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PROSTATE CANCER INCIDENCE IN PODKARPACKIE PROVINCE IN 2002-2011

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ABSTRACT

INTRODUCTION. Prostate cancer is an important epidemiological problem in Podkarpackie province. A significant rise in the number of new cases was reported. The values of crude and standardized rates, percentage share and cumulative risk also increased.

OBJECTIVE. This article aims at analyzing incidence and mortality rates of prostate cancer in 2002-2011.

MATERIAL AND METHODS. Analysis was based on data retrieved from the Podkarpackie Cancer Registry in Rzeszów. A total of 4 263 prostate cancer cases and 2 032 fatal cases were analyzed from the list of orderly arranged patients. Crude and standardized rates of incidence and mortality, cumulative risk and percentage share of prostate cancer out of all cancers were calculated.

RESULTS. Compared to 2002, the number of cases increased by 150.5% in 2011. Cumulative risk rose from 1.8% in 2002 to 4.7% in 2011. Percentage of prostate cancer cases out of all registered cancers increased more than twofold in the analyzed decade. There was a 22.3% increase in the number of fatal cases due to prostate cancer, accompanied by a slight decrease of standardized mortality rate from 13.2/100 000 in 2002 to 12.6/100 000 in 2011. In the analyzed period, 41.8% of patients were diagnosed with locally advanced prostate cancer.

Key words: *prostate cancer, cases, fatal cases*

INTRODUCTION

According to 2012 estimates (1), prostate cancer is one of the most prevalent cancers in males in Europe (22.8%) and the United States (28.3%).

Screening, aimed at detecting cancers at an early stage, affected diagnosis of prostate cancer with an example being implementation of prostate-specific antigen (PSA) testing in serum in 1980s in the United States. There was nearly twofold increase of standardized incidence rate between 1988 and 2002 (2). Irrespective of the growing popularity and accessibility of PSA, no significant decrease of mortality due to prostate cancer was reported. Normal PSA level in serum ranges from 0 to ~4 ng/ml. Elevated PSA level may be indicative of neoplastic processes. Despite increased PSA level, 25% of males were not diagnosed with cancer while nearly 20% of prostate cancer cases had normal PSA level in serum (3). As prostate cancer is rarely of severe course,

it is not an underlying cause of death in a number of cases, but age-related comorbidities (4).

Risk factors which may affect developing prostate cancer are: family genetics, obesity, high-fat diet, androgen effect and ethnicity (African-American males have a 20% higher chance of developing cancer compared to white Americans) (5). Genetic susceptibility increases the risk of cancer by ca 15%. From epidemiological studies conducted in a group of 5 000 Americans transpires that low-fat diet and low cholesterol level in blood reduce the risk of cancer by even 60% and 15%, respectively (6,7,8). It was stated that males with a BMI of >30 are at increased odds, ranging from 20% to 34%, of death due to prostate cancer compared to males with normal BMI values (5,6).

Prostate cancer is the second most incident cancer and the fifth leading cause of death worldwide. According to the estimates, the highest percentage of cases (68.5%) in 2012 was reported in males aged >65

Table I. Prostate cancer incidence and mortality rates in Poland in 2002-2011 (3)

Prostate cancer incidence in Poland					Year	Prostate cancer mortality in Poland				
Number of new cancer cases	Crude rate per 100,000	Standardized rate	Percentage (%)	Cumulative risk (%)		Number of cancer cases	Crude rate per 100,000	Standardized rate	Percentage (%)	Cumulative risk (%)
5236	28.3	20.8	9.0	2.5	2002	3488	18.8	13.5	6.9	1.2
5832	31.5	23.0	9.4	2.8	2003	3390	18.3	12.9	6.8	1.1
6257	33.9	24.5	10.0	2.9	2004	3578	19.4	13.3	7.0	1.2
7095	38.4	27.3	11.1	3.4	2005	3592	19.5	12.9	7.0	1.1
7154	38.8	27.2	11.2	3.4	2006	3681	20.0	12.9	7.1	1.1
7638	41.5	28.3	11.9	3.5	2007	3932	21.4	13.4	7.5	1.2
8269	44.9	29.9	12.6	3.8	2008	3892	21.1	12.9	7.5	1.2
9142	49.6	32.8	13.3	4.3	2009	4041	21.9	13.1	7.7	1.2
9273	49.7	32.3	13.2	4.2	2010	3940	21.1	12.4	7.6	1.1
10318	55.3	35.1	14.4	4.5	2011	4085	21.9	12.5	7.9	1.2

years. Standardized incidence rate, crude incidence rate and cumulative risk were calculated at 31.1/100 000, 31.2/100 000 and 3.8%, respectively (1). The highest incidence was reported in male population in Norway, France, Australia and the United States with standardized incidence rates: 129.7/100 000, 127.3/100 000, 115.2/100 000 and 98.2/100 000, respectively. The lowest standardized incidence rate was noted in the South-Central Asia, i.e. 4.5/100 000. The highest standardized mortality rates were registered in the Caribbean islands (29.3/100 000) and Southern Africa (24.4/100 000), while the lowest values were observed in Asia (3.8/100 000) (1).

In Europe, prostate cancer was the first and the third cause of cancer incidence and mortality, respectively, accounting for 22.8% of all cases and 9.5% of deaths in 2012. Standardized incidence rate in 2012 was 37.3/100 000, crude rate – 67.6/100 000 and cumulative risk – 4.5%. Standardized mortality rate amounted to 11.3/100 000, crude rate – 25.8/100 000 and cumulative risk – 1.0%. Prostate cancer was most commonly diagnosed in males aged more than 65 years (1).

Excluding lung cancer, prostate cancer was the most frequently diagnosed cancer in males in Poland. In 2011, a total of 10,318 cases were reported, accounting for 14.4% of all cancers. Compared to 2002, an increase in the number of new cases was noted by 97.1%. Increasing tendency is reflected by all analyzed incidence rates. In 2011, standardized rate was estimated at 35.1/100 000 (Tab. I). Cumulative risk increased from 2.5% in 2002 to 4.5% in 2011. In the successive years, the number of prostate cancer deaths increased by 77 new cases per year on average. Increasing linear tendency was also reflected by crude mortality rate and percentage share. A decrease of standardized rates was reported, i.e. from 13.5/100 000 in 2002 to 12.5/100 000 in 2011. Cumulative risk in a 10-year-period was 1.2% on average (Tab. I, Fig.1, 2).

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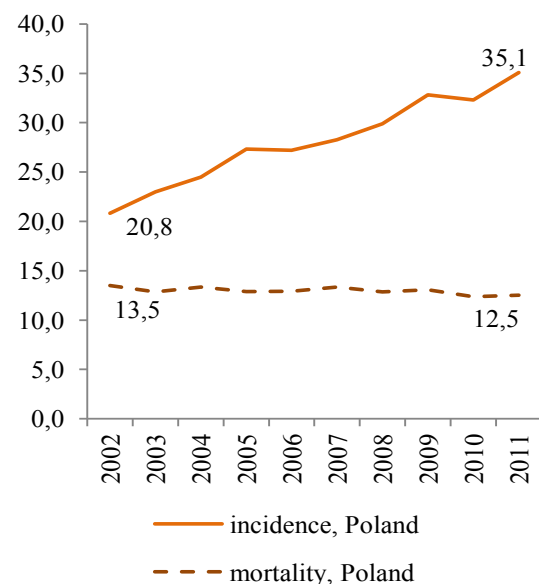


Fig.1. Prostate cancer incidence and mortality in Poland in 2002-2011, standardized rate per 100 000

The majority of prostate cancer cases occur in the 7th or 8th decades of life (87% and 55% of cases are diagnosed in males aged more than 60 and 70 years, respectively). Having analyzed crude incidence rates, a sharp increase was reported, beginning from the 6th decade while maximum was observed for 7th and 8th decades of life (ca 350/100 000) (Fig. 2).

Nearly 60% of prostate cancer deaths are reported in males aged more than 75 years, however, more than 90% of deaths were noted in males aged more than 60 years. The highest mortality rates are reported in males at the 8th and 9th decades of life (ca 500/100 000) (Fig. 2).

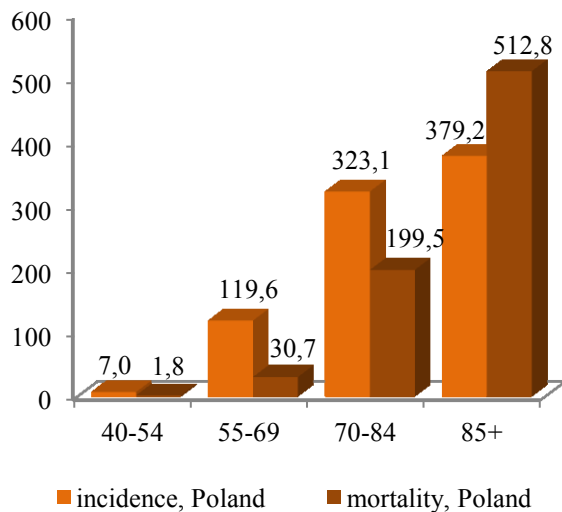


Fig.2. Prostate cancer incidence and mortality by age group in Poland in 2002-2011

The highest standardized prostate cancer incidence rates in 2002-2011 were reported in the following provinces: Wielkopolskie – 35.3/100 000 and Pomorskie- 34.9/100 000 while the lowest in Łódzkie – 22.1/100 000 and Opolskie – 22.2/100 000 provinces (3). The highest and the lowest mortality rates were registered in Wielkopolskie – 14.7/100 000 and Opolskie -11.8/100 000 provinces, respectively (3).

This article aimed at analyzing prostate cancer incidence and mortality rates in Podkarpackie province in 2002-2011.

MATERIAL AND METHODS

Analysis was based on data retrieved from Podkarpackie Cancer Registry in Rzeszów. Data were collected on a basis of cancer notification forms (MZ/N-1a) of orderly arranged patients diagnosed with prostate cancer. All cases registered in Podkarpackie province in 2002-2011 were subject to epidemiological analysis, i.e.: 4 263 cases and 2 032 fatal cases. Crude and standardized incidence and mortality rates, cumulative risk were calculated as well as percentage share of prostate cancer out of all cancers reported in particular years. Demographic tables of the Central Statistical Office (CSO) were employed to calculate crude rates. For standardized rates, world standard population, proposed by Segi and then, modified by Doll, was used. Statistical analysis was performed, using Microsoft Excel 2010 and SAS Enterprise Guide 5.1.

To identify statistically significant differences in prostate cancer incidence and mortality between Podkarpackie province and Poland, standardized incidence and mortality rates were analyzed. For standard tests

comparing two fractions based on normal distribution, it is required for fraction rate not to be too close to zero or oneness. In case of incidence and mortality rates, fraction rate is very close to zero. Thus, test based on Poisson distribution (distribution of rare events) was employed, using absolute numbers of cases and deaths. Poisson distribution is a very good approximation of Bernoulli distribution, being a model which correctly describes the number of cases and deaths.

We assumed that the percentage of cases for Poland and Podkarpackie province is p and q , respectively. If the relation is $q > p$, then the probability that random variable, describing the percentage of cases in Podkarpackie province, is at least equal to q , assuming that the real percentage of cases is p , i.e. $P(F \geq q | p)$. The objective is to identify whether the percentage of cases in Podkarpackie province is statistically significantly higher compared to the average for Poland. Number of Podkarpackie province inhabitants is defined as n , while X means random variable, describing the number of cases in Podkarpackie province. Thus, $P(F \geq q | p)$ is equal to $P(X \geq nq | p)$, which is p -value. If $P(X \geq nq | p) < 0.05$, we conclude that the percentage of cases in Podkarpackie province is statistically significantly higher compared to Poland. If $q < p$, we search $P(X \leq nq | p)$. Aforesaid approach applies also for mortality rate.

RESULTS

In Podkarpackie province, prostate cancer accounted for 12.7% and 8.5% of all cancer cases and fatal cases, respectively in 2002-2011. Number of newly registered cases in 2011 amounted to 556. Compared to 2002, its value was higher by 150.5%. Having analyzed standardized incidence rates, an increase was reported from 15.9/100 000 in 2002 to 36.1/ 100 000 in 2011. Cumulative risk increased from 1.8% in 2002 to 4.7% in 2011. Percentage share of prostate cancer out of all cancers registered in the analyzed period increased more than twofold in that decade (Tab. II, Fig.3).

An increase by 22.3% in the number of fatal cases was also reported, i.e. from 179 in 2002 to 219 in 2011 as well as a rise of crude rate with concomitant decrease of mortality rate. Standardized mortality rate decreased from 13.2/100 000 in 2002 to 12.6/100 000 in 2011. A slight decrease was also noted for cumulative risk (2002-1.3%, 2011-1.2%). Compared to 2002, the percentage of prostate cancer deaths increased by 1.8% in 2011 (Tab. II, Fig. 3).

The highest number of prostate cancer cases was reported in the 7th and 8th decade of life. A sharp increase was observed in males aged more than 70 years compared to those aged 55-69 years (Fig. 4).

Table II. Prostate cancer incidence and mortality rates in Podkarpackie province in 2002-2011

Prostate cancer incidence in Podkarpackie province					Year	Prostate cancer mortality in Podkarpackie province				
Number of new cancer cases	Crude rate per 100,000	Standardized rate	Percentage (%)	Cumulative risk (%)		Number of cancer cases	Crude rate per 100,000	Standardized rate	Percentage (%)	Cumulative risk (%)
222	21.4	15.9	7.4	1.8	2002	179	17.3	13.2	7.8	1.3
381	37.0	27.6	11.1	3.4	2003	184	17.9	12.7	7.7	1.1
397	38.5	29.9	11.3	3.5	2004	208	20.2	14.8	8.8	1.3
417	40.4	29.6	11.3	3.5	2005	196	19.0	13.1	8.3	1.1
396	38.4	27.0	10.9	3.2	2006	207	20.1	13.4	8.5	1.2
390	37.9	26.6	10.6	3.2	2007	211	20.5	13.1	8.4	1.2
455	44.2	30.3	12.1	3.5	2008	209	20.3	12.4	8.3	1.0
521	50.6	35.3	13.3	4.4	2009	216	21.0	12.8	8.4	1.1
528	50.7	34.5	13.5	4.3	2010	203	19.5	11.7	8.7	0.9
556	53.4	36.1	14.6	4.7	2011	219	21.0	12.6	9.6	1.2

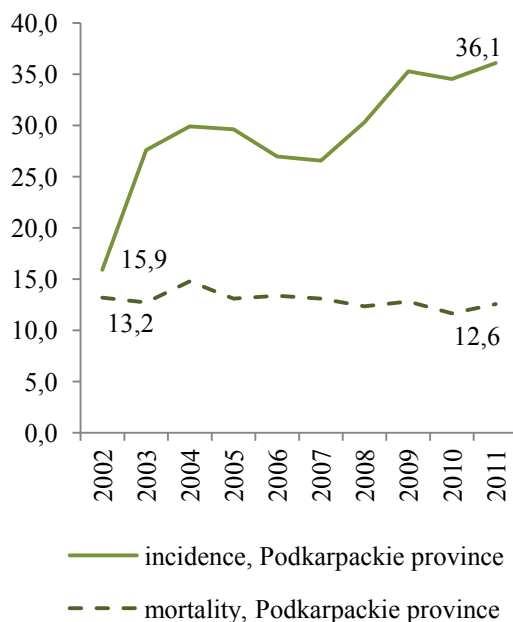


Fig.3 Prostate cancer incidence and mortality in Podkarpackie province in 2002-2011, standardized rate per 100 000

More than 60% of prostate cancer deaths occur in males aged more than 70 years with the highest mortality rate noted in males aged more than 85 years (548.4/100 000). Risk of death due to prostate cancer increases with age, beginning from the 7th decade of life (Fig. 4). Average age of the study group was 71 years. The youngest and the oldest patients at the moment of diagnosis were at the age of 26 and 100 years, respectively.

In 2002-2011, prostate cancers were most commonly diagnosed at the locally advanced stage – 41.8%, then not exactly defined - 30.0%, generalized – 16.0% and regional – 12.2%.

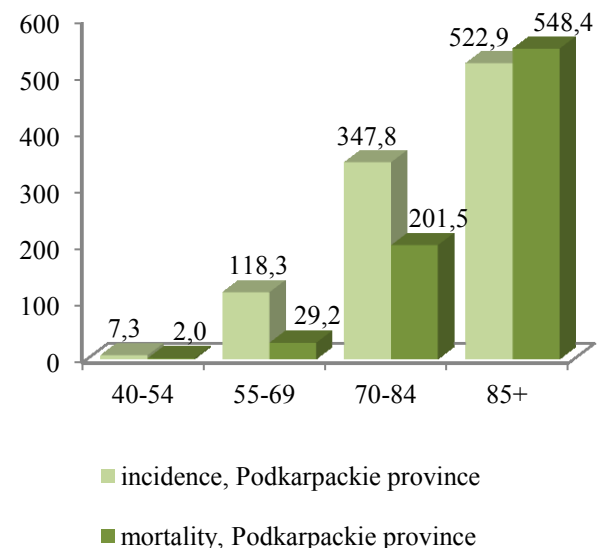


Fig.4 Prostate cancer incidence and mortality by age group in Podkarpackie province in 2002-2011

In the analyzed 10-year-period, an increase in the number of cancers diagnosed at the locally advanced stage was reported, i.e. from 37.1% in 2002 to 48.9% in 2011, with concomitant decrease of cancer diagnosed at regional stage and not exactly defined with their respective shares being – 4.4 and 7.1 percentage points. Percentage of diagnoses at generalized stage was of approximate values (Fig.5).

Based on cancer notification forms (MZ/N-1a), clinical stage of cancer advancement (TNM) was established exclusively in 11.7% (499) of all patients registered in 2002-2011. Lymph node involvement or distant metastasis were not determined in 80.6% of these patients. Less than a half of these males had tumor restricted to the prostate. Occult tumor was determined in 27.1% of patients.

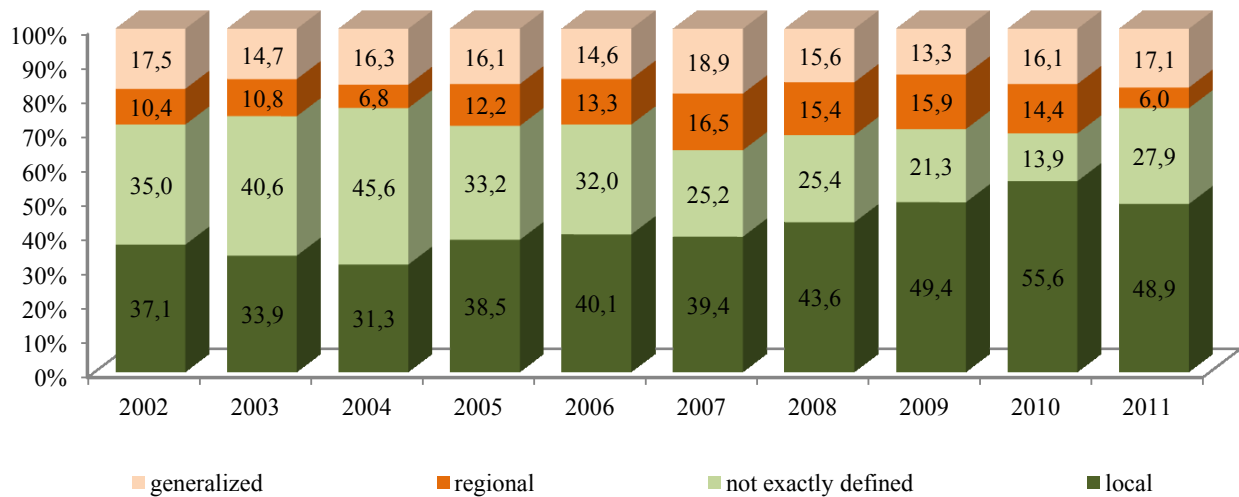


Fig.5. Prostate cancer stage at the time of diagnosis, 2002-2011

In 2002-2011, the most common therapeutic method was radical treatment which was initiated in case of 1,316 out of 1,931 cases diagnosed at the locally advanced stage. A total of 407 cases diagnosed

with regional stage of cancer and 240 with generalized stage were subject to palliative treatment while for 409 patients, symptomatic treatment was initiated due to the spread of neoplastic changes (Fig. 6).

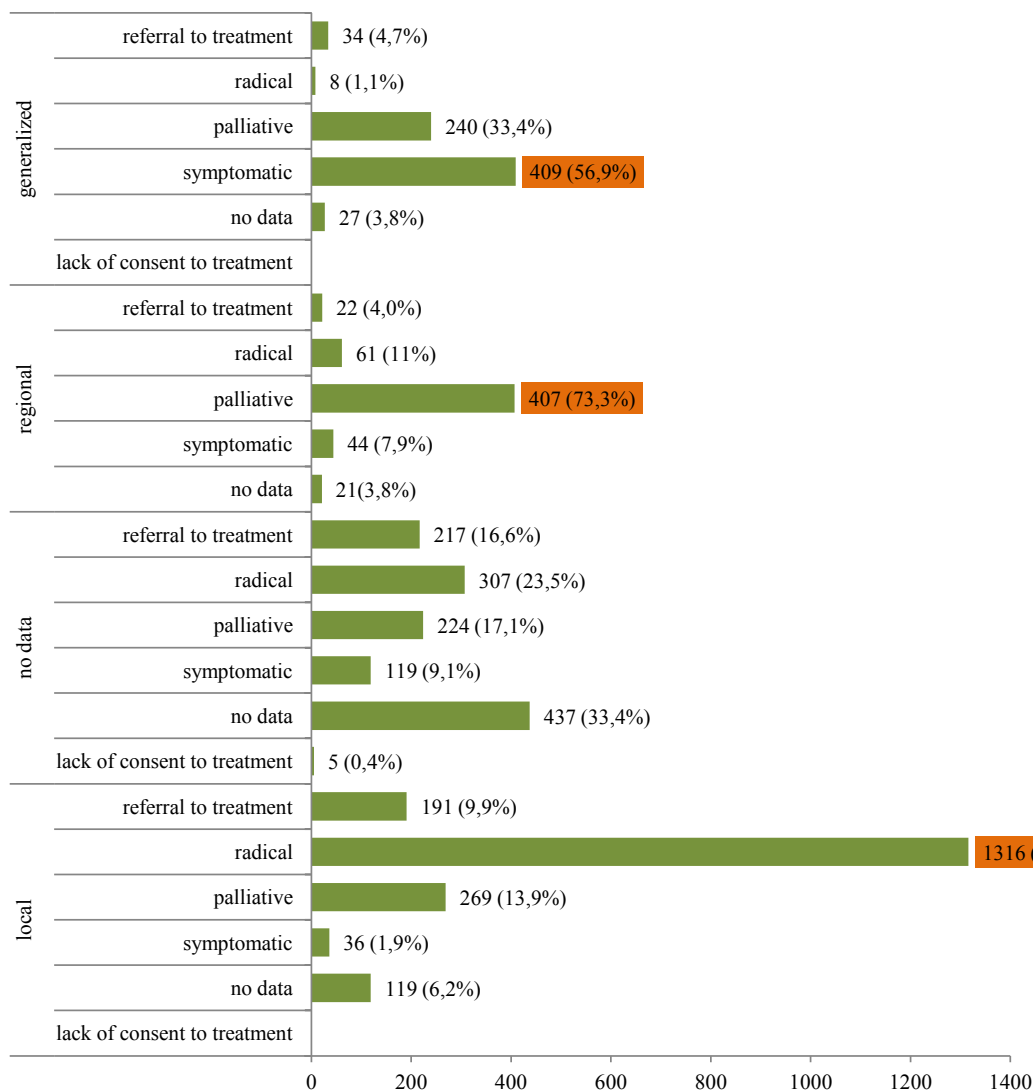


Fig. 6. Cancer stage-dependent treatment in prostate cancer cases in 2002-2011 (qualitative approach)

Out of 4,263 prostate cancer cases diagnosed in 2002-2011, 37.5%, 25.2% and 13.5% were subject to radical, palliative and symptomatic treatment, respectively. For 13.4% of patients, the information on treatment was lacking while 10.3% of patients did not undergo treatment despite referral to oncologist and their consent for treatment. Exclusively 0.1% of patients refused to undergo treatment.

The most common type of prostate cancer was adenocarcinoma – 90.1%.

Table III. Poisson distribution of incidence and mortality in Poland and Podkarpackie province

Year	p-value	
	Incidence	Mortality
2002	0.000	0.393
2003	0.001	0.472
2004	0.000	0.101
2005	0.081	0.409
2006	0.435	0.350
2007	0.151	0.405
2008	0.408	0.337
2009	0.086	0.393
2010	0.105	0.266
2011	0.296	0.487

It was noted that mortality rates in Podkarpackie province and Poland did not differ statistically significantly in 2002-2011 (Tab. III). In 2002, incidence rate in Podkarpackie province was statistically significantly lower while in 2003-2004, it was statistically significantly higher compared to Poland. In the successive years, no statistically significant differences were reported. Although differences in 2002-2004 are non-accidental and statistically significant, from the fact that there was no stable tendency in Podkarpackie province in this period (always below or over) we conclude that several systematic factors have influenced the results. Consequently, we may acknowledge that Podkarpackie province does not differ statistically significantly from Poland with regard to prostate cancer incidence and mortality.

DISCUSSION

For both, Poland and Podkarpackie province, an increase of prostate cancer incidence and mortality rates was reported. In 2011, a slightly higher incidence rate in Podkarpackie province was noted compared to Poland, i.e. 36.1/100 000 vs 35.1/100 000, respectively. Increase of percentage share was also observed for Poland, ranging from 9.0% to 14.4%, while for Podkarpackie province - from 7.4% to 14.6%. It suggests a rise in the percentage of prostate cancer out of all newly detected cancers. In the analyzed decade, cumulative

risk increased by 2.07 and 2.88 percentage points for Poland and Podkarpackie province, respectively.

Having compared data for Poland and Podkarpackie province, a decrease of standardized mortality rates was reported in the analyzed period. It may be directly associated with the changes in the age pyramid of prostate cancer fatal cases (Fig. 7,8).

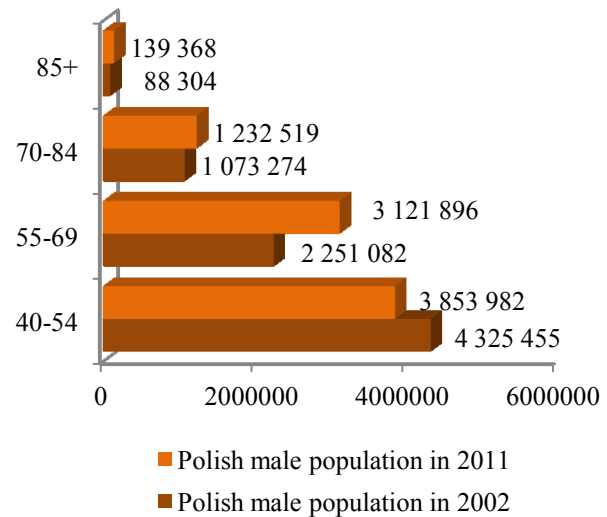


Fig. 7. Polish male population in 2002 and 2011 (3)

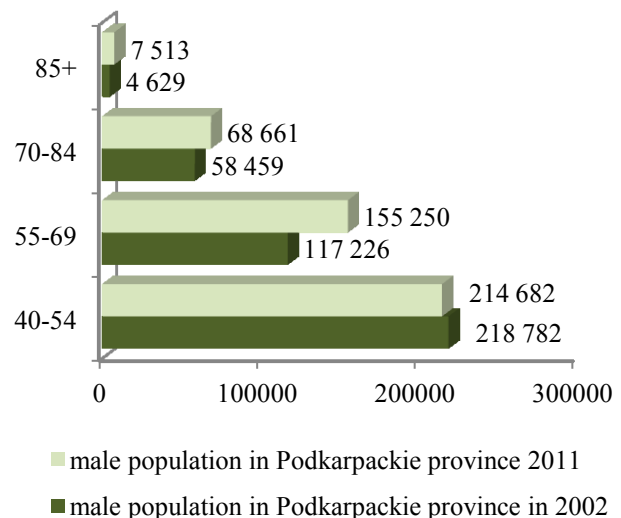


Fig. 8. Male population in Podkarpackie province in 2002 and 2011 (3)

Changes in the age pyramid, resulting from population ageing, affect an increase of prostate cancer incidence in males aged more than 60 years. The highest increase was reported in the following age groups: 55-69 and 70-84 years (Fig. 2,4,7,8). An alarming fact is an increasing number of prostate cancer diagnoses in 50-year-old males (Poland: 2002-138 cases, 2011: 292 cases; Podkarpackie province: 2002 - 8 cases, 2011- 52 cases) (3).

For Poland and Podkarpackie province, nearly 90% of cases occur in males aged more than 60 years (Fig.9). The highest mortality in males is reported in the 8th and

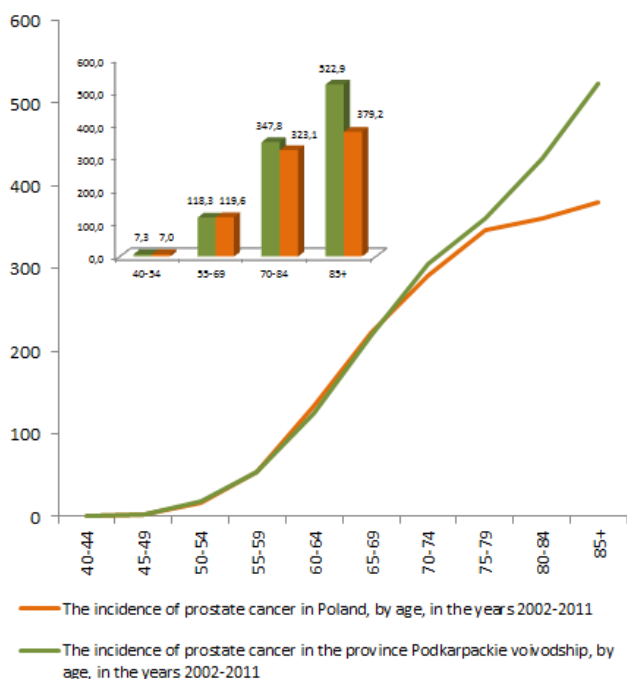


Fig. 9. Prostate cancer incidence by age groups in Poland and Podkarpackie province in 2002-2011

9th decade of life (Poland – 512.8/100 000, Podkarpackie province – 548.4/100 000).

In Poland, there are considerable disparities in prostate cancer incidence. Increase of incidence rate, exceeding the national average ($> 28.2/100\ 000$), was reported in the following provinces: Wielkopolskie, Pomorskie, Świętokrzyskie, Śląskie, Podkarpackie and Mazowieckie in 2002-2011. The lowest incidence was noted in Opolskie (22.2/100 000) and Łódzkie (22.1/100 000) provinces. The highest mortality rates were registered in the following provinces: Wielkopolskie, Podlaskie, Pomorskie, Kujawsko-pomorskie, Warmińsko-mazurskie, Lubuskie, Świętokrzyskie and Podkarpackie. In the aforesaid provinces, mortality rates were higher compared to Poland (13.0/100 000). The lowest mortality rate was reported in Opolskie province (3).

In Podkarpackie province, prostate cancer in 2002–2011 was most commonly diagnosed at locally advanced stage (41.8%). According to *Wilt et al.*, who conducted the study on a group of 13 022 British males in 2011 (average age - 67 years) with a history of radical prostatectomy, 53.4% of patients had tumor restricted to the prostate (9). Based on few studies conducted in a limited scope by Polish authors, it may be presumed that this percentage ranges from 32.0% to 65.6% (10). In the countries of the Western Europe and United States, the percentage of locally advanced cancers, detected beyond screening, ranges from 42.5% to 60.0%. Percentage of cancers restricted to the prostate, detected within screening, varies between 70.9 and 100% (10).

Based on cancer notification forms (MZ/N-1a), involvement of lymph nodes in males living in Podkarpackie province, registered in 2002-2011, was determined in 19.4% of patients. Studies by *Dobruch et al.* suggest that metastasis is identified even in 42% of males with a history of radical prostatectomy (11). A slight percentage of patients with N1 (regional lymph node metastasis) may be indicative of low completeness of N data.

Increase in the number of locally advanced cancers, accompanied by concomitant decrease of regionally advanced and not exactly defined cancers in Podkarpackie province, may result from the better access to PSA testing, screening programmes and raising awareness of males.

In the analyzed period, 37.5% of males were subject to radical treatment in Podkarpackie province. It may be stated, however, that data presented are not complete and percentage share of radical treatment is considerably higher. Based on cancer notification forms, it is not feasible to present treatment adopted as underreporting of data is common. Data presented by *Dobruch et al.* suggest that more than 1,500 radical prostatectomies are performed per year in Poland. Furthermore, this number is gradually increasing. *Dobruch* assumes that introducing a validation system assessing the risk of infiltration and distant metastasis could lead to the increase of radical methods in treatment (10).

Having compared prostate cancer incidence and mortality between Poland and Podkarpackie province and other countries in Europe and worldwide, the highest standardized rates are reported in France, Norway, Australia and North America while the lowest in China and Asian countries (Tab. IV). *Donato* states that Asian

Table IV. Estimated prostate cancer incidence and mortality rates in selected countries worldwide in 2012 (1)

Global prostate cancer incidence				
Country	Number of new cancer cases	Crude rate per 100,000	Standardized rate	Cumulative risk (%)
France, Martinique	771	403.8	227.2	26.0
Norway	5789	232.9	129.7	16.1
France	73609	238.2	127.3	16.1
Australia	21966	192.2	115.2	14.0
North America	260336	150.2	97.2	12.3
European Union	361963	145.7	74.0	9.5
South America	114701	58.0	60.1	7.1
Slovakia	1934	726	50.0	6.0
Poland	11029	59.7	35.9	4.4
Global	1111689	31.2	31.1	3.8
Africa	59493	11.1	23.2	2.8
Ukraine	6637	32.1	20.3	2.6
Asia	196190	9.0	9.4	1.0
China	46745	6.6	5.3	0.4

diet, based on ligands, flavonoids and isoflavonoids, prevents the progression of occult cancer to that clinically overt (12).

CONCLUSIONS

1. Increase of prostate cancer incidence may be associated with ageing of Polish males and those living in Podkarpackie province. Considerable increase was reported in age groups at higher risk of cancer.
2. Increasing number of prostate cancer cases may result from better detectability which is associated with raising awareness of males and increased oncologic vigilance of general practitioners.
3. Having compared data for Poland and Podkarpackie province in the analyzed decade, a decrease of standardized mortality rates was reported. It may result from the changes in the age pyramid of prostate cancer fatal cases.
4. Prostate cancer was most commonly diagnosed at the locally advanced stage (41.8%), which is translated into the initiation of radical treatment in 37.5% of patients.
5. There are no statistically significant differences in prostate cancer incidence and mortality between Podkarpackie province and Poland.

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