countries which enjoy a longer life span than the average one for Europe. As a consequence, the researchers might draw wrong conclusions. It is reasonable to compare the life span in Central and Eastern European countries with the life span in the 15 old EU member states as such a comparison clearly shows the gap between these two groups of countries and is a motivating factor to strive to catch up with the health standards which the 15 countries enjoy.

The analysis of expected years of life lost makes us consider not only social but also economic aspect of the loss connected with premature mor-

tality. Malignant neoplasms are the most common causes of death in Poles aged 45-64 [7] and they are, along with cardiovascular diseases, a cause of the greatest number of lost years of life. We should expect an increase in the death rate due to malignant neoplasms, mainly because of demographic situation, as age is a risk factor in many neoplasms [8]. In the Lodz province elderly people outnumber other age groups and problems connected with old age are especially intensive here [9].

The aim of the study was to analyze years of life lost of inhabitants of the Lodz province due to malignant neoplasms, determine to what extent diseases included in the International Statistical Classification of Diseases and Related Problems (ICD-10) contribute to the highest number of years of life lost as well as to propose certain trends in order to change the situation.

Material and methods

The study material included a database which contained information gathered from 313,144 death certificates (including 66,899 people, i.e. 21.4% who died of malignant neoplasms) of inhabitants of the Lodz province who died between 1 January 1999 and 31 December 2008, revealed for the purpose of this study by the Voivodeship Public Health Centre and the Information Department of the Central Statistical Office. The data encompass all deaths of inhabitants of the Lodz province in the 10-year period under study, therefore our research study concerns the whole population.

Many measures of premature death have been proposed based on years of life lost. One that is popular, with its adoption as one component of disability adjusted life years (DALY), is standard expected years of life lost (SEYLL). SEYLL is calculated from the expected remaining years, as specified by a normative survivorship that is derived from model life tables.

Consider population of size N and suppose there are d_{xc} deaths in an age x , due to particular cause c and e_x^* is a measure of the expected years of life that remain to be lived for a death from any cause at age x in the standard population. If we assume that l is the last year of age till the population lives, the number of years of life lost due to c was calculated with the use of the following formula:

$$SEYLL = \sum_{x=0}^l d_{xc} e_x^* .$$

Some authors use other standards. In this study, the life table for the total of EU-15 countries was used as a standard, separately for men and women.

Dividing above equation by total deaths from a specified cause, gives the SEYLL per death, which means the Average Years of Life Lost (AYLL):

$$SEYLL_d = \frac{\sum_{x=0}^l d_{xc} e_x^*}{\sum_{x=0}^l d_{xc}}$$

The authors also calculated SEYLL_p per living person, where the SEYLL value refers to the number of inhabitants of analyzed population [10, 11].

$$SEYLL_p = \frac{\sum_{x=0}^l d_{xc} e_x^*}{N}$$

For instance, in 2008, 1216 died of trachea, bronchial and lung cancer out of all 1,212,328 males living in the Lodz province. If they survived until the average age of EU-15 males in 2008, they would live longer by 20,695 years in total. This figure constitutes the number of standardized expected life years lost. If we divide the 20,695 years by the 1216 males, we get 17 years of life which were lost on average by each man who died of trachea, bronchial and lung cancer. If we divide the 20,695 years by 1,212,328 and then multiply it by 10,000, we obtain 170.7 life years lost per 10,000 males.

Low mortality rates at an early age and high mortality at a late age, may result in similar SEYLL_p. Years of life lost per death SEYLL_d captures the distinction.

Statistical analysis

The analysis of time trends was carried out with Joinpoint model and Joinpoint Regression program—a software worked out by U.S. National Cancer Institute (for Surveillance, Epidemiology and End Results programme) [12]. This method is an advanced ver-

sion of linear regression, where time trend is expressed with a broken line, that is a sequence of segments which are joined in joinpoints. In these points the change of the value is statistically significant ($p < 0.05$). The authors also estimated annual percentage change (APC) for the indices: SEYLL_p and SEYLL_d for each segment of broken lines with corresponding 95% confidence intervals (CI).

Results

In 2008 the number of expected years of life lost due to malignant neoplasms was above 62,000 in males and around 56,000 in females (Table I). It amounted to 514 lost years per 10,000 males and 420 lost years per 10,000 females. In the male group malignant neoplasms of: the trachea, bronchus and lung (SEYLL_p = 170.7), large intestine, rectum and anus (SEYLL_p = 47.5), stomach (SEYLL_p = 32.0), prostate (SEYLL_p = 26.2) and pancreas (SEYLL_p = 18.3) contributed to the greatest number of lost years of life (Table II).

In the female group malignant neoplasms of: the trachea, bronchus and lung (SEYLL_p = 61.6) and breast (SEYLL_p = 60.4) contributed to the greatest number of lost years of life in 2008. Another malignant neoplasms from the ICD-10 classification which brought about the greatest number of lost years of life in 2008 were: cancer of the large intestine, rectum and anus (SEYLL_p = 42.3), ovary (SEYLL_p = 27.2), pancreas (SEYLL_p = 18.9), uterine cervix (SEYLL_p = 18.5) and stomach (SEYLL_p = 15.3).

The number of lost years of life due to malignant neoplasms was growing in 1999–2008 both in males and females (Figure 1). In the male group the average increase between 1999 and 2002 was 3.3% per annum ($p < 0.05$). In 2002–2008 the value of APC dropped and it was 0.6% per annum ($p < 0.05$). With

Table I. The number of years of life lost due to malignant neoplasms in total (C00-D09) in absolute numbers (SEYLL), rate per 10,000 inhabitants (SEYLL_p) and rate per 1 death case due to this reason (SEYLL_d) according to gender in the Lodz province in 1999–2008

Year	Male			Female		
	SEYLL	SEYLL _p (per 10,000)	SEYLL _d	SEYLL	SEYLL _p (per 10,000)	SEYLL _d
1999	57454	451	16.3	51087	368	18.2
2000	58573	461	16.1	50295	364	18.1
2001	61294	485	16.3	54138	393	18.8
2002	62367	499	16.2	53131	388	18.4
2003	61476	495	16.0	56082	412	18.1
2004	62061	501	16.4	54800	404	18.5
2005	61350	498	16.5	53923	398	18.4
2006	62256	509	16.4	55459	413	18.6
2007	62263	512	16.4	57122	426	18.8
2008	62338	514	16.5	56156	420	18.4

Table II. The number of years of life lost due to common malignant neoplasms according to gender and location in the Lodz province in 2008

Cause of death	SEYLL	SEYLL _p (per 10,000)	SEYLL _d
Male			
Malignant cancers:			
Stomach (C16)	3875	32.0	15.7
Large intestine, rectum and anus (C18-C21)	5753	47.5	14.7
Pancreas (C25)	2218	18.3	16.7
Trachea, bronchus and lung (C33-C34)	20695	170.7	17.0
Prostate (C61)	3176	26.2	11.1
Other	26621	219.6	17.8
Female			
Malignant cancers:			
Stomach (C16)	2049	15.3	15.5
Large intestine, rectum and anus (C18-C21)	5648	42.3	15.8
Pancreas (C25)	2532	18.9	15.7
Trachea, bronchus and lung (C33-C34)	8226	61.6	21.0
Breast (C50)	8079	60.4	21.3
Uterine cervix (C53)	2472	18.5	24.2
Ovary (C56)	3638	27.2	21.4
Other	23512	175.9	17.4

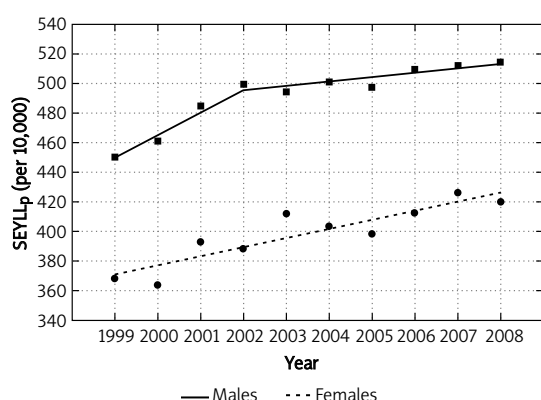


Figure 1. Trends of the number of years of life lost due to malignant neoplasms in total according to gender in the Lodz province from 1999 to 2008

regards to women, the increase was constant in the whole decade – 1.6% annually ($p < 0.05$) (Table III).

Until 2001 malignant cancer of the trachea, bronchus and lung (APC = 6.3%) mostly contributed the greatest number of lost years. An annual drop to APC = 0.1% (Figure 2) was observed in 2001–2008. The number of years of life lost due to malignant neoplasms of: the large intestine, rectum and anus (APC = 3.4%, $p < 0.05$), prostate (APC = 2.5%, $p < 0.05$) and pancreas (APC = 1.8%) was growing in males over the whole decade. A decreasing trend was observed in males who died of malignant cancer of the stomach (APC = –0.7%).

With regards to women, neoplasms of the trachea, bronchus and lung (APC = 5.3%, $p < 0.05$) and breast (APC = 2.5%, $p < 0.05$) contributed to the greatest number of lost years (Figure 3). The value of the SEYLL_p index was also growing because a growing number of cases of ovarian cancer (APC = 1.6%), cancer of pancreas (APC = 1.1%) and the large intestine, rectum and anus (APC = 0.5%). On the other hand, the number of lost years due to cancer of the uterine cervix (APC = –1.7%) and stomach (APC = –1.2%) was decreasing.

The value of the SEYLL_d index, which is the ratio of the years of life lost due to malignant neoplasms to the number of deaths due to the mentioned reasons, confirms that a male who died in 2008 lost on average 16.5 and a female – 18.4 years of life (Table I). Results of a detailed analysis of particular cancers indicates that cancer of the trachea, bronchus and lung brought about the greatest number of deaths (17.0) (Table II). It should be emphasized that a woman who died in 2008 lost on average more than 20 years of life if she died of malignant neoplasms of: the uterine cervix (24.2), ovary (21.4), breast (21.3) and trachea, bronchus and lung (21.0).

Discussion

Deaths caused by malignant neoplasms which occurred in the Lodz province in 2008 made up

Table III. Time trends of the SEYLL_p indices according to causes and gender (per 10,000) in the Lodz province in 1999–2008 – joinpoint regression analysis

Cause of death	Number of joinpoints	Period	APC	95% CI	
Male					
All malignant neoplasms (C00-D09)	1	1999–2002	3.3*	1.9	4.7
		2002–2008	0.6*	0.1	1.0
Stomach (C16)	0	1999–2008	-0.7	-2.3	0.8
Large intestine, rectum and anus (C18-C21)	0	1999–2008	3.4*	2.1	4.8
Pancreas (C25)	0	1999–2008	1.8	-1.1	4.7
Trachea, bronchus and lung (C33-C34)	1	1999–2001	6.3	-1.0	14.1
		2001–2008	0.1	-0.9	1.0
Prostate (C61)	0	1999–2008	2.5*	0.4	4.6
Female					
All malignant neoplasms (C00-D09)	0	1999–2008	1.6*	1.0	2.2
Stomach (C16)	0	1999–2008	-1.2	-3.1	0.7
Large intestine, rectum and anus (C18-C21)	0	1999–2008	0.5	-1.0	2.1
Pancreas (C25)	0	1999–2008	1.1	-1.2	3.4
Trachea, bronchus and lung (C33-C34)	0	1999–2008	5.3*	3.8	6.9
Breast (C50)	0	1999–2008	2.5*	0.7	4.3
Uterine cervix (C53)	0	1999–2008	-1.7	-4.8	1.5
Ovary (C56)	0	1999–2008	1.6	-0.2	3.4

*Indicates that the magnitude of the APC is statistically significantly different from zero ($p < 0.05$)

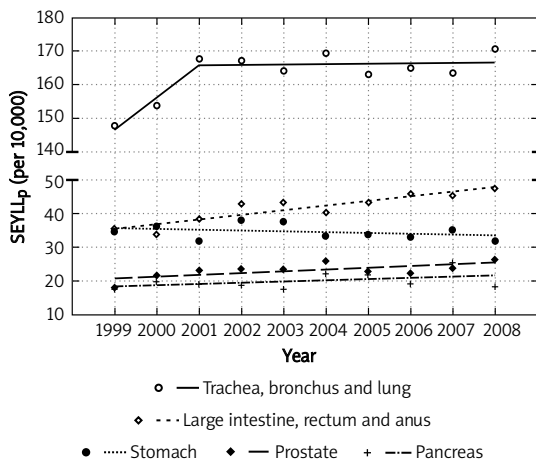


Figure 2. Trends of the number of years of life lost in males due to common malignant neoplasms according to location in the Lodz province from 1999 to 2008

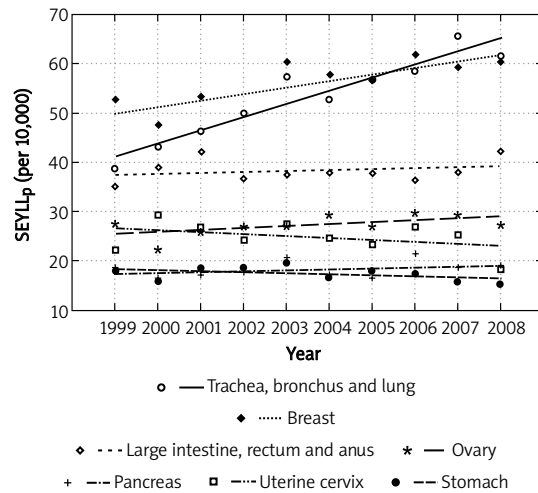


Figure 3. Trends of the number of years of life lost in females due to common malignant neoplasms according to location in the Lodz province from 1999 to 2008

21.4% of the total number of deaths. The percentage of expected years of life lost due to this reason was higher and it was 23.4%. The difference results from premature mortality in females, as in the 30–69 age group, like in the whole country, malignant neoplasms pose the most serious threat to life in female inhabitants of the Lodz province. A negative trend, referring to the number of lost

years and characteristic for both the sexes, seems worrying. After 2002 the pace of the increase slowed down in the male group to the annual value 0.6% and in the female group it is quicker – 1.6% per annum. One of causes of these negative tendencies is the process of ageing of inhabitants of the Lodz province. In 2008 people aged 65 or above made up 15% of the total population. The rate was

the highest in the country. Negative changes in the age structure of the analyzed population resulted in a slight, but stable increase in the mortality rate due to malignant neoplasms. In the group of males the increase was 3.6% in 1999–2002 and after 2002 it decreased to 0.1% per annum. In the female group the average annual increase in the mortality rate due to malignant neoplasms was 1.3%. The increase in the number of lost years was quicker however, which indicated that the process of ageing of the population is not the only cause of the analyzed problem.

Malignant neoplasms of the trachea, bronchus and lung most contributed to the increase in the number of lost years after 2002. In Poland, similarly to western Europe, the incidence of lung cancer in males started to drop, whereas in females it rapidly went up [13–17]. In the male group this kind of cancer still contributed to the greatest number of lost years. Nevertheless, after 2002 this growing trend stopped at the annual value 0.1%. In 2007 in the female population the death rate due to cancer of the trachea, bronchus and lung was for the first time higher than the death rate due to breast cancer [18]. Similar tendencies were observed in female inhabitants of the Lodz province. It is beyond any doubt that mortality due to tracheal, bronchial and lung malignant neoplasms is a consequence of smoking nicotine. A detailed analysis confirmed that in Poland, like in the other “new” European Union member states, young people smoke alarmingly a lot. It especially refers to young girls. In the mid-nineties of 20th century 27% young males and 13% of young females smoked. In 2002 the percentage of male smokers remained the same but with regards to female smokers, it became much higher. It was as high as 20% [19]. If this negative trend remains, we can expect a further increase in the number of years of life lost due to cancer of the trachea, bronchus and lung. Malignant cancer of breast has stopped occupying position number 1 as a contributing factor of the greatest number of years of life lost in females. However, this kind of cancer is still a serious life-threatening factor. The value of the SEYLL index confirms the fact. Poland is at a disadvantage when we compare the mortality rate due to breast cancer in a group of young females with females from other European countries [19]. It is forecasted that within coming decades the morbidity rate due to this kind of cancer will increase [20].

Poland is a country with the highest mortality rate due to cancer of the large intestine [21]. The number of years of life lost due to this kind of cancer is growing in the Lodz province, in both males and females. In the male group the pace of the increase is much quicker. In 2002–2004 due to cancer of the large intestine, rectum and anus inhabi-

tants of the European Union lost annually 45 SEYLL_p per 10,000 males and 39 SEYLL_p per 10,000 females. The country with the greatest loss, in both males and females, was Hungary (SEYLL_p: 90 and 72); the smallest loss was observed in Greece (SEYLL_p: 26 and 24 respectively) [5]. In the Lodz province the values were: 43 per 10,000 males and 37 per 10,000 females and they were slightly lower than the average values in Europe. Epidemiological analyses confirm that in the years 1999–2008 there was an increase in incidence of cancer of the colon in Poland [22] and the negative difference between Poland and the “old” European union member states with regards to cancer of the large intestine is still growing [23].

A relatively better observation was made with regards to the number of years of life lost in males due to prostate cancer. The mean value of the SEYLL_p index in the UE was 29 per 10,000 males. In the following Scandinavian and Baltic countries SEYLL_p was higher than average: Sweden (53), Norway (44), Denmark (42), Estonia (36) and Latvia (36). Poland (22), Slovakia (21), Romania (18) and Malta (17) observed the value of SEYLL_p was lower than average for the EU [5]. In the Lodz province the value of SEYLL_p was slightly higher than the mean value for Poland – 25 per 10,000 males. The number of years of life lost was however growing (APC = 2.5%). The fact results from the process of ageing of the population; the majority of deaths due to prostate cancer occurs in elderly men.

Less and less frequently does stomach cancer occur. Both in the UE and Poland [24]. The mortality rate and the number of years of life lost, both in males and females, were systematically decreasing.

Another decreasing trend was observed in the number of years of life lost due to uterine cervix cancer. Despite the positive trend, Poland, Romania, Bulgaria and other Baltic countries are still places which are threatened with this kind of cancer and the situation in these countries is the worst in the whole Europe. The mortality trend is decreasing. Yet, the difference between Poland and other European countries, especially Scandinavian countries, is not changing for good [25, 26]. Implementing screen tests which were to detect cancer of the uterine cervix have not been really successful, as too few women decide to undergo the tests, especially less educated and living in the rural environment [27, 28].

It should be pointed out that the authors of the study realize that they face certain limitations. One of the limitations of the SEYLL indicator is due to the fact that it includes only the primary death cause without identifying concurring causes. Similar limitations concern other indicators based on mortality data, but it is compensated by the comprehensiveness of data derived from national death

registers. The other limitations refer to a relatively short period of the analysis – 10 years, especially when it comes to the evaluation of SEYLL values. The authors might not have obtained reliable results if they had included the period before the year 1999. Before the administration reform, introduced on 1 January 1999, the Lodz province had a different area and a different number of people lived there.

The authors believe that the analysis of the data gathered from more than 300,000 death certificates (including 66,899 people who died of malignant neoplasms) as well as implementing a methodology which would allow for the evaluation of the number of lost years of life will make a good recording of economic and social aspect of losses caused by cancers and lessen the shortage of reference literature in this field.

In conclusion, the number of years of life lost due to malignant neoplasms in the Lodz province was growing from 1999 to 2008. The cancers which contributed to the greatest number of years of life lost included: tracheal, bronchial and lung malignant neoplasms, both in males and females, breast cancer in females and cancer of the large intestine, rectum and anus both in males and females. The most rapid increase in the number of years of life lost in the period 1999–2008 was caused by cancer of the trachea, bronchus and lung as well as breast cancer in females. In males this trend resulted from cancer of the large intestine, rectum and anus as well as prostate cancer. An average female inhabitant of the Lodz province who died in 2008 due to uterine cervix cancer lost almost 25 years of life. If she died of malignant neoplasms of the ovary, breast and trachea, bronchus and lung, she lost more than 20 years. Men lost a relatively smaller number of years of life due to malignant neoplasms; the SEYLL_d index was the highest (17 years) for tracheal, bronchial and lung cancers.

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