ORIGINAL PAPER

# Years of life lost due to bladder cancer among the inhabitants of Poland in the years 2000 to 2014

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**Introduction** The aim of the study is to evaluate the number of years of life lost in inhabitants of Poland due to bladder cancer (BC), identify trends of the mortality and calculate the pace of change which has happened over the period of the first fifteen years of the 21st century.
**Material and methods** The study material was a database including 44,283 death certificates of Polish inhabitants who died due to bladder cancer in the period 2000–2014. The number of years of life lost were calculated using the SEYLL indices: SEYLLp (Standard Expected Years of Life Lost per living person) and SEYLLd (Standard Expected Years of Life Lost per death).
**Results** The crude death rates (CDR) index increased from 10.79 per 100,000 males in 2000 to 14.30 in 2014 (Annual Percentage Change [APC] = 2.1%, p <0.05). In women, the group value of the CDR index increased from 2.50 in 2000 to 3.83 in 2014 (APC = 2.9%, p <0.05). The standardized death rates (SDR) index fell from 23.27 in 2000 to 22.48 in 2014 (APC =-0.1%, p >0.05) in men, but rose from 3.54 in 2000 to 3.83 in 2014 (APC = 0.4%, p <0.05) in women.
The SEYLLp index (per 100,000 population) due to bladder cancer in Poland increased from 202.9 in 2000 to 243.4 in 2014 (APC = 1.3%, p <0.05) in men, and from 40.4 in 2000 to 60.1 in 2014 (APC = 2.7%, p <0.05) in women.
**Conclusions** Despite the prolongation of patient life, as shown by the SEYLLd factor, Polish patients still lose too many years of life due to BC than compared to United States patients.

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**Key Words:** bladder cancer ‹› years of life lost ‹› premature mortality ‹› trends ‹› Poland

## INTRODUCTION

Bladder cancer (BC) is the seventh most commonly-diagnosed cancer in men and the eleventh in both sexes. The age-standardized incidence rate (per 100,000 citizens) is reported as being high as 19.1 for men and 4.0 for women across the European Union as a whole [1]. Although incidence and mortality rates are steadily decreasing in most western European countries, they have been observed to increase in several eastern European and developing countries [2]. In the European Union, the highest bladder cancer mortality rates are found in Poland, Spain, Hungary and Denmark for men (≈8/100,000),

and in Denmark, the United Kingdom, Norway and the Czech Republic for women (1.6–2.7/100,000) [3]. The treatment of BC depends on transurethral resection (TUR) of the tumor followed by adequate T-stage assessment of the resected tissue by a pathologist. Approximately 75% of newly-diagnosed examples of BC are noninvasive (pTa, pT1, CIS) and have a high rate of recurrence and progression despite local therapy. The remaining 25% of newly-diagnosed urinary bladder cancer cases present with muscle invasion (pT2–pT3) and require radical surgery or radiotherapy, and have poor outcomes despite systematic therapy [4, 5]. There is clearly a need for urologists to provide new forms of effective

treatment and follow-up for patients to improve and provide better outcomes.

In Poland, urinary bladder cancer remains the fourth most common malignancy in men and the fourteenth in women, with an age-standardized incidence of 17.2 for men and 3.8 for women. Mortality due to urinary bladder cancer has grown for more than four decades for both sexes [6].

In Poland, this premature mortality has a direct influence on the number of years lost by the population. Measures used for calculating mortality in units of lost time are growing in popularity in international studies. Many authors believe them to be more reliable indicators of the economic and social impact of loss connected with premature mortality than other, commonly-used measures [7–13]. An analysis of particular diseases contributing to mortality in highly-developed countries based on standardized mortality rates indicates that the most important mortality factor is the group of cardiovascular diseases. However, since these diseases contribute to death more in the elderly people than in the younger ones, they entail fewer serious social and economic implications than factors which contribute to the mortality of younger people. These difference scan be better highlighted using measures based on the number of years of life lost.

The aim of the study was to evaluate the years of life lost in inhabitants of Poland due to bladder cancer, identify trends in mortality and calculate the pace of change occurring over the first fifteen years of the 21$^{st}$ century.

## MATERIAL AND METHODS

The analysis was based on the official database of all death certificates of the inhabitants of Poland who died in the years 2000–2014. These were made available for this study by the Department of Information of the Polish Central Statistical Office.

Crude death rates (CDR) and standardized death rates (SDR) were calculated according to standard formulas described in detail in our previous work [14].

CDR are used to determine the number of deaths in a population due to bladder cancer per year in relation to population size.

$$CDR = \frac{k_i}{p_i} \times 100{,}000$$

where: $k_i$ is the number of death in i-this age group, $p_i$ is population size of i-this age group, i – number of the age group

The CDR value is very useful, as it represents the true extent of the mortality associated with an illness and allows its demand on specific health services to be estimated. However, it has the disadvantage that it cannot be used for comparisons: CDR is closely dependent on the internal structures of the populations being compared, particularly the age structure of the population. This coefficient is higher in the case of a population characterized by a significant proportion of elderly than one without.

In order to present mortality in such a way for it to be comparable over time and between different populations, SDR is calculated. The SDR allows the number of deaths which would occur in the tested population to be determined, assuming that the age structure of the test population is the same as that of the population adopted as a standard; or rather, if the differences resulting from the different age structures of the compared populations were eliminated.

$$SDR = \frac{\sum\limits_{i=1}^{N} \frac{k_i}{p_i} \times w_i}{\sum\limits_{i=1}^{N} w_i}$$

where: $k_i$ is the number of deaths in i-this age group, $p_i$ is population size of i-this age group, $w_i$ is the weight assigned to the i-this age group, resulting from the distribution of the standard population, i – number of the age group

The standardization procedure was performed using a direct method, in compliance with the European Standard Population data, updated in 2012 [15]. Years of life lost were calculated and analyzed using the method described by Murray et al. [16]. The SEYLL index (Standard Expected Years of Life Lost) was calculated from the expected remaining years, as specified by a normative survivorship derived from model life tables for the referential (standard) population. A few methods can be used to calculate the number of years of life lost and the main difference between them is the choice of reference point, i.e. the mortality level which is considered 'ideal'. To avoid chance fluctuations in death, the WHO Global Burden of Disease (GBD) 2010 study developed a new reference standard life table based on the identification of the lowest observed death rate for any age group in countries with a population greater than five million [15]. In the present study, the SEYLL index was calculated according to the following formula:

$$SEYLL_p = \sum_{x=0}^{l} d_x e_x$$

where: $d_x$ stands for the number of deaths at age x, $e_x$ is the number of expected years of life that remain to be lived by the population which is at age x, based on GBD 2010 life table and $l$ is the age of the oldest dead person.

The authors also calculated the $SEYLL_p$ (per living person) index, where the absolute SEYLL number was compared with the size of the Polish population in particular years and $SEYLL_d$ (per death) index, which relates the absolute SEYLL numbers to the number of subjects who died due to the analyzed cause.

The analysis of time trends was carried out with Joinpoint Regression, a statistical software package developed by the U.S. National Cancer Institute for the Surveillance, Epidemiology and End Results Program [17]. The data in the present study was analyzed using a linear regression model where the natural logarithm of the studied measures was a dependent variable and the calendar year was an independent variable (y = a+bx, where y = ln of the analysed measures, x = calendar year). Annual Percentage Change (APC) of the rate values for each trend was calculated according to the following formula formula:

$$APC = 100 \times (\exp^b - 1)$$

To assess changes in the numbers of deaths over time, the Annual Percentage Change (APC) factor was calculated with a corresponding 95% confidence interval (CI).

## RESULTS

Bladder cancer is classified as ICD-10 code C67 according to International Statistical Classification of Diseases and Health Related Problems – Tenth Revision – ICD-10. It was found to be the cause of death of 44,283 inhabitants of Poland during the analyzed 15- year period, i.e. 2000 to 2014. The number of deaths due to BC increased in both sexes during this time period (Table 1). For men, the CDR factor increased from 10.79 per 100,000 men in 2000 to 14.30 in 2014, with an Annual Percentage Change (APC) of 2.1% (p <0.05) (Figure 1); while in women, the CDR increased from 2.50 in 2000 to 3.83 in 2014 (APC = 2.9%, p <0.05). The SDR factor fell slightly from 23.27 in 2000 to 22.48 in 2014 for men (APC = -0.1%, p >0.05), while for women, it increased from 3.54 in 2000 to 3.83 in 2014 (APC = 0.4%, p <0.05) (Figure 1).

In total, 37,516 years of life were lost for men and 7,970 for women due to BC in the year 2000 (Table 2); these values rose to 45,312 years for men and 11,930 years for women in the year 2014. Comparing these two sets of values, 202.9 years of life were lost per 100,000 men and 40.4 per 100,000 women in 2000; while in 2014, these values were 243.4 per 100,000 men and 60.1 per 100,000 women.

**Table 1.** *Number of deaths, crude death rates (CDR) and standardized deathrates (SDR) per 100,000 in habitants due to bladder cancer in Poland, 2000–2014*

| Years | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | Number of deaths | CDR (per 100,000) | SDR (per 100,000) | Number of deaths | CDR (per 100,000) | SDR (per 100,000) |
| 2000 | 1999 | 10.79 | 23.27 | 493 | 2.50 | 3.54 |
| 2001 | 1976 | 10.67 | 22.43 | 530 | 2.69 | 3.72 |
| 2002 | 2070 | 11.19 | 23.30 | 514 | 2.61 | 3.49 |
| 2003 | 2284 | 12.36 | 24.96 | 522 | 2.65 | 3.47 |
| 2004 | 2262 | 12.25 | 24.36 | 533 | 2.71 | 3.43 |
| 2005 | 2158 | 11.69 | 22.53 | 586 | 2.97 | 3.73 |
| 2006 | 2218 | 12.04 | 22.89 | 588 | 2.98 | 3.61 |
| 2007 | 2376 | 12.91 | 24.02 | 611 | 3.10 | 3.69 |
| 2008 | 2354 | 12.78 | 23.42 | 653 | 3.31 | 3.82 |
| 2009 | 2499 | 13.56 | 24.19 | 647 | 3.28 | 3.71 |
| 2010 | 2470 | 13.24 | 23.30 | 641 | 3.22 | 3.58 |
| 2011 | 2559 | 13.72 | 23.61 | 678 | 3.41 | 3.67 |
| 2012 | 2550 | 13.67 | 22.83 | 674 | 3.39 | 3.55 |
| 2013 | 2686 | 14.42 | 23.59 | 727 | 3.66 | 3.80 |
| 2014 | 2662 | 14.30 | 22.48 | 761 | 3.83 | 3.87 |
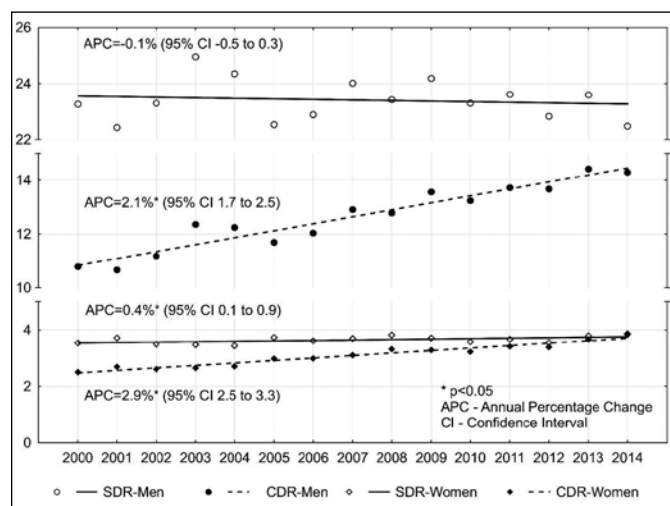
**Figure 1.** *Time trends in crude death rates (CDR) and standardized death rates (SDR) per 100,000 persons due to bladder cancer in Poland, 2000–2014.*
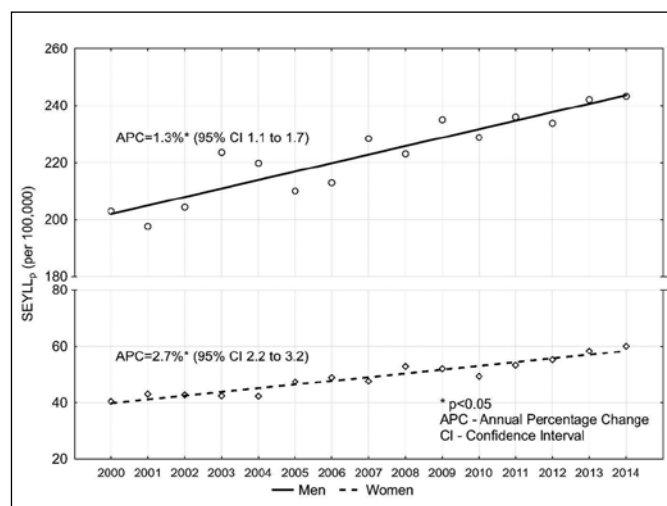


**Figure 2.** *Time trends in standard expected years of life lost per living persons (SEYLLp) due to bladder cancerin Poland, 2000–2014.*

The SEYLLp factor therefore grew by 1.3% annually (p <0.05) in men and 2.7% annually (p <0.05) in women (Figure 2).

Every man who died in the year 2000 due to BC lost an average of 18.8 years of life (SEYLLd), while in the year 2014, this factor fell to 17 years. Similarly, the number of life years lost per one woman fell from 16.2 years in the year 2000 to 15.7 years in the year 2014.

## DISCUSSION

This paper presents an analysis of life years lost due to BC. It is the first study to assess the burden of BC in Polish inhabitants, expressed as years of life lost. The analyzed data demonstrates the changes occurring over the space of 15 years which should be considered unsatisfactory in terms of the efficacy of treatment: Although the number of life years

**Table 2.** *Number of years of life lost due to bladder cancer in absolute numbers (SEYLL), indices per 100,000 population (SEYLLₚ) and indices per single death (SEYLLₐ)*

| Years | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | SEYLL | SEYLL$_p$ (per 100,000) | SEYLL$_d$ | SEYLL | SEYLL$_p$ (per 100,000) | SEYLL$_d$ |
| 2000 | 37,615 | 202.9 | 18.8 | 7,970 | 40.4 | 16.2 |
| 2001 | 36,619 | 197.7 | 18.5 | 8,480 | 43.0 | 16.0 |
| 2002 | 37,817 | 204.3 | 18.3 | 8,415 | 42.7 | 16.4 |
| 2003 | 41,332 | 223.6 | 18.1 | 8,358 | 42.4 | 16.0 |
| 2004 | 40,606 | 219.8 | 18.0 | 8,326 | 42.3 | 15.6 |
| 2005 | 38,769 | 210.1 | 18.0 | 9,346 | 47.4 | 15.9 |
| 2006 | 39,236 | 212.9 | 17.7 | 9,647 | 49.0 | 16.4 |
| 2007 | 42,058 | 228.4 | 17.7 | 9,382 | 47.6 | 15.4 |
| 2008 | 41,079 | 223.1 | 17.5 | 10,415 | 52.8 | 15.9 |
| 2009 | 43,313 | 235.0 | 17.3 | 10,271 | 52.0 | 15.9 |
| 2010 | 42,684 | 228.8 | 17.3 | 9,819 | 49.4 | 15.3 |
| 2011 | 44,019 | 236.0 | 17.2 | 10,594 | 53.3 | 15.6 |
| 2012 | 43,606 | 233.8 | 17.1 | 10,972 | 55.2 | 16.3 |
| 2013 | 45,115 | 242.2 | 16.8 | 11,586 | 58.3 | 15.9 |
| 2014 | 45,312 | 243.4 | 17.0 | 11,930 | 60.1 | 15.7 |

lost due to BC had slowly decreased, the number of deaths continued to increase. This increase in the CDR value could to some extent be a result of the aging of the population of Poland, as shown by a comparison with the rate of change in standardized mortality rates, which are independent of changes in the age structure. However, as the SDR factor was used, the lack of positive changes in mortality from BC could not be explained only by an aging population. The lower SEYLLd value indicated that the patients tend to be older at the time of first diagnosis of BC, or that their life was prolonged. The results indicate that BC causes more years of life lost in men than women, which was not surprising because BC is much more common in men than women, and the absolute number of BC deaths is greater. A similar analysis of patients diagnosed with BC in the United States of America found that loss of median life expectancy at diagnosis was 3.9 to 12 years for men and 6.5 to 13 years for women [18, 19]. BC has strong associations with smoking, and many patients with BC have a long smoking history. [20]. Smoking is a well-known cause of other cancers, most notably lung cancer, as well as cardiovascular disease [21]. However, the circumstances underpinning the current situation and pace of change in Polish patients diagnosed with BC are complex; however, cigarette smoking is one of the most well-established factors [22]. In the first few years of the 21$^{st}$ century in Poland, smokers made up about 43% of the male population and 23% of the female population [23]; these numbers fell to 33% for men, but remained approximately constant at 23% for women. The prevalence of tobacco-related disease among women is currently increasing due to the cohort effect, i.e. birth time during the calendar period. The highest level of smoking, which could sometimes reach 50%, was observed in the generation of women born between 1940 and 1960. In the population of women born after 1960, the proportion of smokers fell to between 20 and 25%. With regard to another smoking-related cancer, such as lung cancer, the trends in women of different age and time groups can be accurately explained by exposure to carcinogenic tobacco smoke after 20 years of latency. The observed cohort effect causes the morbidity and mortality of these cohorts to show an upward trend that will continue for some time [24, 25]. In the mid-1970s and early 1980s, 65% to 75% of Polish men aged 20 to 60, smoked cigarettes every day, and by 1990, over 40% of Polish men were dying prematurely from smoking-attributed diseases. The data presented above refers to patients who smoked and are currently over the age of 65 and who could potentially have BC now or in the future.

In Poland, 80% of deaths from BC were reported after 65 years of age and most deaths were recorded in the eighth decade of life for men, and in the ninth decade of life for women. Worryingly, between 2010 and 2011, 23.9% of younger people aged 15–19 were smoking, compared to 38.0% in the years 2013–2014 [26], and this growing incidence of smoking among young people has disturbing implications for the future.

There is no well-evidenced national base of results for patients with BC treated in Polish Urology departments. In recent years, only a few reports have described the results of BC treatment, but their outcomes are not satisfactory. In one such multicenter study enrolling 1,360 consecutive patients diagnosed with primary urothelial carcinoma of the bladder in the years 2012–2013, the authors emphasize that the high mortality rate from BC in Central Europe could result from the very high incidence of high-risk T1 tumors and high prevalence of prognostic factors of poor survival [27]. In 63 patients who underwent radical cystectomy (RC), the five-year overall surivival (OS) was 31.7%, which was notably inferior to other European high volume Urological Centers. The authors note that the mortality rate in Polish centers is much higher than in most published series [28]. Another analysis of 902 patients who underwent RC found the mean time interval between diagnosis and radical treatment of patients with BC in Central Europe to be adequate, but emphasized that a relatively high number of patients who still had to wait longer than eight weeks for radical cystectomy [29].

Although BC stage is the most important predictor of disease-specific outcomes, the present study did not separate patients by individual stage due to the lack of appropriate data. This type of analysis could be helpful in daily practice; however, it has certain limitations. Comparing life expectancy derived from model life tables for the referential (standard) population to the analysis of BC patient is of questionable value.

Although we believe that Polish urologists can provide better treatment outcomes, they have to suffer restrictions which are not their own, but are unfortunately placed on them by the health system that prevails in Poland.

## CONCLUSIONS

Despite the prolongation of patient life, as shown by the Standard Expected Years of Life Lost per death (SEYLLd) factor analysis, Polish patients still lose too many years of life due to bladder cancer (BC) when compared to the United States patients. Despite the complexity of the disease and the profile of patients, there is an urgent need to implement better treatment

and follow-up. To optimize overall survival and the quality of life of patients, the development of an appropriate predictive tool for the Polish population should be prioritized, as this could be invaluable in identifying patients which require more aggressive treatment to improve outcomes. In response to the large number of tobacco- related diseases, including bladder cancer, greater emphasis needs to be placed on raising awareness of the subject of healthy living, beginning in primary school. As prevention is widely regarded as being better than cure, it is recommended that restrictions on smoking in certain places should be tightened further and the price of cigarettes raised.

**CONFLICTS OF INTEREST**

The authors declare no conflicts of interest.

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