

## TRENDS OF PREMATURE MORTALITY IN ŚWIĘTOKRZYSKIE PROVINCE (POLAND), YEARS 2002-2010

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### ABSTRACT

**Background.** Premature mortality in younger age groups influences the society as far as social and economic aspects are concerned. Therefore, it is important to come up with a tool which will allow to assess them, and will enable to implement only these health care measures that bring tangible benefits. That is the reason for introducing PYLL rate (PYLL - potential years of life lost), which is an addition to the analysis of premature mortality as it includes the number of deaths due to a particular cause and the age at death.

**Objective.** The purpose of this study was to analyse the level and trends of PYLL rate according to death causes in years 2002 – 2010 in Świętokrzyskie Province.

**Material and methods.** The material for the analysis was the information from the Central Statistical Office on the number of deaths due to all causes registered among the inhabitants of Świętokrzyskie Province in years 2002-2010. Causes of death were coded according to the 10<sup>th</sup> revision of the International Classification of Diseases. The analysis of premature mortality was carried out with the use of PYLL rate. PYLL rate was calculated according to the method proposed by *Romeder*, according to which the premature mortality was defined as death before the age of 70. The analysis of time trends of PYLL rate and the APC (annual percent change) of the PYLL rate were calculated using jointpoint model as well as the Jointpoint Regression Program (Version 4.0.1 – January 2013).

**Results.** In men, in years 2002 – 2007 PYLL rate increased by 1.5% per year ( $p < 0.05$ ). From year 2007 the trend went downward and PYLL rate decreased on average by 3.1% per year till year 2010. External causes of death, cardiovascular diseases and cancers in years 2002 – 2010 were the reason for almost 74.0% PYLL in men. In year 2010 PYLL rate due to all death causes amounted to 8913.8/10<sup>5</sup> and was three times higher than in women (2975.5/10<sup>5</sup>). In women, however, during the analysed period PYLL rate did not change significantly, and was dominated by cancers, cardiovascular diseases and external death causes. Similarly to men, those three groups of death causes were responsible for an average 76.0% PYLL.

**Conclusions.** The analysis of the causes of premature mortality in Świętokrzyskie Province shows that in the majority of cases it is due to preventable deaths, which calls for the necessity of more intensive measures in primary and secondary prevention as well as the improvement in treatment standards, mainly of cardiovascular diseases, cancers, injuries and accidents.

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

### STRESZCZENIE

**Wprowadzenie.** Przedwczesna umieralność w młodszych grupach wieku wpływa na funkcjonowanie społeczeństwa zarówno pod względem społecznym jak i ekonomicznym. Dlatego ważne stało się opracowanie narzędzia, które pozwoli na ich ocenę i podejmowanie tylko tych działań z zakresu ochrony zdrowia, które przynoszą wymierne efekty. Dlatego wprowadzono wskaźnik PYLL (*Potential Years of Life Lost*), który jest uzupełnieniem analizy umieralności przedwczesnej, gdyż uwzględnia liczbę zgonów z powodu określonej przyczyny oraz wiek, w którym nastąpił zgon.

**Cel.** Celem badań była analiza poziomu oraz trendów współczynnika potencjalnych utraconych lat życia (PYLL) według przyczyn w województwie świętokrzyskim w latach 2002-2010.

**Materiał i metody.** Materiał stanowiły publikowane informacje Głównego Urzędu Statystycznego o liczbie zgonów z powodu ogółu przyczyn zarejestrowanych wśród mieszkańców województwa świętokrzyskiego w latach 2002-2010. Przy-

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czynny zgonów były kodowane zgodnie z X Rewizją Międzynarodowej Klasyfikacji Chorób i Problemów Zdrowotnych. Analizę umieralności przedwczesnej przeprowadzono z wykorzystaniem wskaźnika potencjalnych utraconych lata życia (PYLL - *Potential Years of Life Lost*). Liczbę potencjalnych utraconych lat życia obliczono z zastosowaniem metodologii zaproponowanej przez *Romedera*. Za umieralność przedwczesną przyjęto zgon przed 70 rokiem życia. Analizy trendów czasowych współczynnika PYLL oraz wartości średniej rocznej zmiany (APC - *annual percent change*) współczynnika PYLL obliczono za pomocą modeli *joinpoint* i programu *Joinpoint Regression Program (Version 4.0.1 – January 2013)*.

**Wyniki.** U mężczyzn w latach 2002-2007 współczynnik PYLL wzrastał o 1,5% rocznie ( $p < 0,05$ ). Od roku 2007 trend zmienił kierunek na malejący, a wartość współczynnika do 2010 roku obniżała się średnio o 3,1% rocznie. Zewnętrzne przyczyny zgonu, choroby układu krążenia oraz nowotwory złośliwe w latach 2002-2010 były przyczyną utraty średnio 74,0% PYLL u mężczyzn. W 2010 roku wartość wskaźnika PYLL z powodu wszystkich przyczyn u mężczyzn wynosiła  $8913,8/10^5$  i była 3-krotnie wyższa niż u kobiet ( $2975,5/10^5$ ). U kobiet przyczyną utraty PYLL były nowotwory złośliwe, choroby układu krążenia oraz zewnętrzne przyczyny zgonów. Podobnie jak u mężczyzn, te trzy grupy przyczyn zgonu były odpowiedzialne za utratę średnio 76,0% PYLL.

**Wnioski.** Analiza przyczyn umieralności przedwczesnej w województwie świętokrzyskim wskazuje, że w zdecydowanej większości jest ona spowodowana „zgonami możliwymi do uniknięcia”, co wskazuje na konieczność intensyfikacji działań profilaktyki pierwotnej i wtórnej oraz poprawę standardów leczenia, głównie chorób układu krążenia i nowotworów złośliwych oraz wypadków i urazów.

**Słowa kluczowe:** umieralność przedwczesna, potencjalne utracone lata życia, województwo świętokrzyskie

## INTRODUCTION

Premature mortality in younger age groups influences the society in their social and economic aspects, therefore, measures undertaken within the health care policy aim at longer human life expectancy. In order to render such measures effective it is important to establish a tool which will allow to assess social and economic consequences of premature mortality. It will enable to implement only these health care measures that are really effective, and to eliminate or modify the ineffective ones.

A traditional premature mortality indicator shows the intensity of deaths in a population and allows for the analysis of time trends and the comparison of premature mortality in various populations. Though, it does not include social and economic burdens of premature deaths for a society. Thus, potential years of life lost (*PYLL - potential years life lost*) indicator has been introduced, which is an addition to the premature mortality analysis as it includes the amount of deaths resulted from a particular cause as well as the age at death [2, 5].

Potential years of life lost is an indicator which arbitrarily assumes the life expectancy, e.g. in OECD countries it is set for the age of 70. Under such an assumption death at the age of 50 is accountable for 20 potential years of life lost, which results from the above difference. Thus, deaths in the younger age groups cause a greater loss burden as they are the reason for more potential years of life lost [3]. In Poland, the use in epidemiological studies of synthetic PYLL rate is not widespread.

The purpose of the work was the analysis of the levels and trends of the rate of potential years of life lost due to particular causes in Świętokrzyskie Province (Poland) in years 2002 – 2010.

## MATERIAL AND METHODS

The material based on the data from the Central Statistical Office on the number of registered deaths in Świętokrzyskie Province in years 2002 – 2010 [4]. Causes of death were coded according to the 10<sup>th</sup> revision of the International Classification of Diseases [13].

Potential years of life lost were calculated according to the method proposed by *Romedera* according to which the premature mortality was defined as death before the age of 70 [8].

The number of deaths in 5-year age groups was used to calculate PYLL in Świętokrzyskie Province in years 2002 - 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 persons. The calculations were performed separately for both sexes.

PYLL number and PYLL rate were calculated for all deaths overall as well as for the selected groups of death causes (Table 1).

Table 1. Selected causes of deaths used in the analysis of rate of potential years of life lost

Classification of diseases according to ICD-10	Category
A00-Y98	All causes
C00-C97	Cancers
I00-I99	Cardiovascular disease
V01-Y98	External causes

*Statistical analysis*

Time trends for PYLL rate in years 2002 - 2010 in Świętokrzyskie Province were analysed, for all death causes overall, separately for cardiovascular diseases, cancers, external death causes and for other causes overall.

The changes in PYLL rates were evaluated using the joinpoint model. This method is an extension of linear regression model, in which the time trend is expressed with the joined log-linear segments (joinpoints) at which changes in time trends occur in a statistically significant way ( $p < 0.05$ ) [7].

On the basis of the linear regression model, in which the natural logarithm of PYLL rate was a dependent 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 evaluated according to the following formula:  $APC = 100 * (\exp^b - 1)$

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

The analysis of trends and APC were calculated using the Joinpoint Regression Program (Version 4.0.1 – January 2013) [6].

**RESULTS**

Tables 2 and 3 present the number of premature deaths, PYLL rate and proportion of PYLL due to selected causes in years 2002 – 2010. Table 4 presents the PYLL rate trends in the analysed period.

In men, in year 2010 PYLL rate due to all death causes amounted to  $8913.8/10^5$ , and it was three higher than in women ( $2975.5/10^5$ ). In years 2002 – 2007 PYLL rate in men increased by 1.5% per year ( $p < 0.05$ ). From

Table 2. Number of deaths in 1-69 age group and PYLL<sup>a</sup> in men in Świętokrzyskie Province in 2002-2010

Year	Causes of deaths														
	Cardiovascular disease			Cancers			External causes			Other causes			All causes		
	Number of deaths	Rate of PYLL	% <sup>b</sup>	Number of deaths	Rate of PYLL	% <sup>b</sup>	Number of deaths	Rate of PYLL	% <sup>b</sup>	Number of deaths	Rate of PYLL	% <sup>b</sup>	Number of deaths	Rate of PYLL	%
2002	1128	2303.4	25.4	919	1757.6	19.4	628	2914.9	32.2	724	2083.8	23.0	3399	9060.0	100
2003	1127	2289.7	25.1	892	1700.0	18.7	580	2885.3	31.7	770	2235.5	24.5	3369	9110.0	100
2004	1146	2378.9	25.9	871	1697.1	18.5	588	2778.9	30.3	786	2324.0	25.3	3391	9180.5	100
2005	1128	2481.6	26.1	930	1804.0	19.0	628	2830.4	29.8	786	2383.2	25.1	3472	9494.8	100
2006	1158	2517.1	26.2	907	1840.8	19.1	588	2679	27.9	913	2572.5	26.8	3566	9615.0	100
2007	1136	2491.0	26.0	901	1851.4	19.3	574	2669.6	27.8	864	2582.6	26.9	3475	9597.8	100
2008	1093	2475.0	25.7	903	1792.1	18.6	574	2592.7	26.9	938	2777.4	28.8	3508	9640.2	100
2009	1197	2633.2	29.5	842	1676.8	18.8	411	1870.8	20.9	876	2753.5	30.8	3326	8932.1	100
2010	1104	2282.4	25.7	903	1630.5	18.3	623	2791.8	31.4	774	2186.2	24.6	3404	8913.8	100
2002-2010 <sup>c</sup>	1135	2428.0	26.2	896	1750.0	18.9	577	2668.2	28.8	826	2433.2	26.2	3434	9282.7	100.0

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

b – proportion of PYLL by causes in all PYLL

c – the annual average for 2002-2010

year 2007 the trend changed and went downward, and PYLL rate decreased by 3.1% on average annually till year 2010 whereas in women, during the analysed period PYLL rate did not change significantly.

External death causes, cardiovascular diseases and cancers were the causes for almost 74.0% of PYLL rate in men in years 2002 – 2010. The external death causes, on average, amounted to 28.8% of causes of PYLL. In the analysed period PYLL rate decreased by 2.7% per year due to that reason. Cardiovascular diseases, on average, contributed to 26.2% of PYLL. In years 2002 – 2010 PYLL rate due to cardiovascular diseases increased by 0.8% per year. Cancers were the third cause of PYLL in men and in the structure of the death causes amounted to 18.9%. In years 2002 – 2007 PYLL trend due to cancers increased by 2.2% per year, in 2007 it began to decrease by 5.0% per year.

In the analysed period cancers, cardiovascular diseases and external causes dominated in the structure of causes of PYLL in women. Similarly to men, those three groups of death causes were responsible for an average 76.0% of PYLL.

In the period mentioned above the highest PYLL rate in women was caused by cancers, which in the structure of causes of PYLL amounted to 39.9% on average. PYLL rate due to that cause increased by 0.4% per year. An increase of PYLL was also for cardiovascular diseases, 0.7% per year. Cardiovascular diseases in women contributed to an average 21.8% of PYLL. The third cause of PYLL were external causes of death, which contributed to 14.5% of PYLL in women. The PYLL trend due to external causes was a favourable one as it decreased by 2.6% per year.

## DISCUSSION

In Poland, from the mid 1960s to the end of 1980s, premature mortality in men increased systematically whereas it remained on the same level in women. After year 1991, a slowdown in the trend in both men and women was seen, and then a reverse change and a decrease in premature mortality were observed. The reason for such changes was most of all a decrease in mortality due to cardiovascular diseases [14].

Despite those changes Poland in years 1995 – 2007 was still characteristic for having one of the highest levels of premature mortality in the European Union, and the tempo of PYLL rate changes was among the slowest ones in the EU [1].

In years 2002 – 2010 in Świętokrzyskie Province, PYLL rate due to all death causes in men was three times higher than in women. The biggest surplus of PYLL rate in men to women was for external causes (6 times higher), the smallest one – cancers (1.5 times higher).

Table 3. Number of deaths in 1-69 age group and PYLL<sup>a</sup> in women in Świętokrzyskie Province in 2002-2010

Year	Causes of deaths														
	Cardiovascular disease			Cancers			External causes			Other causes			All causes		
	Number of deaths	Rate of PYLL	% <sup>b</sup>	Number of deaths	Rate of PYLL	% <sup>b</sup>	Number of deaths	Rate of PYLL	% <sup>b</sup>	Number of deaths	Rate of PYLL	% <sup>b</sup>	Number of deaths	Rate of PYLL	%
2002	426	687.1	22.8	489	1114.5	36.9	112	528.6	17.5	272	688.1	22.8	1299	3019.5	100
2003	365	578.5	19.0	549	1271.9	41.8	89	449.1	14.7	278	747.1	24.5	1281	3045.2	100
2004	394	638.6	22.4	515	1165.2	40.8	86	403.2	14.1	240	648.4	22.7	1235	2856	100
2005	378	646.5	22.3	502	1128.0	39.0	91	401.4	13.9	268	719.1	24.8	1239	2895.2	100
2006	382	678.0	22.7	535	1234.7	41.4	100	442.3	14.8	247	630.1	21.1	1264	2983.7	100
2007	349	601.2	20.0	550	1214.8	40.4	95	453.5	15.1	275	736.5	24.5	1269	3006.6	100
2008	364	660.8	20.7	573	1229.4	38.4	106	517.9	16.2	262	788.4	24.7	1305	3197.8	100
2009	373	736.2	25.1	525	1127.4	38.4	72	339.7	11.6	276	729.4	24.9	1246	2933.4	100
2010	350	633.7	21.3	564	1243.0	41.9	98	373.5	12.6	274	719.5	24.2	1286	2975.5	100
2002-2010 <sup>c</sup>	376	651.2	21.8	534	1192.1	39.9	94	434.4	14.5	266	711.8	23.8	1269	2990.3	100

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

b – proportion of PYLL by causes in all PYLL

c – the annual average for 2002-2010

Table 4. Trends of PYLL<sup>a</sup> in Świętokrzyskie Province in 2002-2010

	Men			Women		
	Time	APC <sup>b</sup>	95% PU <sup>c</sup>	Time	APC <sup>b</sup>	95% CI <sup>c</sup>
All causes	2002-2007	+1.5 <sup>d</sup>	(0.0; 3.0)	2002-2010	+0.1	(-0.9; 1.2)
	2007-2010	-3.1	(-6.2; 0.1)			
Cancers	2002-2007	+2.2	(-0.4; 4.8)	2002-2010	+0.4	(-1.2; 2.0)
	2007-2010	-5.0	(-10.2; 0.5)			
Cardiovascular disease	2002-2010	+0.8	(-0.7; 2.3)	2002-2010	+0.7	(-1.6; 3.0)
External causes	2002-2010	-2.7	(-5.4; 3.2)	2002-2010	-2.6	(-6.5; 1.4)
Other causes	2002-2008	+5.0 <sup>d</sup>	(3.8; 6.3)	2002-2010	+0.9	(-1.3; 3.1)
	2008-2010	-10.0 <sup>d</sup>	(-16.2; -3.3)			

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

b – annual percent change

c – 95% Confidence Interval

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

Men in all EU countries die earlier than women, and in year 2010 an average surplus in mortality among men in comparison to women amounted to approximately 65%, in Poland it was higher, and amounted to 91%. Higher mortality in men in Poland occurred at all age groups, but was the highest in persons above the age of 60 [11].

In Poland, in year 2006, the prime cause of premature mortality in men were external causes (26.0%), cardiovascular diseases (23.0%) and cancers (19%) [12]. Till year 2010 the situation did not change significantly. The results of the analysis show that the structure of causes of premature mortality in Świętokrzyskie Province was similar to the situation in the whole country.

In year 2006, in Poland, the prime causes of premature mortality in women were cancers (37.0%), cardiovascular diseases (18.5%) and external causes (12%), and similarly to men, there were no significant changes up to year 2010. The structure of causes of premature mortality in women in Świętokrzyskie Province was also similar to the situation in the whole country.

Both in Poland and Świętokrzyskie Province the structure of causes of premature mortality in men and women was different in comparison to the one in the European Union. According to the OECD data in Europe, in year 2007, the prime category of causes for potential years of life lost before the age of 70. in men were external causes (29%), cancers (21%) and cardiovascular diseases (18%). As for women, those were cancers (31%), external causes (17%) and cardiovascular diseases (13%) [1].

In Świętokrzyskie Province in years 2002 – 2007 the level of premature mortality in men due to all death reasons increased, and the increase was statistically significant. After year 2007 the trend favourably changed and PYLL rate decreased. A similar trend was for cancers, and after year 2008 it was also for “other” death causes. In women PYLL rate due to all death causes, cardiovascular diseases and “other” causes

slightly increased. The decrease of PYLL rate for was external causes.

In the majority of highly developed countries deaths due to cardiovascular diseases, cancers and external reasons constitute over 70% of potential years of life lost before the age of 70. both in men and women [9]. In most cases there these are preventable deaths thanks to measures undertaken in the field of health promotion, social education, early detection of diseases, effective treatment and rehabilitation [3, 10]. Therefore, knowledge about the causes and an increase 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 to optimal treatment as well as better social – economic conditions of a population may contribute to a decrease of potential years of life lost [9].

## CONCLUSIONS

1. In Świętokrzyskie Province, after a period of fast increase of premature mortality due to all death causes in men the trend changed after year 2007 and PYLL rate began to decrease. In women, the rate did not change significantly.
2. Prime causes of potential years of life lost in men were, as follows: external causes, cardiovascular diseases and cancers. In women these were: cancers, cardiovascular diseases and external causes.
3. PYLL rate in all groups of death causes were higher in men than in women. The biggest differences related to external causes, the smallest one to cancers.
4. Epidemiological situation for premature mortality in Świętokrzyskie Province shows that in the majority of cases it is caused by preventable deaths, which leads to a need to intensify measures in primary and

secondary prevention as well as to improve treatment standards, mainly for cardiovascular diseases and cancers.

### Conflict of interest

*The authors declare no conflict of interest.*

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