



Demographical analyses of lung cancer incidence and mortality trends in Vojvodina

Vladimir Petrović¹, Marica Miladinov-Mikov²

ABSTRACT

BACKGROUND: Studies conducted in Vojvodina from 1960 to 1978 showed that the highest number and percentage of lung cancer cases and deaths occurred in seventh decade of life. Our aim was to analyze epidemiological characteristics of lung cancer in Vojvodina demographically from 1989 to 1998.

METHODS: Data used for analyses were provided by the Cancer Registry of Vojvodina from the Institute of Oncology Sremska Kamenica. Descriptive epidemiological method was used.

RESULTS: The sex ratio (males to females) of lung cancer incidence in Vojvodina is 5.14. Our study showed that the most unfavorable lung cancer incidence trends were present in age groups ranged from 45 to 49, 60 to 64, 65 to 69, and 70 to 74 years in men and in age groups ranged from 35 to 39, 40 to 44, and 45 to 49 years in women. We also found that the most unfavorable lung cancer mortality trends were present in age groups ranged from 45 to 49, 60 to 64, 65 to 69, and 70 to 74 years in men and in age groups range from 45 to 49 and 70 to 74 years in women. Favorable lung cancer mortality and incidence trend was present only in the age group ranged from 80 to 84 years in men. The highest percentage of diseased and deaths was in the age group ranged from 60 to 69 years for both sexes. In younger age groups the percentage of diseased was less than 2%.

CONCLUSION: Preventive measures against lung cancer in our population do not show good results yet. This is either because of greater exposure of population to the risk factors or because of greater exposure to the risk factors of certain age cohorts. Decrease in sex ratio has shown that females are closing onto males when we talk about numbers of new lung cancer cases. It is clear that lung cancer incidence trends in males by age groups has shown greater variability while in females variability occurs on smaller scale when lung cancer incidence trends by age groups are discussed.

KEY WORDS: Lung Neoplasms; Epidemiology; Mortality; Incidence; Non MeSH Vojvodina

¹Institute of Public Health Novi Sad, ²Institute of Oncology Sremska Kamenica, Serbia & Montenegro, Address correspondence to: Assist. mr. sc. med. Vladimir Petrović, Institute of Public Health Novi Sad, 21000 Novi Sad, Futoška 121, Serbia & Montenegro; The manuscript was received: 24.02.2005, Provisionally accepted: 22.03.2005, Accepted for publication: 08.04.2005

© 2005, Institute of Oncology Sremska Kamenica, Serbia & Montenegro

INTRODUCTION

Studies conducted in Vojvodina from 1960 to 1978 showed that the highest number and percentage of lung cancer cases and deaths occurred in seventh decade of life. Average age of lung cancer patients in Vojvodina was 62.8 years (men: 62.9; women: 62.1). Percentage of patients younger than 40 years of life was 1.8% in men and 4.9% in women. During the observed period of time in Vojvodina the sex ratio among lung cancer patients was declining. In the year 1960 it was 1:15.53 and at the end of the observed period it was 1:7.33 in favor of male population (1). Crude incidence rate during the observed period from 1989 to 1998 in males was 114.31/100 000 while in females it was 21.12/100.000. Crude mortality rate for the period of observation in males in Vojvodina was 95.60/100.000, while in females it was 16.99/100 000.

Our aim was to analyze epidemiological characteristics of lung cancer in Vojvodina demographically in the period from 1989 to 1998 by conducting following analyses: Analyses of lung cancer sex ratio; Analyses of lung cancer age specific incidence and mortality trends in males and females in Vojvodina; Analyses of age distribution of lung cancer cases and deaths in males and females in Vojvodina.

MATERIAL AND METHODS

Data used for analyses were provided by Cancer registry of Vojvodina from the Institute of Oncology Sremska Kamenica. Our data included the number of diseased and deaths from lung cancer according to 5-year age group intervals and by sex, separately for the period from 1989 to 1998. Descriptive epidemiological method was used. Data were analyzed demographically for the entire period of observation, separately for male and female population.

Age specific incidence and mortality trends for all age groups were described for male and female population for the entire observed period, based on crude incidence and mortality rates. Statistical significance was checked on the basis of correlation coefficient (r) by the use of table values for probability (p) on the level of 0.05 and 0.01 for certain degree of freedom. Age distribution of diseased and deaths in all age groups was analyzed by gender on the basis of percentage structure. Data from vital statistics from census in year 1991 were provided and used for calculations. Commercial statistical SPSS program has been used for statistical analyses.

RESULTS

Sex ratio of lung cancer incidence in Vojvodina during 1989-1998

Average annual number of cases in Vojvodina is 1121 for males and 218 for females. Sex ratio of lung cancer incidence in Vojvodina during the period of observation has shown that 5.14 cases occur in males for each female case (Table 1).

Table 1. Sex ratio of lung cancer incidence in Vojvodina in the period 1989-1998

Year	F : M
1989	1 : 5.29
1990	1 : 5.44
1991	1 : 5.45
1992	1 : 4.23
1993	1 : 4.54
1994	1 : 4.52
1995	1 : 5.44
1996	1 : 5.73
1997	1 : 5.46
1998	1 : 5.62
Total	1 : 5.14

Lung cancer incidence trends in males and females by age groups in Vojvodina during 1989-1998

Lung cancer was registered in almost all age groups during the period of observation. Disease was not registered in age groups ranged from 5 to 9 and 10 in 14 years in men and in age groups ranged from 0 to 4, 10 to 14, and 15 to 19 years in women. Average age of diseased in males was 62.3 +/-10 years (CV=16%) and in females it was 63.2 +/-12.1 years (CV=19%).

There was a high statistical significance between age and lung cancer incidence in males and females in Vojvodina. Correlation was positive and very high.

$$r_{\text{females}} = 0.841; p < 0.01 \quad r_{\text{males}} = 0.726; p < 0.01 \quad (N=18)$$

Lung cancer incidence trends in males during the period of observation in age groups ranged from 45 to 49, 60 to 64, 65 to 69, and 70 to 74 years showed very intensive increase and were extremely unfavorable. Correlation was positive, very high, and was highly statistically significant (Figure 1).

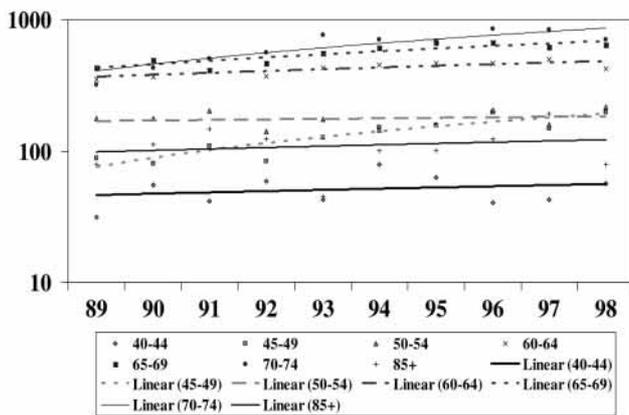


Figure 1. Age groups with increasing lung cancer incidence trend in males in Vojvodina in the period 1989-1998

$$Y_{45-49} = 12.9653X + 62.3042; \quad r = 0.900; p < 0.01 \quad (N=10)$$

$$Y_{60-64} = 12.8953X + 352.5729; \quad r = 0.817; p < 0.01$$

$$Y_{65-69} = 28.6160X + 1398.0699; \quad r = 0.885; p < 0.01$$

$$Y_{70-74} = 50.5689X + 357.7568; \quad r = 0.866; p < 0.01$$

Lung cancer incidence trends in males during the period of observation in age groups ranged from 40 to 44, 50 to 54, and 85+ years showed increase, which was not intensive but was also unfavorable. Correlation in these age groups was positive, very low but not statistically significant.

$$Y_{40-44} = 1.0892X + 45.1583; \quad r = 0.235; p > 0.05$$

$$Y_{50-54} = 1.6152X + 166.6462; \quad r = 0.190; p > 0.05$$

$$Y_{85+} = 2.5923X + 96.0528; \quad r = 0.195; p > 0.05$$

Lung cancer incidence trend in males during the period of observation in age group ranged from 80 to 84 years showed intensive decrease and was favorable. Correlation was negative, high and statistically significant.

$$Y_{80-84} = -21.4427X + 382.0968; \quad r = -0.705; p < 0.05$$

Lung cancer incidence trends in males during the period of observation in age groups ranged from 30 to 34, 35 to 39, 55 to 59, and 75-79 years showed decrease, which was not intensive but was favorable. Correlation was negative and very low in the age group ranged 30 to 34 years, while in other age groups it was negative, low but not statistically significant.

$$Y_{30-34} = -0.1453X + 5.3269; \quad r = -0.261; p > 0.05$$

$$Y_{35-39} = -0.6981X + 18.2084; \quad r = -0.470; p > 0.05$$

$$Y_{55-59} = -5.2384X + 293.2071; \quad r = -0.447; p > 0.05$$

$$Y_{75-79} = -10.3849X + 404.9087; \quad r = -0.408; p > 0.05$$

Incidence oscillated by age groups during the period of observation in females also, but the situation was completely different than the one registered in males.

Lung cancer incidence trends in females during the period of observation in age groups ranged from 35 to 39 and 45 to 49 years showed very intensive increase and were extremely unfavorable. Correlation was positive, very high and was highly statistically significant.

$$Y_{35-39} = 0.7999X + 1.8913; \quad r = 0.795; p < 0.01 \quad (N=10)$$

$$Y_{45-49} = 3.3594X + 7.9101; \quad r = 0.920; p < 0.01$$

Lung cancer incidence trend in females during the period of observation in age group from 40 to 44 years showed intensive increase and was unfavorable. Correlation was positive and high and was statistically significant (Figure 2).

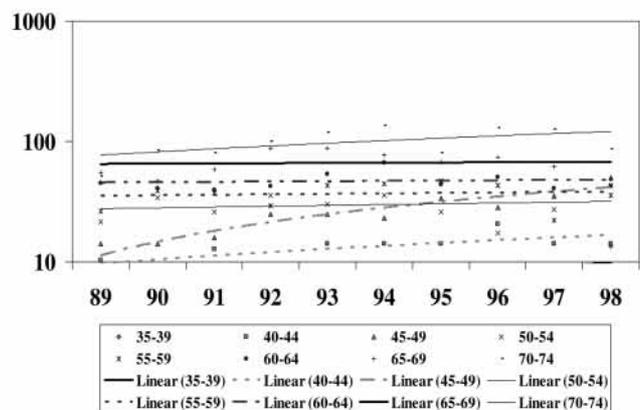


Figure 2. Age groups with increasing lung cancer incidence trend in females in Vojvodina in the period 1989-1998

$$Y_{40-44} = 0.7801X + 8.8389; \quad r = 0.660; p < 0.05 \quad (N=10)$$

Lung cancer incidence trends in females during the period of observation in age groups ranged from 50 to 54, 55 to 59, 60 to 64, 65 to 69, and 70 to 74 years showed increase, which was not intensive, but was also unfavorable. Correlation in these age groups was positive, very low but not statistically significant.

$$Y_{50-54} = 0.4613X + 27.1902; \quad r = 0.181; p > 0.05$$

$$Y_{55-59} = 0.3273X + 34.8943; \quad r = 0.119; p > 0.05$$

$$Y_{60-64} = 0.2916X + 45.0999; \quad r = 0.106; p > 0.05$$

$$Y_{65-69} = 0.3056X + 64.8838; \quad r = 0.063; p > 0.05$$

$$Y_{70-74} = 4.9251X + 72.2348; \quad r = 0.144; p > 0.05$$

Lung cancer incidence trends in females during the period of observation in age groups ranged from 75 to 79, 80 to 84, and 85+ years showed decrease, which was not intensive but was favorable and not statistically significant. Correlation was negative and high in age groups ranged from 75 to 79 and 80 to 84 years, negative and very low in age groups ranged from 30 to 34 and 85+ years.

$$Y_{30-34} = -0.1906X + 3.3726; \quad r = -0.364; \quad p > 0.05$$

$$Y_{75-79} = -3.1292X + 87.9396; \quad r = -0.563; \quad p > 0.05$$

$$Y_{80-84} = -4.1731X + 78.2632; \quad r = -0.553; \quad p > 0.05$$

$$Y_{85+} = -1.4924X + 44.4219; \quad r = -0.276; \quad p > 0.05$$

Lung cancer mortality trends in males and females by age groups in Vojvodina during 1989-1998

Lung cancer deaths were registered in almost all age groups during the period of observation. Total of 9376 deaths in males and 1755 deaths in females were registered during the period of observation. Deaths were not registered in age groups ranged from 0 to 4, 5 to 9, and 10 to 14 years in males and in age groups ranged from 0 to 4, 5 to 9, 10 to 14, and 15 to 19 years in females.

Average age of deaths in males was 62,6 +/- 9.9 years (CV=16%) and in females it was 64.3 +/- 11.8 years (CV=18%).

Lung cancer mortality trends in males during the period of observation in age groups ranged from 45 to 49, 60 to 64, 65 to 69, and 70 to 74 years showed very intensive increase and were extremely unfavorable. Correlation was positive, very high, and highly statistically significant (Figure 3).

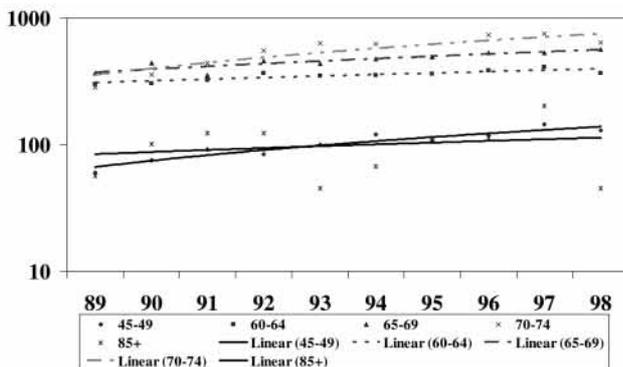


Figure 3. Age groups with increasing lung cancer mortality trend in males in Vojvodina in the period 1989-1998

$$Y_{45-49} = 8.0203X + 58.6535; \quad r = 0.938; \quad p < 0.01 \quad (N=10)$$

$$Y_{60-64} = 9.7595X + 298.2696; \quad r = 0.868; \quad p < 0.01$$

$$Y_{65-69} = 21.0135X + 350.0673; \quad r = 0.914; \quad p < 0.01$$

$$Y_{70-74} = 43.9935X + 309.7532; \quad r = 0.857; \quad p < 0.01$$

Lung cancer mortality trend in males during the period of observation in age group 85+ years showed increase, which was not intensive, but was also unfavorable. Correlation in this age group was positive, very low but not statistically significant.

$$Y_{85+} = 3.2745X + 81.0446; \quad r = 0.204; \quad p > 0.05$$

Lung cancer mortality trend in males during the period of observation in age group ranged from 80 to 84 years showed intensive decrease and was favorable. Correlation was negative, high and highly statistically significant.

$$Y_{80-84} = -20.9226X + 355.3945; \quad r = -0.750; \quad p < 0.05$$

Lung cancer mortality trends in males during the period of observation in age groups ranged from 30 to 34, 35 to 39, 40 to 44, 50 to 54, 55 to 59, and 75 to 79 years showed a decrease, which was not intensive but was favorable. Correlation was negative and very low

in the age groups ranged from 40 to 44 and 50 to 54 years, while in other age groups it was negative, low but not statistically significant.

$$Y_{30-34} = -0.2663X + 4.5278; \quad r = -0.262; \quad p > 0.05$$

$$Y_{35-39} = -0.5614X + 15.4376; \quad r = -0.388; \quad p > 0.05$$

$$Y_{40-44} = -0.3123X + 42.0583; \quad r = -0.122; \quad p > 0.05$$

$$Y_{50-54} = -3.3975X + 162.6639; \quad r = -0.476; \quad p > 0.05$$

$$Y_{55-59} = -5.8013X + 252.5616; \quad r = -0.524; \quad p > 0.05$$

$$Y_{75-79} = -20.9226X + 355.3945; \quad r = -0.456; \quad p > 0.05$$

Mortality oscillates by age groups during the period of observation in females also, but the situation is completely different than the one registered in males.

Lung cancer mortality trend in females during the period of observation in age group from 70 to 74 years showed very intensive increase and was extremely unfavorable. Correlation was positive, very high, and highly statistically significant (Figure 4).

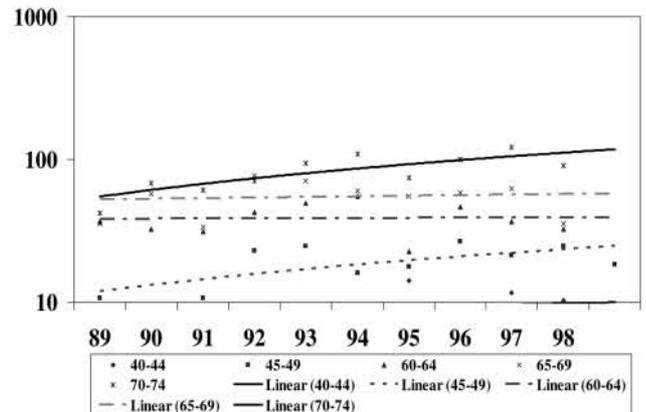


Figure 4. Age groups with increasing lung cancer mortality trend in females in Vojvodina in the period 1989-1998

$$Y_{70-74} = 6.2932X + 48.5865; \quad r = 0.782; \quad p < 0.01 \quad (N=10)$$

Lung cancer mortality trend in females during the period of observation in age group ranged from 45 to 49 years showed an intensive increase and was unfavorable. Correlation was positive, high, and statistically significant.

$$Y_{45-49} = 1.7065X + 8.8546; \quad r = 0.745; \quad p < 0.05 \quad (N=10)$$

Lung cancer mortality trends in females during the period of observation in age groups ranged from 35 to 39, 40 to 44, 60 to 64, and 65 to 69 years showed increase, which was not intensive, but was also unfavorable. Correlation in age groups from 60 to 64 and from 65 to 69 years was positive, very low, while in age group from 40 to 44 years was positive and low. Correlation between mortality and age during the period of observation was not statistically significant.

$$Y_{35-39} = 0.1047X + 2.8780; \quad r = 0.133; \quad p > 0.05$$

$$Y_{40-44} = 0.2886X + 7.2942; \quad r = 0.335; \quad p > 0.05$$

$$Y_{60-64} = 0.0944X + 38.1179; \quad r = 0.029; \quad p > 0.05$$

$$Y_{65-69} = 0.5196X + 51.7725; \quad r = 0.104; \quad p > 0.05$$

Lung cancer mortality trends in females during the period of observation in age groups ranged from 30 to 34, 50 to 54, 55 to 59, 75 to 79, 80 to 84, and 85+ show decrease, which was not intensive but was favorable and not statistically significant. Correlation was negative and high in age groups from 55 to 59 years, negative and very low in age groups from 50 to 54 and 85+ years, and negative and low in age groups from 75 to 79 and from 80 to 84 years of age.

$$Y_{30-34} = -0.0830X + 2.0965; \quad r = -0.200; \quad p > 0.05$$

$$Y_{50-54} = -0.5400X + 24.5095; r=-0.228; p>0.05$$

$$Y_{55-59} = -1.0410X + 35.6329; r=-0.520; p>0.05$$

$$Y_{75-79} = -2.4648X + 77.5660; r=-0.481; p>0.05$$

$$Y_{80-84} = -2.3944X + 63.9651; r=-0.305; p>0.05$$

$$Y_{85+} = -1.1413X + 39.5934; r=-0.215; p>0.05$$

Age distribution of lung cancer cases in males and females in Vojvodina during 1989-1998

Age distribution among all lung cancer patients showed that the highest percentage of cases occurs in the age group ranged from 60 to 69 years (40.47%). Age distribution also showed that over 90% of cases occurs from 40 to 80 years of life. Percentage of cases in younger age groups, under 40 years of age, was less than 2%. Age distribution by sex showed similar result as in total. Dominant age group was from 60 to 69 years of age (41.9% in males and 33.3% in females) (Table 2).

Table 2. Age distribution of lung cancer cases in males and females in the period 1989-1998 year in Vojvodina

Age group	Males		Females	
	Number of cases	Percentage (%)	Number of cases	Percentage (%)
0-29	16	0.14	9	0.41
30-39	155	1.38	68	3.12
40-49	1139	10.16	251	11.50
50-59	2911	25.96	472	21.63
60-69	4694	41.87	726	33.27
70-79	1922	17.14	508	23.28
80+	375	3.34	148	6.78
Total	11212	100.00	2182	100.00

Age distribution of lung cancer deaths in males and females in Vojvodina during 1989-1998

Age distribution of all deaths from lung cancer showed that the highest percentage of deaths occurred in the age group ranged from 60 to 69 years in males (41.8%) and in females (34.1%). During seventh decade of life more than one third of deaths occurred during the period of observation (Table 3).

Table 3. Age distribution of lung cancer deaths in males and females in the period 1989-1998 year in Vojvodina

Age group	Males		Females	
	Number of cases	Percentage (%)	Number of cases	Percentage (%)
0-29	10	0.11	4	0.23
30-39	127	1.35	40	2.28
40-49	884	9.43	172	9.80
50-59	2413	25.74	366	20.85
60-69	3917	41.78	598	34.07
70-79	1685	17.97	439	25.01
80+	340	3.63	136	7.75
Total	9376	100.00	1755	100.00

DISCUSSION

Sex ratio in Denmark is decreasing every 5 years and number of cases among females is closing onto number of cases in males. The lowest sex ratio was registered in 1994 when it was close to 2:1 in favor of males. It is expected that sex ratio will reverse in the next 15 years in case of continuance of actual trends (2). In our study sex ratio of lung cancer in Vojvodina during the observed period showed that 5.14 cases occurred in males for each female case.

There is a statistically significant decrease in lung cancer mortality trends in the USA regardless the race and ethnicity primarily in the age groups above 55 years (3). Study in

the USA shows decrease in lung cancer incidence trend in younger age groups in males and females and that it will take several years for the beginning of similar situation in older age groups especially in females. Study also shows that an aging population contributes to larger number of cases being diagnosed (4).

There is a decrease in lung cancer mortality trend in Australia in age groups from 20 to 44 years that started in 1986. Mortality rates are lower in females under 50 years of age than those over 50 years of age (5). Descriptive study conducted in New South Wales in the period from the year 1985 till year 1995 showed a significant decrease in lung cancer incidence trend based on continuous decrease in incidence in males in age groups from 40 to 80 years and especially in age groups from 40 to 60 years due to decrease of 40%-60% of registered cases. Australian study also shows a stable increase in lung cancer incidence trend in females older than 65 years. Incidence rates in New South Wales do not show changes in younger females and males of the oldest age (6). There is a decrease in lung cancer incidence trend in Japan in males 55-59 years of age registered for all the most represented histological types of lung cancer (7).

Our study showed that the most unfavorable lung cancer incidence trends were present in age groups from 45 to 49, 60 to 64, 65 to 69, and 70 to 74 years in males and in age groups from 35 to 39, 40 to 44, and 45 to 49 years in females. In these age groups lung cancer incidence trends were increasing and very intensive. Our study also showed that the most unfavorable lung cancer mortality trends, which are increasing and very intensive, were present in age groups from 45 to 49, 60 to 64, 65-69, and 70 to 74 years in males and in age groups from 45 to 49 and 70 to 74 years in females. These lung cancer mortality trends were extremely unfavorable. Favorable lung cancer mortality and incidence trend was present only in the age group from 80 to 84 years in males.

The most common age of lung cancer cases in the USA is between 50 to 70 years. According to the data from 1999, in the USA only 5% of patients were younger than 40 years (8). An Italian study shows that the percentage of lung cancer cases younger than 40 years is very low, only 2.8%. In previous years percentage was between 1.3% and 5.5% (9). Our study showed that the dominant age of lung cancer cases and deaths from lung cancer among male and female patients occurred during the seventh decade of life (more than one third of all cases and deaths). Percentage of patients younger than 40 years was less than 2%.

CONCLUSION

Preventive measures, primarily measures directed to smoking cessation, in our population do not show good results yet. This is either because of greater exposure of population to the risk factors or because of greater exposure to the risk factors of certain age cohorts. Decrease in sex ratio show that females are closing onto males when we talk about numbers of new lung cancer cases. It is clear that lung cancer incidence trends in males by age groups show greater variability while in females variability occurs on smaller scale when lung cancer incidence trends by age groups are discussed.

It is to assume that cases in males occur due to exposition to different risk factors and due to combined effect of known and unknown risk factors. Several risk factors might have had influence on occurrence of cases in males such as cigarette smoking as a major risk factor, occupational exposure, stress, migrations (war) and other unknown factors. Because of lung cancer being a disease with long asymptomatic period and because of unfavorable trends in females in younger age groups it is to assume that risk factors act on females early in life probably in puberty.

REFERENCES

1. Burany B, Zrilić V, Gudurić B, Nikolić V, Popović K, Janča K. Opšta i specijalna epidemiologija malignih neoplazmi sa posebnim osvrtom na najučestalije lokalizacije. Novi Sad: Medicinski fakultet Novi Sad; 1984. p. 95-6.
2. Skuladottir H, Olsen JH, Hirsch FR. Incidence of lung cancer in Denmark: historical and actual status. *Lung Cancer* 2000;27(2):100-18.
3. Jemal A, Chu K, Tarone RE. Recent trends in lung cancer mortality in the United States. *J Natl Cancer Inst* 2001;93(4):277-83.
4. Merill RM. Measuring the projected public health impact of lung cancer through lifetime and age-conditional risk estimates. *Ann Epidemiol* 2000;10(2):88-96.
5. Blizzard L, Dwyer T. Declining lung cancer mortality of young Australian women despite increased smoking is linked to reduced cigarette tar-yields. *Br J Cancer* 2001;84(3):392-6.
6. Morgan LC, Grayson D, Peters HE, Clarke CW, Peters MJ. Lung cancer in New South Wales: current trends and the influence of age and sex. *Med J Aust* 2000;172(12):578-82.
7. Soda H, Oka M, Soda M, Naktomi K, Kawabata S, Suenaga M et al. Birth cohort effects on incidence of lung cancers: a population-based study in Nagasaki, Japan. *Jpn J Cancer Res* 2000;91(10):960-5.
8. Popovac D. Bolesti pluća. V dopunjeno i prerađeno izdanje. Beograd: Data status; 1999. p. 431-49.
9. Cangemi V, Volpino P, D Andrea N, Galati G, Ramacciato G, Puopolo M et al. Lung cancer in young patients. *Panminerva Med* 1996;38(1):1-7.