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PREMATURE MORTALITY DUE TO CANCER IN ŚWIĘTOKRZYSKIE PROVINCE (POLAND) IN 1999-2010

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ABSTRACT

THE PURPOSE OF THE STUDY. The purpose of the study was to analyze the level and the trends of premature mortality caused by selected cancers in Świętokrzyskie Province in years 1999-2010.

MATERIAL AND METHODS. The material for the study was the data published in the Świętokrzyskie Cancer Registry on the number of deaths caused by cancers as well as the information from the Central Statistical Office on the number of deaths due to general death causes in Świętokrzyskie Province in years 1999-2010.

The premature mortality analysis was conducted with the use of PYLL indicator (PYLL - potential years of life lost). PYLL rate was calculated according to the method proposed by *J. Romeder*, according to which the premature mortality was defined as death before the age of 70. Time trends of PYLL rate and the average annual percent change (APC - annual percent change) were assessed using *jointpoint* models as well as the *Jointpoint Regression Program (Version 4.0.1 – January 2013)*.

RESULTS. In year 2010 cancers were responsible for 18.3% of PYLL in men and 48.1% in women. In years 1999-2010 PYLL rate in men decreased due to lung cancer (APC=0.75%) and stomach cancer (APC=1.2%). The increase in rate of PYLL was noted for colorectal cancer (APC=3.3%, $p<0.05$) and prostate cancer (APC=1.6%). In women, rate of PYLL increased due to lung cancer (APC=6.2%, $p<0.05$), colorectal cancer (APC=2.9%), breast cancer (APC=1.8%) and ovarian cancer (APC=0.15%). Rate of PYLL decreased due to cervical cancer (APC=4.3%, $p<0.05$) and stomach cancer (APC=1.5%).

SUMMARY AND CONCLUSIONS. During the analysed period the highest increase of premature mortality was observed in colorectal cancer in both sexes and lung cancer in women, a slightly smaller increase was noted for breast cancer and prostate cancer. What is particularly important is the trend and a slight decrease of premature mortality rate caused by lung cancer in men and its significant decrease for cervical cancer as well as stomach cancer in both sexes.

Key words: cancers, potential years of life lost, premature mortality, Świętokrzyskie Province

INTRODUCTION

The concept of potential years of life lost (PYLL - potential years of life lost) assumes that the aim of activities undertaken within the healthcare system is to save lives. First of all, to avoid premature deaths,

which would not have occurred if it had been possible to prevent illness, early detect it, treat it and provide rehabilitation thanks to social education, health care and promotion of health (1, 2).

A traditional mortality rate allows for the analysis of time trends and the comparison of premature mortality

in various populations. Though, it does not include the social and economic burden of premature death for a society. PYLL rate complements the premature mortality analysis since it includes the number of deaths resulted from a particular cause as well as the age-at-death (3).

Potential years of life lost (PYLL) is the indicator which arbitrarily assumes the life expectancy, e.g. in OECD countries, it is set for the age of 70 (4). Considering this death at the age of 50 is accountable for 20 potential years of life lost. Thus, deaths in younger age groups cause greater social and economical loss burden because they are the reason for more potential years of life lost.

Knowledge about the causes, level and time trends in premature deaths in a population is essential to determine priorities in health care planning and to measure their effectiveness (3). Such measures, especially these concerning preventive medicine at primary and secondary levels, improvement in availability of optimal treatment, as well as better social – economic conditions of a population may contribute to a decrease of potential years of life lost (5).

Cancers, cardiovascular disease, and external causes (injuries and accidents) are the major causes of premature mortality in Poland. Cancers are the first cause of potential years of life lost in women and the second in men (6).

The aim of the study was to analyse the levels and trends of premature mortality caused by selected cancers in Świętokrzyskie Province in years 1999-2010.

MATERIAL AND METHODS

The material based on the data from the Świętokrzyskie Cancer Registry on the number of deaths, caused by cancers together with the data from the Central Statistical Office on the number of registered deaths due to general causes of death in Świętokrzyskie Province in years 1999 – 2010 (7, 8). The population of Świętokrzyskie Province between years 1999 and 2010

consisted on average of 1 277 214 inhabitants, 628 067 men and 659 147 women (9).

Causes of death were coded according to the 10th revision of the International Classification of Diseases (10). Potential years of life lost (PYLL) were calculated according to the method proposed by *J. Romeder* (11).

The number of deaths in 5-year age groups was used to calculate PYLL in Świętokrzyskie Province in years 1999 – 2010. The calculations were made according to the formula:

$$PYLL = \sum_{i=0}^{70} d_i \times (70 - i)$$

where,

70 – is the cut-off age before death occurrence

i – is the average number of potential years of life lost due to death causes registered at a given age group (e.g. 42.5 years for the age group 25 – 29)

d_i – is the number of deaths in *i* age group.

PYLL rate was calculated as a quotient of PYLL number and the number of inhabitants in Świętokrzyskie Province at the age group 1 - 69. PYLL rate was calculated per 100 000 people, separately for both sexes.

PYLL number and PYLL rate were calculated for general-causes of deaths, all deaths caused by cancers, and separately for selected cancers in men and women.

Statistical analysis. Time trends for PYLL rate in years 1999 – 2010 in Świętokrzyskie Province were analysed for general-causes of deaths, all deaths caused by cancers, and separately for selected cancers in men and women.

The changes in PYLL rates were analysed using the *joinpoint* models. This method is an extension of linear regression model, in which the time trend is determined by the joined log-linear segments (*joinpoints*) at which changes in time trends occur in a statistically significant way ($p < 0.05$) (12).

On the basis of the linear regression model, in which the natural logarithm of PYLL rate was a dependent

Table I. Trends of rate of potential years of life lost in Świętokrzyskie Province in 1999-2010.

	Rate of PYLL/10 ⁵				Trend		
	1999	%	2010	%	Time	APC ^b	95% CI ^c
Men							
All causes	8240.5	100.0	8913.8	100.0	1999-2007	+2.1 ^d	(1.5; 2.8)
					2007-2010	-3.4 ^d	(-6.2; -0.5)
All cancers	1705.1	21.0	1630.5	18.3	1999-2007	+1.4 ^d	(0.4; 2.5)
					2007-2010	-4.0	(-8.6; 0.7)
Women							
All causes	3050.6	100.0	2975.5	100.0	1999-2010	-0.3	(-0.9; 0.4)
All cancers	1114.5	36.5	1243.0	41.8	1999-2010	+0.3	(-0.6; 1.2)

a – rate of potential years of life lost per 100 000 population b – Annual Percent Change

c – Confidence Interval

d – the APC is statistically significantly different from zero ($p < 0.05$)

variable, and the calendar year was an independent variable

($y = a + bx$, where $y = \ln(\text{PYLL rate})$, $x = \text{calendar year}$),

APC (annual percent change) of PYLL rates for each trend was determined according to the following formula:

$$\text{APC} = 100 * (\exp^b - 1).$$

A confidence interval of 95% was set in order to estimate the statistical significance of APC level in the analysed period. The significance level was fixed at $p < 0.05$.

The trends and APC were analysed using the *Joinpoint Regression Program (Version 4.0.1 – January 2013)* (13).

RESULTS

As presented in Table I, in years 1999 – 2007 PYLL rate for men for all death causes increased by 2.1% per year ($p < 0.05$). From year 2007, the trend changed and decreased, and PYLL rate decreased till year 2010 by 3.4% per year ($p < 0.05$). In women, though, the trend during the analysed period decreased more slowly.

In year 2010, cancers in men were the cause of 18.3% PYLL. This percentage was 2.7 percentage points lower than in year 1999. Up to year 2007, PYLL rate increased by 1.4% per year ($p < 0.05$), and then, similarly to all death causes, it also changed its trend and decreased by 4.0% per year.

In women, in year 2010 there was a 41.8% of PYLL caused by cancers, and it was 5.3 percentage points higher than in year 1999. (Table I. Trends of rate of potential years of life lost in Świętokrzyskie Province in 1999 – 2010).

Tables II and III present the number of premature deaths together with rates and trends of PYLL caused by selected cancers in years 1999 – 2010 separately in women and men.

The highest PYLL rate in year 2010 in men was $537.6/10^5$ for lung cancer. In comparison to year 1999, the rate slightly decreased, and the average annual trend change was 0.75%. PYLL rate also decreased for stomach cancer. However, a significant increase of the rate was for colorectal cancer with its annual trend change of 3.3% ($p < 0.05$). PYLL rate for prostate cancer also increased (annual change 1.6%).

In women, in year 2010 PYLL rate was the highest for breast cancer and grew up to $242.0/10^5$. It increased on average by 1.8% per year. The biggest changes were noticed for lung cancer, the average annual increase of the rate was 6.2%, and it was statistically significant ($p < 0.05$). PYLL rate also increased for colorectal cancer (2.9% per year) and ovarian cancer (0.15% per year). Positive changes concerned the PYLL decrease for cervical cancer in women, on average 4.3% per year ($p < 0.05$) as well as for stomach cancer, 1.5% per year.

(Table I. Number of deaths in 1 – 69 age group and rate of potential years of life lost due to cancer in men in Świętokrzyskie Province in years 1999 – 2010).

Table II. Number of deaths in 1 – 69 age group and rate of potential years of life lost due to cancer in women in Świętokrzyskie Province in years 1999 – 2010).

Table II. Number of deaths in 1-69 age group and rate of potential years of life lost^a due to cancer in men in Świętokrzyskie Province in 1999-2010.

	Stomach cancer		Colorectal cancer		Lung cancer		Prostate cancer		All cancers	
	Number of deaths	PYLL ^a	Number of deaths	PYLL ^a	Number of deaths	PYLL ^a	Number of deaths	PYLL ^a	Number of deaths	PYLL ^a
1999	69	123.8	65	119.8	350	585.3	31	31.5	918	1705.1
2000	57	87.3	69	124.2	340	577.3	29	27.5	866	1606.2
2001	66	90.6	58	92.3	361	583.8	22	22.2	930	1700.8
2002	71	124.7	76	145.8	372	628.0	36	38.8	919	1757.6
2003	80	176.8	65	107.0	360	596.1	24	27.7	892	1700.0
2004	49	93.5	87	138.8	310	544.7	28	45.2	871	1697.1
2005	72	143.4	68	112.8	354	626.1	42	48.1	930	1804.0
2006	60	100.3	73	141.3	361	620.9	24	30.8	907	1840.8
2007	55	100.9	79	142.1	306	624.5	27	31.0	901	1851.4
2008	63	125.8	81	141.8	318	552.9	17	17.3	903	1792.1
2009	50	85.6	77	150.2	294	511.7	31	38.8	842	1676.8
2010	52	92.3	102	174.1	331	537.6	33	44.4	903	1630.5
APC ^b		-1.2		+3.3 ^d		-0.75		+1.6		*
95%CI ^c		(-5.4; 3.2)		(0.8; 5.9)		(-2.0; 0.5)		(-4.2; 7.7)		

a – rate of potential years of life lost per 100 000 population b – Annual Percent Change

c – Confidence Interval

d – the APC is statistically significantly different from zero ($p < 0.05$)

*- APC and 95% Confidence Interval are in Table I

Table III. Number of deaths in 1-69 age group and rate of potential years of life lost^a due to cancer in women in Świętokrzyskie Province in 1999-2010.

	Stomach cancer		Colorectal cancer		Lung cancer		Breast cancer		Cervix uteri cancer		Ovarian cancer		All cancers	
	Number of deaths	PYLL ^a	Number of deaths	PYLL ^a	Number of deaths	PYLL ^a	Number of deaths	PYLL ^a	Number of deaths	PYLL ^a	Number of deaths	PYLL ^a	Number of deaths	PYLL ^a
1999	26	46.3	53	82.2	41	84.7	89	194.7	48	133.9	42	97.5	539	1123.6
2000	32	39.8	45	85.9	49	92.5	101	212.8	51	142.3	41	96.7	557	1175.8
2001	27	54.7	42	81.8	64	126.8	101	231.6	39	108.9	41	93.9	578	1246.5
2002	22	38.3	52	96.5	50	93.9	93	227.4	31	101.3	28	68.7	489	1114.5
2003	27	59.0	36	55.1	64	130.3	106	267.6	39	116.7	33	75.6	549	1271.9
2004	24	57.5	43	76.9	57	108.5	76	188.9	21	97.5	33	77.7	515	1165.2
2005	22	29.1	39	81.7	62	135.1	91	234.5	41	108.2	37	96.7	502	1128.0
2006	19	38.7	51	102.6	84	173.3	86	215.1	36	83.5	35	86.6	535	1234.7
2007	17	43.4	49	85.4	91	181.0	85	203.4	47	133.6	33	83.6	550	1214.8
2008	21	38.2	53	97.4	81	169.2	113	300.3	37	83.0	34	79.0	573	1229.4
2009	20	43.3	53	106.8	74	152.4	97	259.2	32	79.3	41	84.3	525	1127.4
2010	20	41.2	62	115.6	85	149.2	104	242.0	30	78.9	50	109.3	564	1243.0
APC ^b		-1.5		+2.9		+6.2 ^d		+1.8		-4.3 ^d		+0.15		*
95% CI ^c		(-5.2; 2.3)		(-0.3; 6.2)		(3.2; 9.2)		(-0.6; 4.2)		(-6.9; -1.6)		(-2.4; 2.8)		

a – rate of potential years of life lost per 100 000 population

b – Annual Percent Change

c – Confidence Interval

d – the APC is statistically significantly different from zero ($p < 0.05$)

* - APC and 95% Confidence Interval are in Table I

DISCUSSION

In Poland, from the mid 1960s to the end of 1980s, premature mortality in men was increasing systematically whereas it remained on the same level in women. After year 1991, a slowdown in trend for men and women was seen, and then, a reverse change and a decrease in premature mortality were observed. The most important cause of these changes was a decrease in mortality due to cardiovascular disease (14).

Despite those changes, in years 1995 – 2007, Poland stood out from the other countries for having one of the highest levels of premature mortality in the European Union, and the pace of favourable PYLL rate changes was among the slowest ones in the EU (15).

In years 1999 – 2010 in Świętokrzyskie Province, PYLL rate was about 3 times higher in men than in women. Those results correspond with higher general mortality in men than women in Poland. In year 2010 an average surplus in mortality rates among men in comparison to women amounted to approximately 65%, in Poland it was higher – 91%. Higher mortality in men in Poland occurred at all age groups, but was the highest in persons above the age of 60 (16).

The results of the research show that till year 2007 PYLL rate in Świętokrzyskie Province increased in men due to all death causes as well as cancers, and those changes were statistically significant. After year 2007 the trend favourably changed and PYLL rate began to decrease. It seems that the trend change was, among the others, due to the increased mortality of lung cancer in men. Moreover, improvement in cancer curability in general also influenced that fact (17). In women, though, PYLL rate increased slightly, which may result from the fast increase in premature mortality due to lung cancer.

In women, PYLL rate had a slight and statistically insignificant increase due to overall cancers, which was probably caused by a statistically significant increase in premature mortality due to lung cancer.

According to the OECD data, in Europe, in year 2007 the major cause of potential years of life lost in men were: external causes – injuries and accidents (29%), cancers (21%) and cardiovascular disease (18%). As for women, those were cancers (31%), external causes (17%) and cardiovascular disease (13%) (15).

In Poland, in year 2006, cancers were the major cause of 19% of PYLL in men and 37% – in women (6). Till year 2010 the situation did not change significantly and in Poland cancers remained the third primary cause of premature mortality in men, and the first in women (16).

The results of the research show that in year 2010 in Świętokrzyskie Province cancers were the causes of 18.3% of PYLL in men and 41.8% in women.

Favourable changes in PYLL rate, though statistically insignificant, were noted for stomach cancer in both sexes and lung cancer in men. A favourable and statistically significant change was also for cervical cancer in women.

In Świętokrzyskie Province, however, unfavourable changes were prevalent, which indicate the increase of threat of premature mortality. The fastest and statistically significant pace of increase in PYLL was caused by colorectal cancer in men and lung cancer in women. An increasing trend was noted for prostate cancer in men, and colorectal cancer, breast cancer and ovarian cancer in women.

The analysis of time trends as well as epidemiological prognosis indicate that the threat of cancers in Poland will grow (18). The threat of colorectal cancer in both sexes, lung and breast cancer in women and prostate cancer in men is expected to rise. The results of the research suggest that changes in Świętokrzyskie Province will be similar.

In Poland, lung cancer is still the leading cause of death, however, the trends are different for either sex. In men, the general mortality trend decreases slowly whereas it increases rapidly in women. Similar changes, especially in the female population, have also been noticed in many EU countries (19). In other countries, for example: France, Spain, Italy the trend is either stable or decreases (20).

Lung cancer belongs to preventable diseases. The results of the research and the ones published for the country show that measures undertaken to fight tobacco smoking have a certain favourable influence in men, however, they are of small effectiveness in women, which should be related to cultural changes running in the Polish society (18,19).

In the last thirty years in Poland incidence and mortality due to colorectal cancer have increased. In men, that increase was the fastest among cancers. In Świętokrzyskie Province the trend was similar. Also, in women premature mortality due to colorectal cancer increased. Although the trend was not statistically significant in women, but it indicates the increase of threat of this cancer in the region.

The risk of death due to colorectal cancer in Poland, the Czech Republic, Slovakia and Hungary belongs to the highest in Europe, and the spread between Poland and North-West European countries systematically grows (21).

Premature deaths due to colorectal cancer are preventable through intensified primary prevention based on modification of risk factors related to lifestyle, secondary prevention based on colonoscopy and fecal occult blood tests, and finally, the improvement of standards of diagnosis and treatment. Population screenings carried out in the 90s showed that standards

of diagnosis and treatment were seldom followed (22). It should be expected that a modern Cancer Centre, which systematically develops its actions will overcome the unfavourable changes.

Cervical cancer is also a cancer which can be effectively prevented. Poland is a country of mid/high risk of incidence and mortality due to cervical cancer. In Europe, the risk is higher in Romania and Bulgaria. Although in Poland general mortality due to cervical cancer decreases, the distance between Poland and Western European countries does not become smaller (23). The presented results show that premature mortality trend due to cervical cancer in Świętokrzyskie Province was similar to the general mortality trend in Poland, and was also too slow, which calls for the need of intensification of prevention and improvement of treatment standards.

Cancers account for the main health, social and economic burdens in highly developed countries, thus, problems related to this threat require systematic and multi-dimensional involvement of all health care institutions. In Poland, The *National Cancer Control Programme* has been implemented (24). The Programme focuses on the country's priorities, complying with the recommendations of the European Union included in the *Strategies for Cancer Control* (25). According to these recommendations the health results of undertaken interventions ought to be carefully monitored and evaluated using *Cancer Health Indicators (CHI)*. They constitute the basis for intervention modifications in case the expected health results have not been achieved. The indicator recommended for the evaluation of premature mortality due to cancers is the rate of potential years of life lost (26).

SUMMARY AND CONCLUSIONS

In men, in Świętokrzyskie Province, the trend changed after year 2007 and PYLL rate started to decrease after a period of fast increase in premature mortality due to all causes, including cancers. In women, it decreased slowly, but systematically.

In the analyzed period, the highest increase in premature mortality was noted for colorectal cancer in both sexes, and lung cancer in women ($p < 0.05$), and to a lesser extent, for breast cancer and prostate cancer ($p < 0.05$) in men. Especially important are the trend and a slight decrease in premature mortality due to lung cancer in men, and a significant decrease in premature deaths due to cervical cancer ($p < 0.05$) as well as stomach cancer in both sexes.

As the research concludes, it is absolutely necessary to intensify prevention measures and improve treatment standards in Świętokrzyskie Province so as the issues of

premature mortality due to cancer may be adequately addressed.

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