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Decade-long trends in prostate cancer incidence and mortality in Poland, 1999–2012

Urszula Wojciechowska[1], Lauren M. Hurwitz[2], Grzegorz Helicki[1], Jennifer Cullen[2,3], David G. McLeod[2,3], Roman Sosnowski[1], Joanna Didkowska[1]

[1] *Department of Uro-Oncology, Maria Sklodowska-Curie Memorial Cancer Center and Institute of Oncology, Warsaw, Poland*
[2] *Center for Prostate Disease Research, Rockville, MD, USA*
[3] *Department. of Surgery, Uniformed Services University of the Health Sciences, Bethesda, MD, USA*

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ABSTRACT

Introduction: In Poland, prostate cancer is the second most common cancer and third leading cause of cancer death among men. Understanding trends in prostate cancer incidence and mortality can inform efforts for prostate cancer prevention and control, yet information on national trends is lacking.

Aim: This study examined temporal trends in prostate cancer incidence and mortality in Poland for the years 1999–2012.

Material and methods: Data on prostate cancer cases and deaths in Poland were provided by the Polish National Cancer Registry (PNCR). For each year, age-standardized incidence and mortality rates were calculated overall, as well as for each vovoideship, urban and rural regions, and age category.

Results and discussion: The overall standardized incidence rate in Poland was found to double during this time period, from 17.39 cases per 100,000 person-years in 1999, to 36.12 in 2012. In contrast, standardized mortality rates remained stable, with 11.89 deaths per 100,000 person-years in 1999 and 12.41 deaths per 100,000 person-years in 2012. Standardized incidence and mortality varied by vovoideship. Standardized incidence but not mortality was higher in urban regions.

Conclusions: This study demonstrates the utility of using PNCR data for cancer epidemiologic research and identifies trends in prostate cancer incidence and mortality that require further inquiry.

Corresponding author: Jennifer Cullen, Center for Prostate Disease Research, 1530 East Jefferson Street, Rockville, MD, 20852, USA.
E-mail address: jcullen@cpdr.org.

1. INTRODUCTION

There is substantial worldwide variation in prostate cancer incidence and mortality.[1] In Poland, prostate cancer is the second most common cancer and the third leading cause of cancer death among men.[2] Despite the large burden of the disease, however, few studies have examined the epidemiology of prostate cancer in Poland. Of the studies that have compared prostate cancer incidence, prevalence, mortality, and survival across European countries, most have utilized only regional registry data for Poland, and none have taken a detailed look at Polish prostate cancer trends in incidence and mortality across region and time.[3–9] Understanding such trends can help to promote further research and target resources for prostate cancer prevention and control, as well as clarify the public health burden of this prevalent cancer among men worldwide.

2. AIM

The purpose of the current study was to examine temporal and regional trends in prostate cancer incidence and mortality in years 1999–2012 using population-based data from the Polish National Cancer Registry (PNCR).

3. MATERIAL AND METHODS

This study utilized data provided by the PNCR. The PNCR collects data from a network of 16 regional registries located throughout Poland. There is one regional registry within each of Poland's 16 voivodeships (administrative units). Each regional registry captures data from the entire population of its voivodeship; as a result, 100% of Poland is covered by cancer registration.

Regional registries receive data in the form of Cancer Registration Forms that are filled out by physicians upon cancer diagnosis and treatment of cancer patients. Prior to 2013, each regional registry maintained its own database. In 2013, the registry data were combined into a single, centralized database managed by the PNCR. The PNCR works to ensure the quality and completeness of the data and is responsible for publishing annual reports of cancer burden in Poland (published at http://onkologia.org.pl).

For the current project, the PNCR provided data on the number of incident cases of prostate cancer, the number of deaths attributed to prostate cancer (International Classification of Diseases for Oncology, 10th Edition, code C61), and the total number of men in the Polish population, per five-year age category and per year. These counts were also given for each of Poland's 16 voivodeships and for urban and rural regions, separately. The data were provided for the years 1999–2012.

Using these data, yearly incidence and mortality rates were calculated for all of Poland, for each voivodeship, for urban and rural regions, and for five age groups (>50, 50–59, 60–69, 70–79, ≤80). Incidence and mortality rates were age-adjusted using the method of direct standardization and the World Standard Population.[10,11] Annual percent change (APC) was used to quantify time trends in incidence and mortality and was computed using generalized linear models;12 trends with a $P < 0.05$ were considered statistically significant. Calculations were run using SAS version 9.3 (SAS Institute Inc., Cary, North Carolina, USA).

Table 1. Standardized incidence rates and annual percent change (APC) by voivodeship, 1999–2012.*

Voivodeship	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	APC	*P* value
Dolnoslaskie	23.15	24.27	25.63	22.60	21.65	25.58	27.79	28.54	28.54	30.73	30.84	27.66	32.10	31.68	2.70	<0.0001
Kujawsko-Pomorskie	23.97	19.05	22.48	16.59	23.00	27.20	28.70	36.41	36.49	37.57	40.51	36.03	35.73	36.55	5.35	<0.0001
Lubelskie	13.16	15.92	22.25	22.41	19.02	23.38	35.17	30.20	32.04	27.56	27.46	33.02	36.19	37.90	5.99	<0.0001
Lubuskie	14.97	14.79	13.80	10.23	19.10	21.52	29.19	22.77	25.34	26.03	33.38	42.61	36.59	44.29	10.20	<0.0001
Lodzkie	11.43	16.58	16.97	15.30	15.94	19.07	24.15	21.59	20.04	23.42	21.75	24.13	45.99	22.21	6.55	0.0004
Malopolskie	20.11	22.27	25.20	27.68	26.75	26.35	30.05	36.11	30.99	29.29	33.56	31.53	33.47	42.68	4.10	<0.0001
Mazowieckie	16.42	21.06	24.08	24.37	28.36	32.98	30.80	30.00	30.46	34.57	33.70	35.14	31.11	29.90	3.38	<0.0001
Opolskie	22.64	20.63	21.52	23.86	22.07	23.30	24.29	22.84	26.92	32.34	26.39	26.73	25.05	34.03	2.89	<0.0001
Podkarpackie	13.60	28.57	26.86	23.45	35.26	30.18	31.80	29.93	27.14	28.55	35.90	34.50	36.02	41.35	4.06	<0.0001
Podlaskie	17.60	21.13	22.81	18.94	19.97	19.72	32.01	30.19	24.06	27.77	28.79	34.21	40.96	33.55	5.59	<0.0001
Pomorskie	19.97	26.65	28.99	27.46	24.45	24.86	29.39	34.47	36.86	40.94	55.06	47.70	51.12	54.45	7.93	<0.0001
Slaskie	16.84	19.16	24.25	28.94	29.62	29.38	31.60	32.83	34.95	33.77	36.61	33.80	33.47	38.53	4.30	<0.0001
Swietokrzyskie	25.88	30.39	29.52	39.37	35.94	29.60	34.39	30.69	30.84	29.12	30.17	26.77	26.30	39.27	0.04	0.9642
Warminsko-Mazurskie	12.08	14.22	18.83	21.86	23.72	28.49	32.24	25.98	29.07	26.72	27.49	23.85	26.52	31.21	3.98	0.0003
Wielkopolskie	16.03	18.95	24.43	27.52	26.13	29.13	35.93	35.16	40.20	44.68	42.95	36.33	38.69	37.40	5.27	<0.0001
Zachodniopomorskie	15.57	19.60	20.85	17.17	20.05	20.06	23.44	23.31	28.76	27.03	29.44	28.51	27.18	31.25	4.71	<0.0001
All	17.39	20.86	23.57	23.96	25.22	26.74	30.38	30.43	31.04	32.18	34.11	32.94	35.07	36.12	4.58	<0.0001

* Rates are expressed per 100 000 person-years, age-standardized to the World Standard Population.[10,11]

Table 2. Standardized mortality rates and annual percent change (APC) by voivodeship, 1999–2012.*

Voivodeship	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	APC	*P* value
Dolnoslaskie	10.20	10.72	12.45	13.33	12.59	11.66	12.83	13.24	11.98	13.66	12.01	11.81	12.10	11.79	0.48	0.3184
Kujawsko-Pomorskie	12.04	14.82	15.23	14.35	12.24	13.86	11.95	12.94	13.47	12.43	14.83	14.09	15.39	13.29	0.27	0.632
Lubelskie	11.11	11.68	10.69	12.35	11.88	11.89	11.63	13.01	11.17	12.90	12.88	11.92	12.27	11.27	0.5	0.161
Lubuskie	10.10	10.98	14.12	14.22	16.02	11.86	14.49	11.99	16.17	12.91	11.81	11.13	13.91	12.65	0.26	0.766
Lodzkie	10.95	12.94	13.40	14.27	13.49	14.74	12.44	12.48	12.60	12.77	11.30	13.33	11.07	12.24	-0.59	0.2667
Malopolskie	10.74	10.83	12.54	12.17	12.08	13.86	12.36	12.54	12.21	11.93	12.23	12.22	11.91	11.92	0.34	0.3678
Mazowieckie	11.69	12.56	12.23	12.47	12.55	12.73	12.22	13.25	13.68	13.40	12.48	10.86	12.23	11.64	-0.14	0.7053
Opolskie	11.19	8.45	9.87	13.08	11.72	12.11	11.51	9.77	12.03	10.02	13.74	12.29	11.71	10.67	0.85	0.2618
Podkarpackie	12.55	12.87	13.88	13.18	12.72	14.76	13.10	13.37	13.10	12.35	12.80	11.65	12.57	11.21	-0.83	0.0217
Podlaskie	11.21	12.30	13.89	12.75	12.13	12.28	15.03	13.42	12.85	14.50	17.35	15.56	13.80	16.31	2.29	<0.0001
Pomorskie	15.82	16.57	15.23	14.93	14.01	13.33	13.66	14.41	13.55	13.91	14.20	12.94	12.47	14.48	-1.37	<0.0001
Slaskie	11.43	11.67	13.43	13.33	11.88	12.45	12.91	11.92	13.69	12.13	12.51	12.32	11.65	12.75	0.09	0.8043
Swietokrzyskie	11.65	13.05	12.46	15.41	14.17	14.03	14.08	13.44	15.16	9.39	13.11	12.48	11.51	11.72	-0.86	0.2458
Warminsko-Mazurskie	12.33	12.82	13.90	13.07	13.67	12.76	14.14	13.98	14.89	13.36	15.92	11.39	12.59	11.97	-0.08	0.8826
Wielkopolskie	14.47	14.87	16.09	15.51	14.10	14.93	14.65	13.56	15.87	15.04	15.23	13.87	14.62	12.78	-0.59	0.0963
Zachodniopomorskie	13.05	12.47	12.65	14.18	13.32	16.32	10.91	12.11	12.85	12.81	11.20	12.34	12.49	14.03	-0.38	0.5562
All	11.89	12.54	13.20	13.50	12.85	13.33	12.88	12.93	13.35	12.87	13.07	12.36	12.51	12.41	-0.07	0.7612

* Per 100 000 person-years, age-standardized to the World Standard Population.[10,11]

4. RESULTS

The standardized incidence rate (SIR) of prostate cancer in Poland increased over the period of 1999–2012 (Table 1). In 1999, the SIR of prostate cancer was 17.39 cases per 100,000 person-years. This rate more than doubled by 2012, reaching 36.12 cases per 100 000 person-years. The APC was 4.58% ($P < 0.0001$). Though incidence rates varied approximately two-fold across the 16 voivodeships, the trend of increasing incidence was nearly universal and was statistically significant in all but one voivodeship (i.e., Swietokrzyskie). Incidence rates also varied substantially across Poland's 380 poviats (Figure 1).

In contrast, the mortality rate for prostate cancer remained largely unchanged over this time period (Table 2). In 1999, the standardized mortality rate (SMR) was 11.89 deaths per 100 000 person-years, while in 2012, the SMR was 12.41 deaths per 100 000 person-years. The APC did not differ significantly from zero. At the level of the voivodeships, mortality rates increased slightly in 1 voivodeship (Podlaskie), decreased slightly in 2 (Podkarpackie, Pomorskie), and remained stable in the other 13. Mortality varied slightly, but was more consistent than SIRs across the 380 poviats (Figure 2).

When the regions of Poland were dichotomized into urban and rural regions, the time trends remained the same.

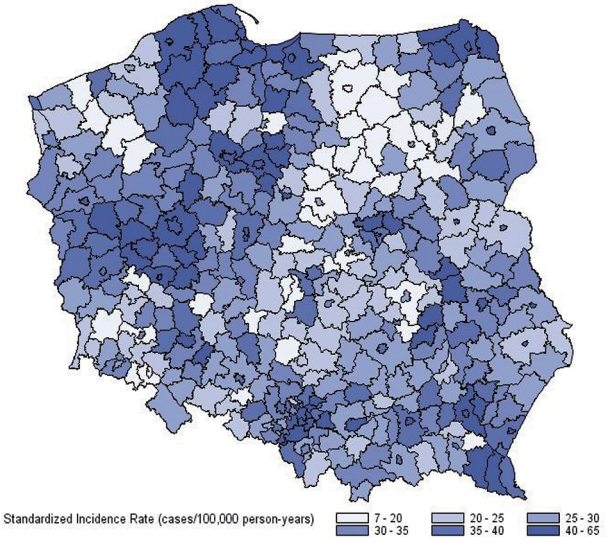

Figure 1. Standardized incidence rates by poviat, 2008–2012.

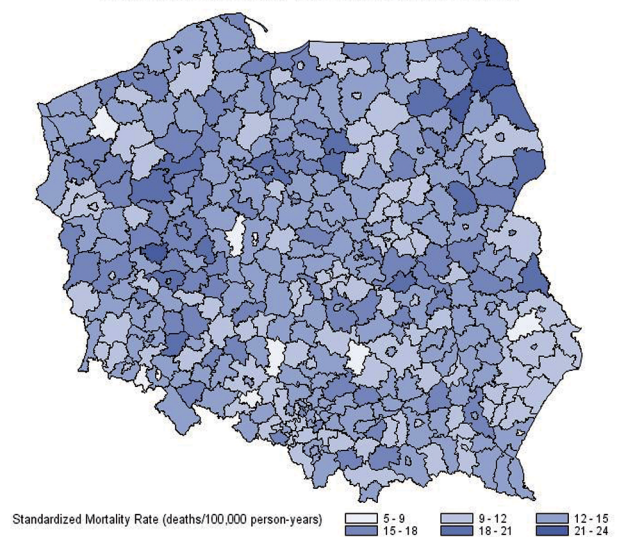

Figure 2. Standardized mortality rates by poviat, 2008–2012.

In both urban and rural regions, SIRs for prostate cancer increased steadily from 1999–2012 while SMRs did not change (Figure 3). However, incidence of prostate cancer in urban regions was consistently higher than incidence in rural regions by 30%–50%. By 2012, the end of the study period, the SIR was 39.27 in urban regions and 30.67 in rural regions. No concurrent gap in SMRs was observed.

Across all time points, incidence and mortality were highest for the older age groups (Figures 4 and 5). In 2012, SIRs were 402.17, 412.51, 223.67, 41.79, and 0.38 for the ≥80, 70–79, 60–69, 50–59, and ≤50 age groups, respectively. All age groups experienced an increase in incidence of prostate cancer across the study period, but for the group of men aged 80 years and older, the incidence rate peaked at 405.96 in 2005. By 2009, there was no difference in incidence rates for the 70–79 and ≥80 age groups. Mortality rates were highest for the ≥80 age group and decreased for each subsequent age group (in 2012: 429.26, 143.48, 44.15, 7.34, and 0.08 for the ≥80, 70–79, 60–69, 50–59, and ≤50 age groups, respectively).

5. DISCUSSION

The PNCR data indicate a sharp increase in prostate cancer incidence during the calendar period of 1999–2012. This observed increase may be attributed to several factors. The most well documented risk factor for prostate cancer development is increasing age.[13] With a growing proportion of Polish men over the age of 50, a concomitant increase in prostate cancer incidence is not unexpected. At the same time, the average life expectancy of a Polish man has been steadily increasing, which could contribute to increased detection of new prostate cancers within the Polish male population. Environmental and behavioral factors might also be driving the observed changes in prostate cancer incidence reported in this study. Specifically, changes in dietary intake, physical activity, and presence of inflammatory conditions might also play a role in increasing prostate cancer incidence.[14] Variation in the timing and duration of these factors would need to be examined to better understand their impact on these observed increases in prostate cancer incidence.

Increased detection of prostate cancer, resulting from improvements in cancer diagnosis and the expanding use of the prostate specific antigen (PSA) serum test to screen or test for prostate cancer might also underlie the observed changes in incidence. Most Polish urologists follow the European Association of Urology guidelines, which promote the use of technological modalities, such as transrectal ultrasound, for prostate cancer diagnosis, prostate core biopsy, depending on a patient's risk factor profile, and use of risk calculators or nomograms in the treatment decision making process.

PSA testing at the beginning of study period was not widespread in Poland, but has had increasing popularity over the years. Although information from IMS Health on the sale of PSA tests indicates that such testing is slow growing, these data represent over the counter sales which are a marginal phenomenon in Poland (Table 3). While there

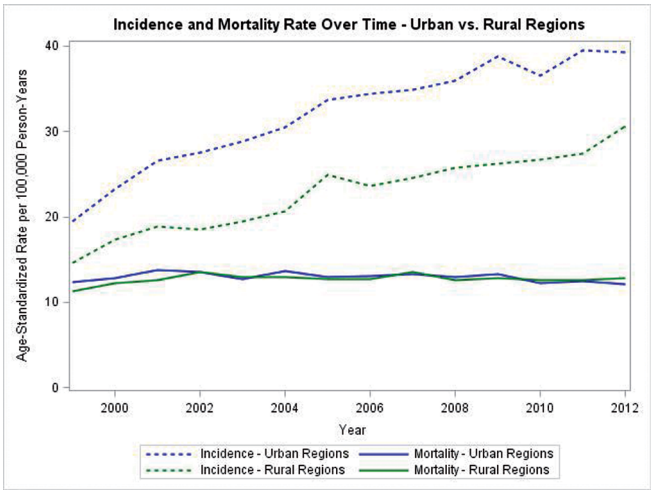

Figure 3. Standardized incidence and mortality rates over time for urban and rural regions. Prostate cancer incidence increased over time in both urban and rural regions, but was consistently higher in urban regions. Mortality rates were similar across region and time.

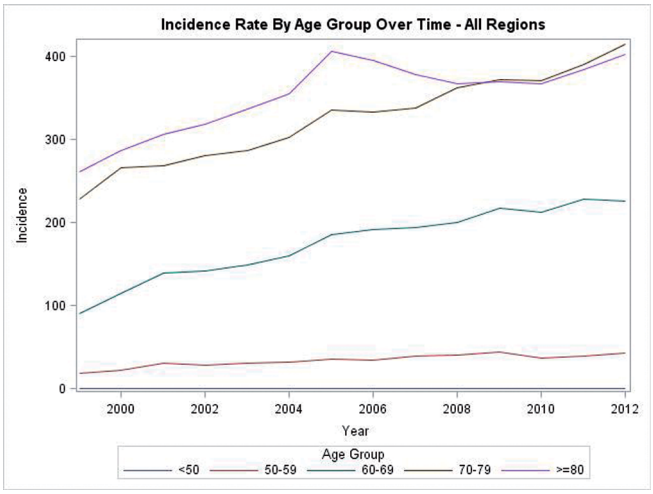

Figure 4. Incidence rates over time by age group.

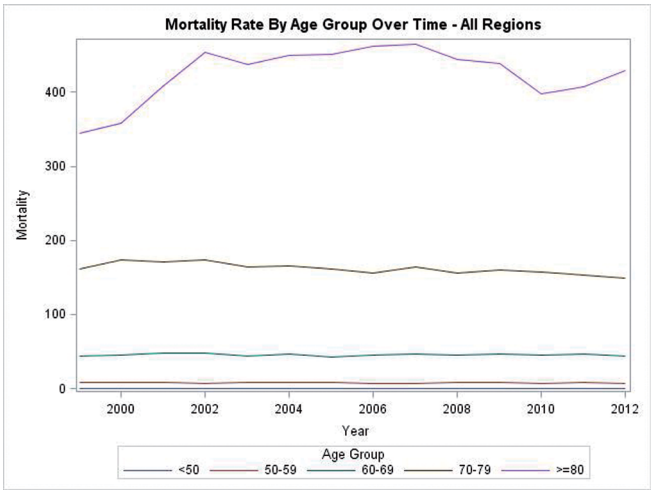

Figure 5. Mortality rates over time by age group.

Table 3. Number of PSA tests sold in Poland by a single reporting pharmaceutical company.

	2007	2008	2009	2010	2011	2012	2013
No of PSA tests	15 100	66 700	93 600	133 900	193 300	189 900	229 300

is still no widespread prostate cancer screening program for Poland nationally or for any specific region within the country, there have been several local educational and early detection efforts in recent years. Most notably, a series of one-day educational sessions, organized by local, nonscientific organizations were conducted but without long-lasting follow up of screened patients. Such short-term efforts were limited to selected cities, poviats or municipalities. There have also been national and local health awareness campaigns with special attention on early prostate cancer detection, proper diagnosis and treatment but those campaigns were initiated toward end of our study period and could not have meaningfully impacted the study findings.[15]

Finally, significant cancer patient under-registration was believed to have occurred at the end of the 1980's, and continual improvements in the quality and completeness of cancer registration may have contributed in part to the rise in cancer incidence over the study period.

Though prostate cancer incidence in Poland increased from 1999 to 2012, the mortality rate remained stable. In fact, a recent population-based study of cancer survival across Europe found that in Poland, the five-year age-standardized survival from prostate cancer improved from 54.3% in 1995–1999, to 68.5% in 2000–2004, and 74.1% in 2005–2009.[6] Increased survival rates may have resulted from improvements in the treatment and management of prostate cancer over this time period. In the recent years the number of radical prostatectomies, especially minimal invasive ones, increased, which improves oncological results as well as quality of life. Those results, as well higher level of health awareness due to educational programs, may have encouraged patients to seek procedures with curative intent instead of palliative treatment. Possible advances include increased availability of prostate cancer drugs, as changes to Poland's political system in 1989 facilitated the expansion of international pharmaceutical companies, and the intensive exchange of radiotherapy equipment that began in Poland in the mid-2000's. Conversely, an increased detection of indolent, low-grade cancers unlikely to cause metastases and cancer-specific death may explain stable mortality despite increasing incidence over time. Stage data from the PNCR, though incomplete, provide support for this explanation (Table 4). The percentage of tumors that were localized at diagnosis increased substantially in recent years, while the percentage of patients presenting with distant metastasis decreased. These trends are consistent with a stage shift to more localized disease, likely a result of expanded opportunistic screening and increased levels of awareness of the importance of early detection. Since uptake of PSA screening has been slow in Poland, and since it takes approximately ten years to be able to assess the impact of early diagnosis on prostate cancer mortality, it may be several years before this stage shift translates into a mortality decline across Poland, if mortality is to decline at all.

Table 4. Stage distribution of prostate cancer cases.

Year	Unknown	Local	Regional	Distant metastasis
1999	42%	27%	10%	21%
2000	44%	28%	10%	18%
2001	42%	31%	10%	17%
2002	44%	31%	9%	16%
2003	37%	35%	12%	15%
2004	40%	35%	11%	15%
2005	39%	36%	11%	14%
2006	35%	40%	11%	14%
2007	33%	42%	11%	15%
2008	28%	46%	11%	15%
2009	29%	46%	11%	14%
2010	28%	46%	11%	14%
2011	31%	46%	10%	14%
2012	24%	52%	9%	16%

A novel finding in this study was the variation in population-based incidence rates for urban versus rural regions. Age-related variation has been well documented and was anticipated.[13] Differences in prevalence of behaviors such as smoking, alcohol use, obesity, physical inactivity, and environmental exposures, plus the impact of health policy within these regions, could all contribute to this disparity.[16,17] There could also be similar underlying rates, but increased detection of prostate cancer in the urban regions, possibly due to greater access to healthcare. This observed gap was observed for the entire study period; however, mortality rates were comparable over time, similar to previous reports in the literature.[18]

The primary strength of the current study was the use of the PNCR data. The PNCR covers 100% of Poland and has been collecting data continuously for 60 years. The data are collected according to the same protocol and standards nationwide, leading to good data quality and completeness. Recently all most all of the PNCR work has been made available on-line, which creates ease of access for researchers and the population. More than 85% of all cancers reported to the PNCR are histopathologically verified. Under-registration is believed to be approximately 10%–15%, depending on the cancer type.

Limitations of this data source include the low quality of stage data, which is only reported as broad categorizations of local, regional, or distant metastasis and is missing for 25%–40% of registered cases. Stage based on the TNM classification system is only available for 20% of registered cases. Furthermore, data on Gleason grade at diagnosis was only collected beginning in 2013. Treatment data is available, but its completeness is unknown. Improved collection of stage, grade, and treatment data as well as follow-up data by the PNCR would be beneficial for future epidemiologic investigations.

Other future studies should explore the diffusion of PSA screening throughout Poland and the effect of local screening programs on regional incidence and mortality. Urban–rural disparities in prostate cancer incidence should also be investigated with more attention and focus on healthcare facilities and utilization of diagnostic and treatment services for the Polish rural population.

Our results should be read with special emphasis by institutions responsible for the Polish health system. The anticipated trends in the short term, based on a recent study, mimic our findings – that the incidence rate will continue to increase.[19] The growing number of prostate cancer patients could have a strong influence on health care utilization and demands. The trend in stage migration could lead to greater interests in less invasive treatment including active surveillances or focal treatment, which is currently not often offered to Polish patients.

6. CONCLUSIONS

The overall standardized incidence rate of prostate cancer in Poland was found to double from 1999 to 2012, based on data from the PNCR. The standardized mortality rate was stable throughout this time period. Differences in standardized incidence and mortality were observed across vovoideship, and incidence was higher in urban regions. This study demonstrates the utility of using PNCR data to identify trends in prostate cancer incidence and mortality that may aid in informing efforts for prostate cancer prevention and control.

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Conflicts of interest

None.

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