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Original papers

Lung cancer mortality and tobacco smoking in Poland – will we observe further changes in mortality in light of recent smoking patterns?

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Introduction. *Lung cancer continues to be a major oncological problem in Poland due to both the large number of cases and poor prognoses of patients. In 1971 it had overtaken stomach cancer as the most frequent neoplasm in Polish men, while in women its' mortality is second only to that from breast cancer. Tobacco smoking is well established as the main cause of lung cancer. There have been significant changes in tobacco consumption and prevalence in Poland during the last three decades. These changes are having, and will continue to have, a major impact on the incidence of lung cancer in the Polish population.*
Methods. *Joinpoint regression was used to derive estimated annual percentage change (EAPC) of lung cancer mortality and to detect points in time where abrupt linear changes in the trends occur. The age-period-cohort statistical model (APC) was used to estimate the secular and generational components of the trends.*
Results. *Results derived from the APC model indicate a plateau in mortality in men starting in the late1980s. Women born after 1940 experienced a significant increase of lung cancer risk. It is likely that mortality from lung cancer in Poland will continue to rise in women in the next 2-3 decades. It is more difficult to predict future changes in lung cancer mortality in Polish men, although a subsequent decline might be anticipated given previous observations in other countries, at the equivalent stage of the epidemic.*
Conclusions. *There are various activities aimed at prevention and early detection of lung cancer, such as screening trials, chemoprevention trials focused on prevention of lung cancer in high-risk groups, as well as studies on the genetic predisposition to smoking and nicotine addiction. However, none of these activities have, as yet, proven to be effective at a population level. Undoubtedly, the first choice strategy to reduce mortality from lung cancer in Poland should be the reduction of the prevalence of smoking in men and women, and to target the rising number of tobacco smokers in the young.*

Umieralność na nowotwory złośliwe płuca i palenie tytoniu w Polsce – czy w związku ze zmianami w częstości palenia będziemy obserwować w przyszłości zmiany w umieralności?

Wprowadzenie. *Rak płuca pozostaje jednym z głównych problemów onkologicznych w Polsce, tak ze względu na dużą liczbę zachorowań, jak i złe rokowania lecznicze. Jest to, od 1971 roku, najczęściej notowany nowotwór u mężczyzn w Polsce, i drugi (po raku piersi) nowotwór u kobiet. Palenie tytoniu jest głównym czynnikiem ryzyka raka płuca. W Polsce, w ciągu ostatnich dziesięcioleci doszło do istotnych zmian w częstości palenia tytoniu. Zmiany te mają i będą miały w przyszłości decydujący wpływ na zachorowalność na raka płuca w polskiej populacji.*
Metody. *Do określenia tempa zmian umieralności w czasie oraz określenia lat, w których następowały istotne statystycznie zmiany trendu, użyto „joinpoint regression" (JR). Dla określenia wpływu okresów czasu i generacji urodzeniowych na umieralność, użyto modeli „age-period-cohort" (APC).*
Wyniki. *Analiza APC oraz JR wskazuje na zahamowanie wzrostu umieralności u mężczyzn od końca lat 80. Kobiety urodzone po 1940 roku mają istotnie podwyższone ryzyko raka płuca. Jest prawdopodobne, że umieralność u kobiet będzie wzrastać przez następne 2-3 dekady. Trudniej jest przewidzieć przyszłe zmiany umieralności u mężczyzn, jakkolwiek, na podstawie wcześniejszych obserwacji z innych krajów, znajdujących się na podobnym stopniu rozwoju epidemii palenia tytoniu, można prognozować obniżanie się poziomu umieralności w najbliższych latach.*
Wnioski. *Istnieje wiele możliwych działań ukierunkowanych na zapobieganie i wczesne wykrywanie raka płuca. Są to m.in. programy skryningowe, chemoprewencja w grupach wysokiego ryzyka, jak również badania nad genetycznymi predyspozycjami do palenia tytoniu i uzależnienia od nikotyny. Jednakże, żadne z tych działań, jak dotychczas, nie są skuteczne w skali populacji, w obniżaniu zachorowalności i umieralności na raka płuca. Dlatego też, podstawową strategią obniżania*

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umieralności z powodu raka płuca w Polsce musi pozostawać działalność skierowana na obniżenie częstości palenia tytoniu wśród mężczyzn i kobiet, oraz zapobieganie rozpoczynania palenia wśród dzieci i młodzieży.

Key words: lung cancer, mortality, Poland, tobacco, smoking, prevention, epidemiology, regression
Słowa kluczowe: nowotwory płuca, umieralność, Polska, palenie tytoniu, prewencja, epidemiologia, regresja

Introduction

Lung cancer is the most common cancer in men worldwide and one of the most common cancers in women. In men, the highest incidence rates are observed in Europe (especially Eastern Europe) and North America. In women high incidence rates are also found in North America and in Europe, particularly Northern and Western Europe [1].

There were approximately 375,000 incident cases of lung cancer in Europe in the year 2000 – (303,000 in men and 72,000 in women). The number of lung cancer deaths in Europe was about 347,000 (280,000 in men and 67,000 in women) [2]. In men, both incidence and mortality are considerably higher in Eastern Europe than in other parts of the continent, while in women, the highest incidence and mortality rates are found in Northern Europe, where they are about two times higher than in other European areas [2, 3]. Lung cancer had overtaken stomach cancer in 1971 as the most frequent neoplasm in Polish men. In women lung cancer is now the second most common neoplasm after breast cancer [4].

Although there are several putative factors influencing risk of developing lung cancer, tobacco smoking is well established as the main causal agent [5-9]. This paper aims to describe the changes in lung cancer mortality in Poland in relation to previous and current trends in tobacco smoking in the Polish population. Special emphasis is placed on the evolution of lung cancer mortality according to period and birth cohort effects.

Material and methods

Data on deaths from malignant neoplasms of the trachea, bronchus and lung were extracted from the World Health Organisation (WHO) Mortality Databank, by five-year age group and sex, using the code 162 according to the ICD-9 revision. Data were available for a 37-year period from 1963 to 1999. Corresponding population data, by age, sex and year, were also extracted.

To evaluate changes in time trends in men and women, age-standardised mortality rates for the period 1965-1999 were calculated for all ages combined and truncated rates for the age groups 20-34, 35-44, 45-54, 55-64, 65-74, and 75 and over, by sex, using the weights of the World Standard Population [10]. A Joinpoint regression was then fitted to calculate the estimated annual percentage change (EAPC) of each trend so as to detect points in time where significant (abrupt linear) changes occur [11, 12]. For each EAPC the corresponding 95% confidence interval (95%CI) was also calculated.

In order to fit age-period-cohort (APC) models, the data were grouped into periods of five years and synthetic overlapping ten-year cohorts derived by subtracting the midpoint of the five-year age group from the midpoint of the period. The APC analyses were restricted to individuals dying of lung cancer between the ages of 30 and 74.

The APC model provides a quantitative method of estimating trends over time using objective criteria [13]. The problem of identifiability, whereby the joint effects of age, period and cohort cannot be estimated without further (often arbitrary) assumptions or reparameterisations of the data makes the implementation and interpretation of APC models problematical [14-16]. In this study, the methods of Clayton and Schifflers are used, thus a hierarchy of models that are fitted for each sex to the rates:

{1} Age;
{2} Age + (Period or Cohort) Drift;
{3a} Age+ Drift + non-linear Period;
{3b} Age+ Drift + non-linear Cohort;
{4} Age + Drift + non-linear Period + non-linear Cohort.

The relative contribution of each effect to the model was determined by comparing the change in the deviance and degrees of freedom in two sequentially fitted models with the appropriate chi-squared statistic. Hence, a comparison of model {2} with {1} provides a test for drift (overall linear effect of time, not attributable specifically to period or cohort) against the model of no temporal trend (model {1}); a comparison of model {3a} versus {2}, and model {3b} versus {2} tests for the effects of non-linear period and non-linear cohort, respectively. Comparing model {4} versus {3a} tests for the effects of non-linear cohort effects, adjusting for drift and non-linear period. Finally, the comparison of model {4} versus {3b} tests the effects of non-linear period, adjusting for drift and non-linear cohort.

The data on tobacco smoking in Poland were derived from the several sources [17-21].

Results

There were 3,100 lung cancer deaths in men in Poland and 692 in women in 1963. The number of deaths increased rapidly in the following 30 years, and by 1999 the number of deaths reached 15,500 in males and 3,600 in females (Table I). The age-standardised mortality rates in 1963 in men and women were $23.8/10^5$ and $3.9/10^5$, respectively, whereas in 1999 the corresponding rates were $67.3/10^5$ and $11.5/10^5$ (Table I).

Joinpoint regression analysis

Table II shows the time trends in lung cancer mortality in men and women. In men, an analysis of time trends for all age groups combined indicated a decrease in the overall rate in the early 1990s, with the EAPC decelerating throughout the study period. This observation held in all age categories except the youngest (20-34), where there were no changes in mortality. All estimated EAPCs (with exception of one for the age 65-74) were statistically significant at the p level of 0.05.

In women, increasing mortality trends were observed in all time periods, but the rates of changes differed between particular periods. An increase of the EAPCs was seen in the youngest women (35-44) and also among

Table I. Lung cancer mortality in Poland, 1963-1999

Year	Men			Women		
	Number of deaths	Crude rate	Age-standardised rate	Number of deaths	Crude rate	Age-standardised rate
1963	3 100	20,8	23,8	692	4,4	3,9
1964	3 574	23,6	26,7	740	4,6	4,1
1965	3 880	25,4	27,7	812	5,0	4,4
1966	4 294	27,9	30,0	857	5,3	4,5
1967	4 666	30,1	31,8	897	5,5	4,6
1968	5 131	32,7	34,2	1 010	6,1	5,1
1969	5 264	33,3	34,0	1 051	6,3	5,1
1970	5 623	35,6	36,1	1 019	6,1	4,8
1971	6 267	39,3	39,3	1 116	6,6	5,2
1972	6 428	40,0	39,8	1 143	6,7	5,1
1973	7 092	43,7	43,0	1 146	6,7	5,1
1974	7 402	45,0	43,6	1 269	7,3	5,4
1975	7 807	46,9	45,0	1 367	7,8	5,8
1976	8 408	50,3	48,2	1 354	7,7	5,7
1977	8 508	50,4	48,2	1 524	8,6	6,2
1978	9 106	53,4	51,0	1 558	8,7	6,3
1979	9 533	55,3	52,2	1 587	8,7	6,3
1980	10 146	58,5	55,1	1 812	9,9	7,2
1981	10 586	60,5	56,9	1 770	9,6	7,0
1982	10 726	60,8	57,3	1 912	10,3	7,3
1983	11 666	65,4	61,5	2 001	10,7	7,6
1984	12 229	67,9	63,5	2 162	11,4	8,1
1985	12 618	69,5	65,1	2 205	11,6	8,2
1986	12 932	70,8	66,3	2 310	12,0	8,4
1987	13 181	71,8	66,9	2 408	12,5	8,6
1988	13 791	74,7	69,3	2 539	13,1	9,3
1989	14 034	75,8	69,4	2 613	13,4	9,4
1990	14 539	78,3	71,1	2 805	14,4	9,9
1991	14 852	79,7	71,9	2 897	14,8	10,2
1992	14 688	78,6	70,3	2 852	14,5	10,0
1993	15 193	81,1	71,9	3 102	15,7	10,6
1994	15 250	81,3	71,3	3 181	16,1	10,7
1995	15 686	83,5	72,2	3 350	16,9	11,3
1996	15 478	82,4	70,3	3 411	17,2	11,3
1997*	-	-	-	-	-	-
1998*	-	-	-	-	-	-
1999	15 523	82,6	67,3	3 632	18,3	11,5

* no data available for the years 1997-1998 (Didkowska et al., 2002)

Table II. Changes in lung cancer mortality time trends, Poland, 1963-1999

Age	Number of joinpoints	Men				
		Year of joinpoint	Period	EAPC*	95%CI	
All	3		1965-1972	**5,2**	4,5	5,8
		1973	1973-1984	**3,6**	3,3	4,0
		1985	1985-1990	**1,7**	0,5	2,9
		1991	1991-1999	**-0,6**	-1,3	0,1
20-34	1		1965-1994	**0,3**	-0,7	1,3
		1995	1995-1999	***(a)	***	***
35-44	1		1965-1979	**5,1**	4,2	6,0
		1980	1980-1999	**-1,3**	-2,0	-0,6
45-54	2		1965-1980	**6,3**	5,8	6,8
		1981	1981-1989	**1,2**	-0,2	2,7
		1990	1990-1999	**-3,7**	-5,0	-2,3
55-64	1		1965-1988	**4,2**	4,0	4,4
		1989	1989-1999	**-1,2**	-1,9	-0,4
65-74	2		1965-1970	**5,4**	4,3	6,9
		1971	1971-1992	**2,6**	2,4	2,8
		1993	1993-1999	**0,3**	-1,1	1,6
75+	2		1965-1972	**7,6**	5,9	9,4
		1973	1973-1983	**3,9**	2,7	5,1
		1984	1984-1999	**1,5**	0,7	2,2

Age	Number of joinpoints	Year of joinpoint	Period	EAPC*	95%CI	
			Women			
All	2		1965-1972	**1,8**	0,9	2,7
		1973	1973-1989	**3,8**	3,5	4,1
		1990	1990-1999	**2,0**	1,1	3,0
20-34	0		1965-1999	**0,2**	-1,0	1,4
35-44	1		1965-1977	**0,6**	-1,7	3,0
		1978	1978-1999	**4,5**	3,2	5,8
45-54	1		1965-1973	**1,3**	-0,7	3,3
		1974	1974-1999	**4,4**	4,0	4,9
55-64	3		1965-1968	**8,0**	3,1	13,2
		1969	1969-1971	**-6,1**	-19,0	8,9
		1972	1972-1979	**7,8**	5,7	10,0
		1980	1980-1999	**2,2**	1,7	2,8
65-74	2		1965-1978	**1,8**	1,1	2,5
		1979	1979-1992	**3,9**	3,1	4,7
		1993	1993-1999	**0,0**	-2,8	2,9
75+	1		1965-1985	**3,7**	3,4	4,1
		1986	1986-1999	**2,2**	1,3	3,1

* – Estimated Annual Percentage Change
(a) not possible to make estimation

45-54 year-olds. Large fluctuations of the EAPCs are observed in women aged 55-64, 65-74 and 75+, although some evidence of decelerating trends, clearly rates have been steadily increasing trends since the 1970s.

Age-period-cohort analysis

Table III shows the total deviance, degrees of freedom and corresponding p-value for each hierarchical model tested to assess the overall fit, while the differences in the deviance and respective degrees of freedom in nested models tested the significance of individual effects.

The full APC model was the best-fitting model for both sexes, although for neither sex did the model adequately fit the data, likely the effect of the variability of the mortality count overdispersed relative to the Poisson distribution.

In males, the relative risk (RR) by birth cohort increased up to the 1937 cohort. For the last two analysed birth cohorts, 1942 and 1947, the RR dropped (Table IV, Figure 1). In females, the RR was close to one until the 1937 cohort. For the last two observed cohorts the RR increased although this rise was statistically significant only for the last cohort) (Table IV, Figure 3).

Significant changes were also observed in risk for subsequent periods of time. In men, the RR increased until the period 1987-1991, but declined in the period 1992-1996 (Table V, Figure 2). In women, continuing increases in the lung cancer risk were observed, and the RR for the period 1992-1996 was 97% higher than that of the reference period 1967-1971 (Table V, Figure 4).

Table III. Age-period-cohort (APC), lung cancer, Poland, 1967-1996

Model	Deviance	DF	p-value	Diff dev	Diff DF	p-value (diff)
			MEN			
AGE	16120,1	45	0,000			
AGE+DRIFT	2372,2	44	0,000	13747,9	1	0,000
AGE+COHORT (DRIFT)	1154,5	32	0,000	1217,7	12	0,000
AGE+PERIOD (DRIFT)	1318,1	40	0,000	1054,1	4	0,000
AGE+PEROD+COHORT	**86,1**	**28**	**0,000**			
(a) Difference AP-APC				1232,0	12	0,000
(b) Difference AC-APC				1068,4	4	0,000
			WOMEN			
AGE	3749,0	45	0,000			
AGE+DRIFT	218,8	44	0,000	3530,2	1	0,000
AGE+COHORT (DRIFT)	100,0	32	0,000	118,8	12	0,000
AGE+PERIOD (DRIFT)	191,1	40	0,000	27,7	4	0,000
AGE+PEROD+COHORT	**69,9**	**28**	**0,000**			
(a) Difference AP-APC				121,2	12	0,000
(b) Difference AC-APC				30,1	4	0,000

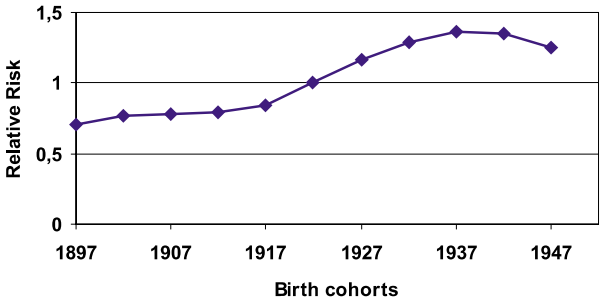


Figure 1. Relative risk for subsequent birth cohorts, lung, men, Poland (reference category – 1922)

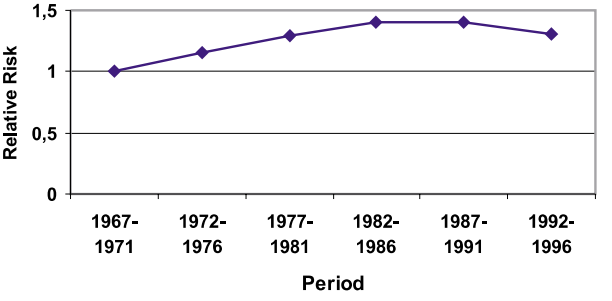


Figure 2. Relative risk by period of time, lung, men, Poland (reference category – 1967-1971)

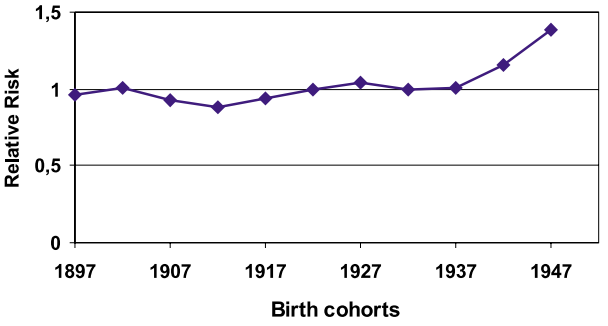


Figure 3. Relative risk for subsequent birth cohorts, lung, women, Poland (reference category – 1922)

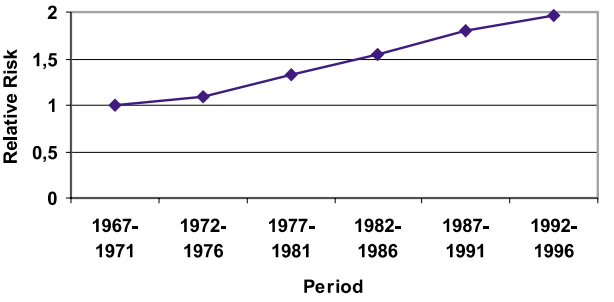


Figure 4. Relative risk by period of time, lung, women, Poland (reference category – 1967-1971)

Table IV. Lung cancer mortality relative risk estimates for subsequent birth cohorts

Cohort	Men RR	Men 95%CI		Women RR	Women 95%CI	
1897	0,70	0,61	0,80	0,96	0,78	1,19
1902	0,77	0,70	0,86	1,01	0,85	1,19
1907	0,79	0,73	0,85	0,93	0,82	1,05
1912	0,80	0,76	0,84	0,88	0,81	0,96
1917	0,84	0,82	0,87	0,94	0,89	0,99
1922	1,00	(reference category)		1,00	(reference category)	
1927	1,17	1,13	1,20	1,04	0,99	1,09
1932	1,29	1,22	1,36	1,00	0,92	1,09
1937	1,36	1,26	1,47	1,01	0,89	1,14
1942	1,35	1,22	1,50	1,15	0,98	1,35
1947	1,25	1,09	1,42	1,38	1,13	1,69

Table V. Lung cancer mortality relative risk estimates for subsequent time periods

Period	Men RR	Men 95%CI		Women RR	Women 95%CI	
1967-1971	1,00	(reference category)		1,00	(reference category)	
1972-1976	1,15	1,12	1,19	1,08	1,02	1,15
1977-1981	1,29	1,23	1,37	1,33	1,21	1,45
1982-1986	1,40	1,29	1,51	1,55	1,37	1,76
1987-1991	1,41	1,27	1,56	1,80	1,53	2,11
1992-1996	1,31	1,15	1,49	1,97	1,62	2,40

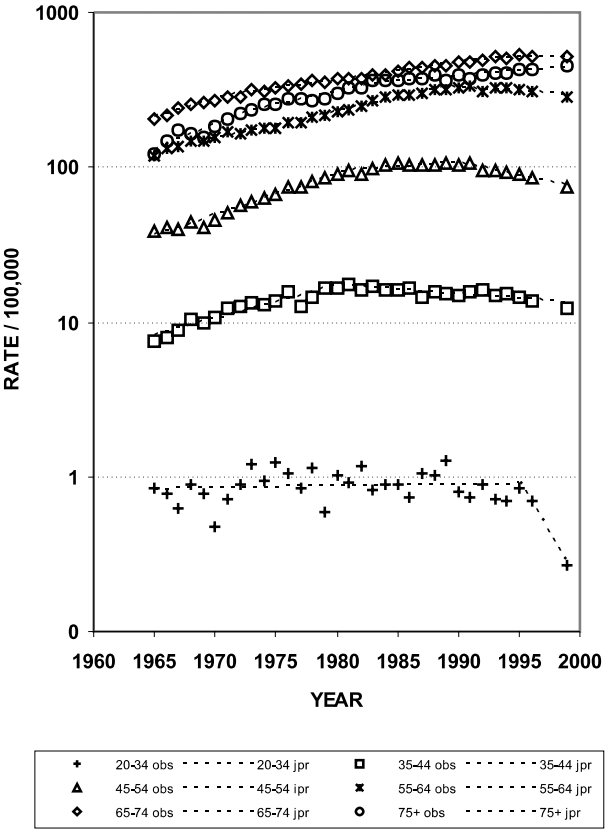


Figure 5. Lung cancer mortality, Poland, by age groups, men, observed values (obs) and joinpoint regression (jpr)

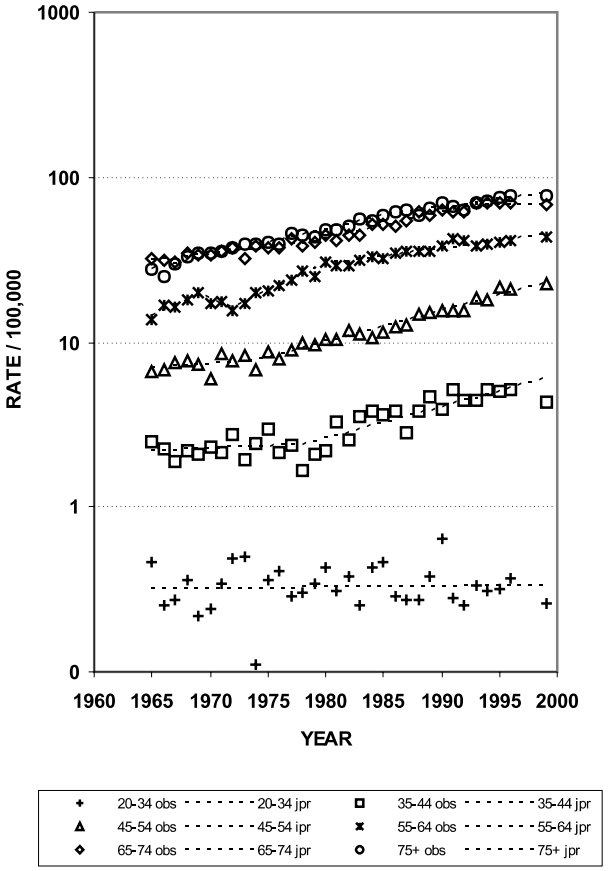


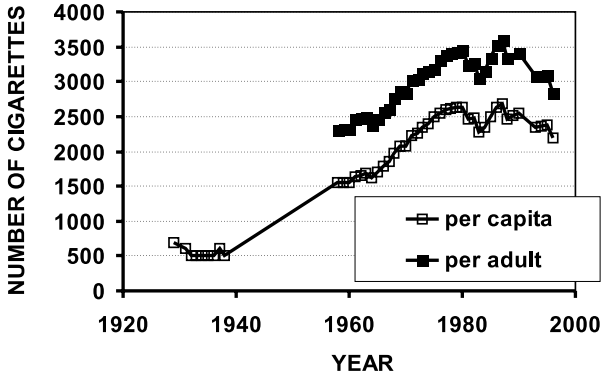
Figure 6. Lung cancer mortality, Poland, by age groups, women, observed values (obs) and joinpoint regression (jpr)

Changes in tobacco consumption in Poland

It has been reported by Didkowska et al. [20] that in 1923, the consumption of tobacco in Poland was approximately 450 cigarettes per person per year. By 1938, estimated annual consumption had risen moderately to 600 cigarettes *per capita*. Further increases in cigarette consumption were observed in Poland after the Second World War. In 1979 annual consumption was estimated at 2,740 cigarettes per person, and after a small decline in the years 1979-1983 (average annual consumption of 2,300 cigarettes per person), consumption again started to increase and reached 2500-2600 *per capita* by the end of the 1980s (Figure 7) [20]. There was however, no sex-specific information available.

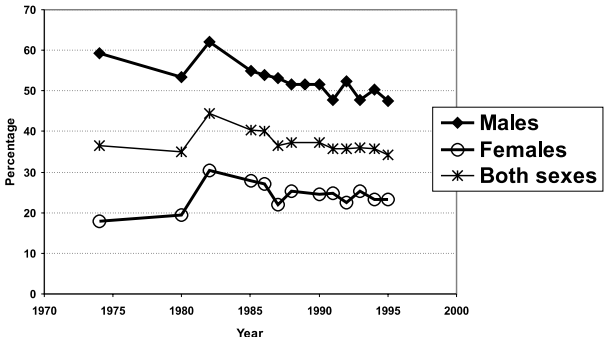
The first survey on tobacco smoking prevalence in the Polish population was carried out in 1974 [17]. Further surveys took place in 1980 and 1982, and since 1985, surveys on tobacco use have been carried out annually (with the exception of 1989) [19]. Figures 8 to 12 illustrate the changing patterns of tobacco smoking prevalence in the Polish population.

In males, the highest overall prevalence of tobacco smoking in Poland was observed in 1982 when about 62% of the adult male population smoked (Figure 8) [19]. The high smoking prevalence noted in that year was probably caused by the introduction of coupons for cigarettes due



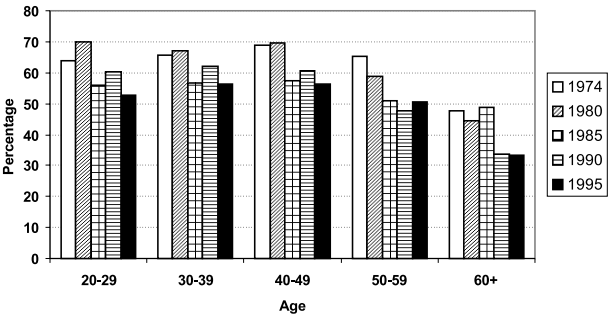
Source: data from Didkowska et al., 1996

Figure 7. Consumption of cigarettes in Poland, 1929-1996



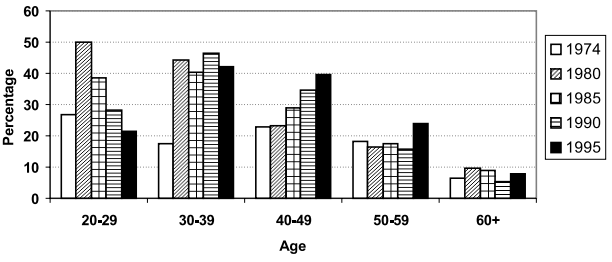
Source: data from Przewozniak & Zatonski, 1996

Figure 8. The prevalence of tobacco smoking in Poland, 1974-1995, by sex



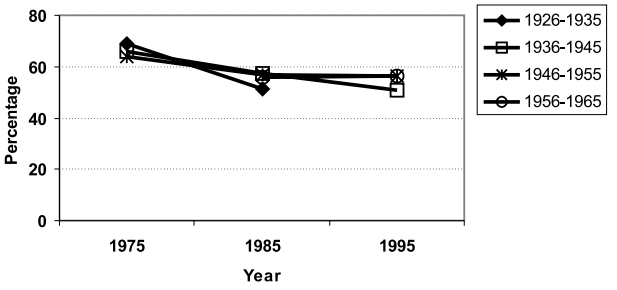
Source: Data from Przewozniak & Zatonski, 1996

Figure 9. The prevalence of tobacco smoking in Poland, 1974-1995, men, by age



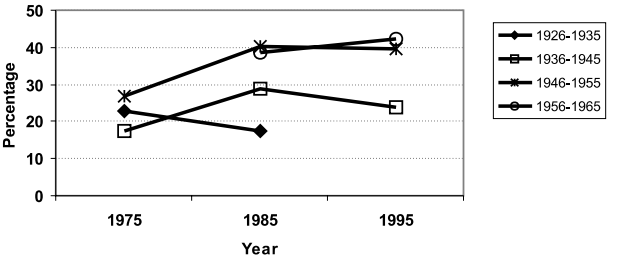
Source: Data from Przewozniak & Zatonski, 1996

Figure 10. The prevalence of tobacco smoking in Poland, 1974-1995, women, by age



Source: Estimated based on the data from Przewozniak & Zatonski, 1996

Figure 11. The prevalence of tobacco smoking by birth cohorts, men, Poland, 1975-1995



Source: Estimated based on the data from Przewozniak & Zatonski, 1996

Figure 12. The prevalence of tobacco smoking by birth cohorts, women, Poland, 1975-1995

to the shortage of cigarettes on the market during Martial Law (1981-1983) [19]. Many ex-smokers returned to smoking during that time. The prevalence in males decreased to approximately 50% by the mid-1990s. The analysis of smoking prevalence by age and cohort shows that the overall decrease of tobacco smoking in men was mainly due to decreases in older age groups and birth cohorts. After 1985 the decrease was observed mainly in men aged over 60 (although no further decrease was observed in that age group after 1990) and among men born in the 1920s and 1930s (Figures 9 and 11). No significant changes in the prevalence of smoking were observed in 20-59 year-olds of age from 1985 to1995, or in men born between 1946 and 1965 (Figures 9 and 11).

As in men, the highest prevalence of tobacco smoking in women also occurred in the early 1980s (30% in 1982) (Figure 8). This dropped to approximately 25% by the end of 1980s and remained at this level during the first half of the 1990s. The analysis of changes in age groups shows declines in smoking prevalence in the 1980s and 1990s in the youngest age group (20-29 years) from 50% in 1980 to 20% in 1995. No changes were observed in women aged 30-39 while in 40-49 year-olds smoking prevalence rose (from 23% in 1980 to 40% in 1995) (Figure 10). Smoking prevalence decreased for the birth cohort born in 1936-1945, while in younger cohorts smoking prevalence reached a plateau around 1990.

It has been reported by Mazur et al. [21] that 65% to 70% of 15 year-old Polish boys have smoked and about 30% smoke regularly. It is also worth emphasising that among 15-year-old girls in Poland 16% were smokers in 1990 and this rose substantially to 28% in 1998 [21].

Discussion

This paper describes the changes in mortality from lung cancer in Poland over last three decades, and analyses these changes in the light of changes of the major lung cancer risk factor, i.e. tobacco smoking. Trends in lung cancer mortality and tobacco smoking in Poland and some other Central and Eastern European countries up to 1990 were discussed previously by Kubik et al. [22]. The current analysis serves as an update and a summary of the influence of secular and generational influences on trends in lung cancer mortality.

In general, the data analysed in this paper showed a tendency towards a deceleration in the increase in the rate of lung cancer mortality in the male population, and in young and middle aged men, the first signs of a decrease were observed in 1990s. In women the trends are systematically rising, an observation particularly evident in the young and middle aged women.

It has been reported previously that the quality of cancer mortality statistics in Poland had reached a satisfactory level, allowing descriptive epidemiological analysis, from the beginning of the 1960s [23]. The data are, generally, of reasonable quality and completeness until 1996. Then, in 1997 and 1998 the completeness and quality likely deteriorated due to problems in the Polish health-care system, hence the data for these two years were not adequate [4]. Since 1999, the situation seems to have improved again [4].

Patterns of lung cancer occurrence are strongly determined by exposure to tobacco smoking in the past. It has been estimated by Parkin et al. [1] that at the beginning of 1990s some 86% of lung cancer cases worldwide in men was attributed to tobacco smoking, with a corresponding proportion in women of approximately 50%. However, in European countries like Poland, with a long history of tobacco smoking, more than 90% of cases in men are tobacco-related [22, 24]. In women, the proportion of tobacco-related lung cancer is much more variable, which reflects differences in development of the tobacco smoking epidemic in particular countries [1]. The attributable proportion for Poland, carried out by Peto et al. [24], was approximately 60%, and by Kubik et al. [22] was 52%.

Despite significant changes in mortality from lung cancer in Poland in recent decades, it nevertheless remains the most frequent cancer in Polish men, and the second most frequent cancer in women [4].

Our analysis showed deceleration in the increase of overall cancer mortality rates in men. Analysis based on the APC model indicates some plateau in mortality in men since the end of 1980s and beginning of 1990s. It remains in accordance with the results of the joinpoint regression analysis, which indicates a non-statistically

significant decrease (-0.6% per year in the period 1991-1999). Our study confirms that the decrease in mortality in men aged 20-44 years observed since the early 1980s [22, 25], and restricted to men aged over 35. Such a decrease in men aged 35-44 is somewhat surprising. The first signs of a decrease in smoking prevalence in Polish men were observed in the mid-1980s. Moreover, the data from tobacco surveys indicated smoking prevalence failed to decline amongst the younger age groups (20-29 and 30-39) between 1974 and 1980.

Women born after 1940 experienced a significant increase in lung cancer mortality risk. In the 1970s and 1980s these women were aged 35 to 54 years. These findings are in accordance with the increasing smoking prevalence in women born during the two decades after the Second World War..

In addition to the increasing *per capita* tobacco consumption in Poland until the end of the 1980s [20] a decrease in smoking prevalence was also reported, from 1982 to 1990 in both men, and women [19], indicating that smoking intensity increased, since a higher volume of cigarettes was smoked by a decreasing proportion of smokers. This observation is confirmed by data from Przewozniak [18], where an increase in the average number of cigarettes smoked per day in the period 1974-1986 was reported (in males, from 13 cigarettes per day in 1974 to 19 in 1986, in females from 9 to 14, respectively). It was also shown that average duration of exposure increased in Poland during the 1980s, from 15 to 22 years in men and from 8 to 15 years in women [18]. This increase in the intensity and duration of exposure to tobacco smoke in 1980s may affect trends in lung cancer mortality in the current and next decade.

It is necessary to remember when analysing time trends of lung cancer mortality or predicting the future development that there are clear birth cohort effects, that is, smoking amongst a given generation creates deleterious health effects in the same generation 2-3 decades later [26, 27]. In men, those countries which first experienced the smoking epidemic (e.g. U.K, Ireland, and the U.S.) were also the first in which a decrease in smoking prevalence occurred, with subsequent declines in risk of lung cancer in the same generations [1].

Several initiatives were implemented in Poland in the 1990s to decrease the prevalence of tobacco smoking in men, and inhibit and subsequently reduce the prevalence in women. In 1997 anti-tobacco legislation was introduced, that included a ban on smoking in public places, and a progressive ban on tobacco advertising. An important feature of the legislation was the establishment of a National Anti-Tobacco Programme embracing both population-wide educational campaigns and advice to help individual smokers quit. The first positive effects are now being observed in the adult population: no further increase of tobacco smoking prevalence has been noted in the second half of the 1990s, and approximately 70% of current smokers declare their willingness to quit [28].

However, the situation is much more difficult in children and adolescents. It is intriguing that among 15 years old girls and boys the prevalence of smoking is almost equal. It will probably be difficult to change the situation in the near future. It was shown that in half of the schools there was no formal ban of smoking – in only 26% of schools was a total ban in smoking implemented, while in 71% smoking was allowed in selected places, and in 2% of schools smoking was formally allowed [21]. In addition, young people react very differently to health warning messages: adolescent smokers use cigarettes to help express their self-image and identity, show solidarity with their peers, and make them feel more grown-up and sociable by association with a product that is dangerous [29].

In view of the current lung cancer burden in the Polish population, the level of tobacco smoking prevalence and per capita consumption, along with factors such as effectiveness of prevention, and effectiveness of screening for and treatment of lung cancer, it is likely that mortality from lung cancer in Poland will continue to rise in women in the next 20-30 years. Support for this hypothesis comes from examination of: changes in the smoking prevalence in last 10-15 years and in young birth cohorts, increasing prevalence of smoking in young girls, changes in the mortality time trends in the past, and increasing risk of death from lung cancer in the youngest generations of women. It is more difficult to predict future changes in lung cancer mortality in Polish men. Surveys of smoking prevalence carried out in the 1980s and 1990s show no reduction in the prevalence in young and middle-age men. Observations on smoking prevalence by birth generation also show stable levels of smoking prevalence within younger birth cohorts. This is somewhat inconsistent with mortality data however, which indicate rates reached a plateau during the most recent decade, corresponding with a similar observation in the youngest birth cohorts.

There are several possible activities that may affect lung cancer incidence and mortality in Poland in the future. Some of them are currently being implemented. The National Anti-Tobacco Programme includes a wide dissemination of proven quitting strategies and involves medical professionals and medical communities in the cessation process. The current data on trends in smoking prevalence amongst young people are not favourable. It is of vital importance for the future health of the Polish population to reduce smoking initiation among children and adolescents by implementing effective school-based tobacco-use prevention programmes [30]. It is, from a long-term perspective, probably the most important strategy for reducing the lung cancer burden in the country. Other control measures, such as increasing tobacco prices by an appropriate regulation of excise taxes, banning tobacco advertising, or banning smoking in public places may only be effective when they co-exist with effective prevention programmes.

Other activities aimed at prevention and early detection of lung cancer include screening trials, chemo-

prevention trials (focused mainly on prevention of lung cancer in high-risk groups), and studies on genetic predisposition to smoking and nicotine addiction. However, none of these activities have, as yet, proven effective at a population level. Undoubtedly, the first choice strategy to reduce mortality from lung cancer in Poland should be the reduction of the prevalence of smoking in men and women, and to target the rising number of young tobacco smokers.

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