Original Article

Epidemiology of prostate cancer in South Korea

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ABSTRACT

Background: Prostate cancer (PCa) is the second most frequently diagnosed cancer in male. In South Korea, PCa incidence has increased significantly, while its mortality rate has decreased steadily. To optimize the distribution of public medical resources, it is essential to analyze the contemporary epidemiology of PCa.
Methods: National population data from the National Health Insurance Statistical Yearbook and the annual report of national cancer registration and statistics in Korea were assessed. From the data, the incidence, prevalence, and mortality rates of PCa were calculated. The data were presented with reference to other types of cancers occurring in various countries from different continents.
Results: From 2007 to 2013, PCa incidence doubled (from 5,516 per year to 10,855 per year), while its prevalence in Korean men tripled (from 18,830 to 51,411) during the same period. The mortality rate increased slightly, from 4.2 in 2000 to 5.9 in 2007 and 6.0 in 2013 (per 100,000, age adjusted). PCa incidence increased significantly faster in men aged < 70 years than in the older age group.
Conclusion: PCa prevalence in South Korea has increased significantly, mainly due to the rise in its incidence. As the country is facing major changes, including westernization of dietary habits and rapid population aging, its prevalence would continue to increase in near future.

Introduction

Cancer is the most common cause of death in Korea. The number of cancer patients in Korea is increasing, which was 218,735 in 2000, 425,281 in 2006, and 960,654 in 2010.[1] Prostate cancer (PCa) is the second most frequently diagnosed cancer in the world, accounting for 15.0% of all cancer diagnoses.[2] In South Korea, PCa incidence has increased significantly, partly due to the rise in average life expectancy, westernized dietary habits, and increased awareness of PCa screening.[3,4] As the PCa incidence increased, the proportion of nonmetastatic disease also increased,[5] and markers of tumor aggressiveness—prostate specific antigen (PSA), stages, and Gleason score—dropped.[6] Partly on that account, cancer-specific survival rates improved significantly.[4] Therefore, one can expect that the prevalence rate of PCa in Korean men would have been changed too. Utilizing data from the National Health Insurance Statistical Yearbook and the annual report of national cancer registration and statistics in Korea, we analyzed the recent trends in the incidence and prevalence of PCa.

Materials and methods

From the annual report of national cancer registration and statistics in Korea in 2012[7] (http://ncc.re.kr/english/infor/kccr.jsp), we gathered serial annual data on the incidence, prevalence, and mortality rates of PCa from 1999 to 2012. In addition, population data from 2007 to 2012 were gathered from the National Health Insurance Statistical Yearbook[1] (http://www.hira.or.kr/).

Definitions of terms

The definitions are cited from the annual report of national cancer registration and statistics in Korea in 2012.[7]

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Crude rate

The crude rate (CR), a rate based on the frequency of cancer in the entire population, is calculated as follows:

$$\text{Crude rate CR (per 100,000 person − years)}$$
$$= \frac{\text{Number of events}}{\text{Corresponding person − years of observation}} \times 100,000$$

Standard population

The standard population provides age distributions to be used in the estimation of age-adjusted rates. The Korean standard population (year 2000) is used in this report. For international comparison, the world standard population is used.[8]

Age-standardized rate

An age-standardized rate is a weighted average of crude age-specific rates, where the CRs are calculated for different age groups and the weights are the proportions of persons in the corresponding age groups of a standard population. In this report, rates were standardized to the Korean standard population or World standard population.

Cumulative rate

The cumulative rate is the sum over each year of age of the age-specific rates, taken from birth to the age of 74 years (the 0−74 rate).

Prevalent cases

As national cancer incidence can be estimated from 1999, prevalent cases in this report are defined as the number of cancer patients alive on a certain day who had been diagnosed with the disease since January 1, 1999. For example, cancer prevalent cases on January 1, 2013 are the cancer patients who were diagnosed between January 1, 1999 and December 31, 2012, and were alive on January 1, 2013. Multiple primary cancer cases are counted multiple times.

Five-year prevalent cases

Five-year prevalent cases are defined as the number of cancer patients alive with the disease within the first 5 years of diagnosis. For example, 5-year cancer prevalent cases on January 1, 2012 are the cancer patients who were diagnosed between January 1, 2008
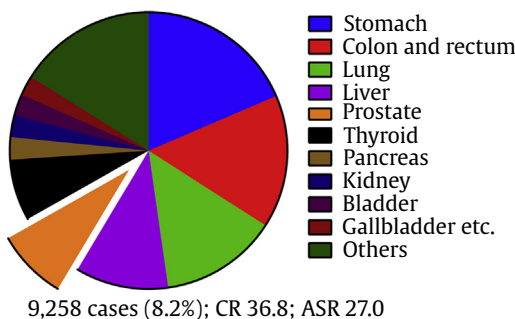

9,258 cases (8.2%); CR 36.8; ASR 27.0

Fig. 1. Cancer incidence distribution by sites in males, in Korea in 2012. Original data available from the annual report of cancer statistics in Korea in 2012. ASR, age-standardized rate; CR, crude rate.
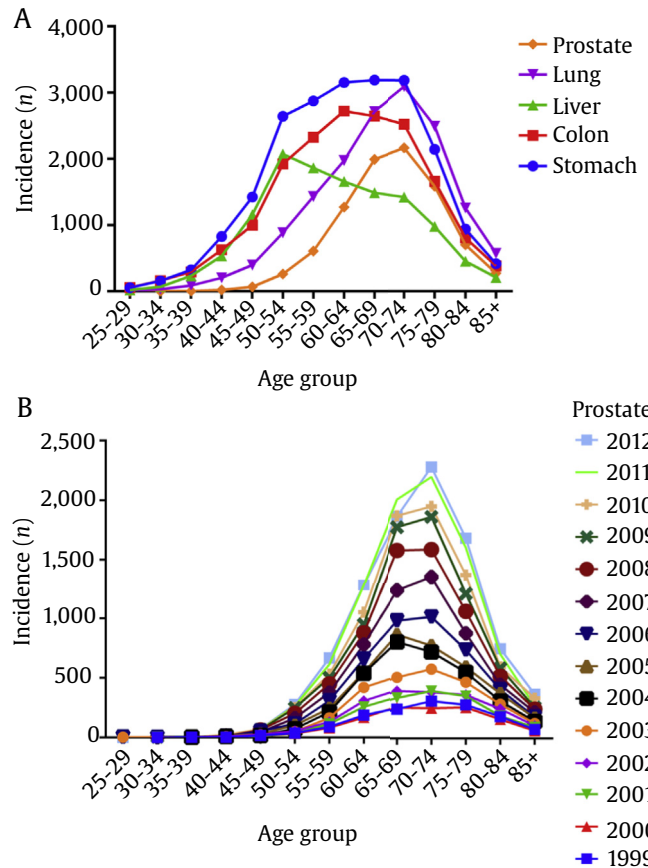

Fig. 2. Male cancer incidence by age group (25−85+) in Korea. (A) Top five male cancers in 2012. (B) Annual trends in prostate cancer incident, from 1999 to 2012. See Table 2 for raw data. Original data available from the annual report of cancer statistics in Korea in 2012.

and December 31, 2012, and were alive on January 1, 2013. Individuals still alive 5 years after their diagnosis are considered "cured." In fact, the death rates of most cancer patients 5 years after the diagnosis are close to those expected in the general population.

Results

Incidence

PCa is ranked fifth among all cancer incidences of major sites in Korean men (Fig. 1). Divided in age groups, PCa incidence increases
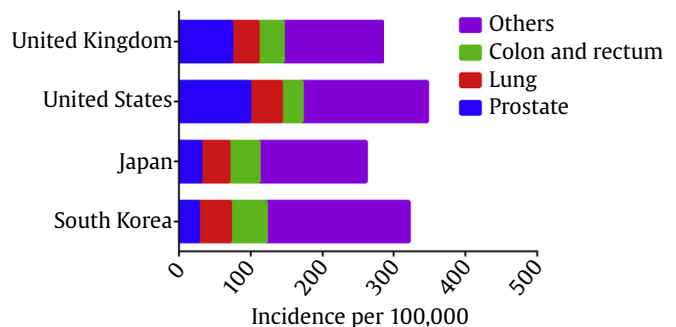

Fig. 3. International comparison of age-standardized cancer incidence rates in male [The incidence rates all types of cancers except for skin cancer (standard population: world standard population.[2])]. Original data available from the annual report of cancer statistics in Korea in 2012.

Table 1
Prostate cancer incidence rate in male, stratified by age group.[a]

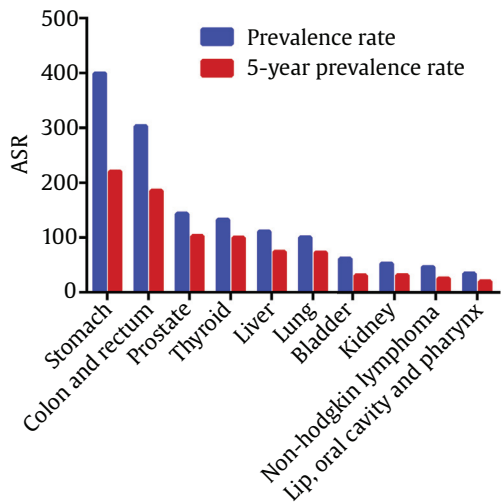| Age group (yr)	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999
All	36.8	36.0	32.2	30.1	26.7	22.5	18.3	15.3	14.0	10.9	8.4	7.5	5.5	6.1
25−29	0.1	0.1	0.1	−	−	−	0.1	−	−	0.1	−	−	−	−
30−34	0.0	0.1	0.1	0.3	−	0.1	0.0	−	−	−	0.1	0.2	0.1	0.0
35−39	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	−	0.1
40−44	0.5	0.9	1.0	0.4	0.6	0.7	0.5	0.7	0.4	0.3	0.4	0.1	0.1	0.1
45−49	3.2	3.2	3.1	2.8	2.8	2.0	2.5	1.4	0.8	1.2	1.5	0.9	1.2	1.2
50−54	12.8	12.6	12.5	13.1	11.4	9.7	7.4	7.1	5.4	3.7	4.3	2.7	2.9	3.3
55−59	41.3	40.7	38.4	39.0	36.3	31.6	26.7	21.8	20.1	16.1	13.0	11.4	8.0	8.6
60−64	112.1	115.6	98.3	93.4	90.9	83.0	70.1	57.8	56.6	44.1	33.6	29.8	20.1	23.2
65−69	211.6	228.8	212.9	201.7	180.7	149.9	127.1	116.2	112.9	75.8	62.5	57.3	47.6	49.3
70−74	308.6	319.3	296.0	296.8	270.2	247.3	201.3	169.0	172.1	148.5	106.4	115.3	77.2	100.1
75−79	377.3	390.6	369.8	363.0	346.9	310.1	280.6	239.7	236.0	211.4	169.3	168.5	126.2	140.3
80−84	379.3	387.1	351.9	373.2	353.2	319.5	300.5	285.6	248.2	242.6	227.7	184.4	167.7	203.7
≥85	363.8	284.9	371.8	304.9	311.0	306.0	275.5	283.1	254.6	240.0	217.1	202.8	150.3	183.2

[a] Unit: cases, *n* per 100,000.

after 60 years of age, and in those aged > 65 years, PCa is ranked fourth (Fig. 2A). International comparison of age-standardized cancer incidence rates shows that the PCa incidence rate in South Korea is similar to that in Japan (27.0 per 100,000 and 30.4 per 100,000, respectively), and still differ widely from the United States or the United Kingdom (98.2 per 100,000 and 73.2 per 100,000, respectively; Fig. 3).

Incidence rates of PCa in each age group from 1999 to 2012 are described in Fig. 2 and Table 1. During that period, the fold-increase rates of PCa incidence among the age groups differed significantly. For example, in men aged 80−84 years, the rate increased only ~1.5-fold (from 203.7 to 379.3). By contrast, in men aged 60−64 years and 50−54 years, the rate increased about 4-fold (from 23.2 to 112.1 and from 3.3 to 12.8, respectively).
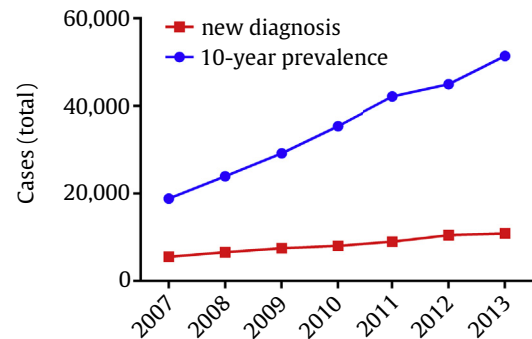
Prevalence rate

Cancer prevalence rates among Korean men from January 1, 1999 to December 31, 2012 were calculated. The PCa prevalence rate (CR) was 194.6 per 100,000, ranking third after stomach and colorectal cancers (Fig. 4). The 5-year prevalence rate of PCa (CR) was 140.1 per 100,000, also ranking third after stomach and colo-rectal cancers. Since 2007, the PCa prevalence rate has increased gradually (Fig. 5).

Mortality

In 2012, cancer was the leading cause of death in South Korea. Among cancers of all sites, PCa mortality was ranked seventh (Fig. 6), accounting for 3.1% of all causes of death in Korean men (Table 2). The PCa mortality rate increased slightly from 4.2 in 2000 to 5.9 in 2007 and 6.0 in 2013 (per 100,000, age standardized; Fig. 7). During the same period, the overall cancer mortality rate

Fig. 5. Annual trends in prostate cancer diagnosis and prevalence in Korea. Original data acquired from the annual report of cancer statistics in Korea in 2012 (2007−2011) and the National Health Insurance Statistical Yearbook (2012 and 2013).
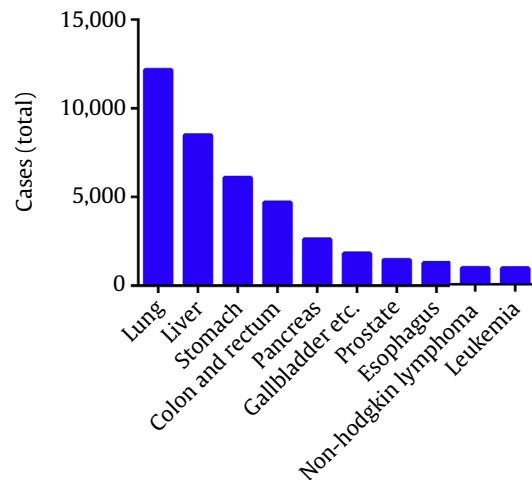

Fig. 4. Cancer prevalence/5-year cancer prevalence of major sites in male, 2012. Age was adjusted to the Korean standard population. Original data available from the annual report of cancer statistics in Korea in 2012. ASR, age-standardized rate.

Fig. 6. Mortalities from cancers of major sites in males, 2012. Original data available from the annual report of cancer statistics in Korea in 2012.

Table 2
Mortalities from cancers of major sites in male, 2012.[a)]

Sites	Cases	%	CR
All cancers	46,620	100	184.5
Lung	12,175	26.2	48.3
Liver	8,494	18.3	33.7
Stomach	6,090	13.1	24.2
Colon and rectum	4,692	10.1	18.6
Pancreas	2,616	5.6	10.4
Gallbladder, etc.	1,818	3.9	7.2
Prostate	1,460	3.1	5.8
Esophagus	1,278	2.8	5.1
Non-Hodgkin lymphoma	927	2	3.7
Leukemia	919	2	3.6

[a)] Unit: cases, %, cases per 100,000.
CR, crude rate.

Fig. 7. Annual trends in prostate cancer mortality rates in Korea. Age was adjusted to the Korean standard population. Original data available from the Statistics Korea (http://kostat.go.kr).

decreased steadily, from 226.7 in 2000 to 196.4 in 2007 and 162.8 in 2013 (per 100,000, age standardized; Fig. 7).
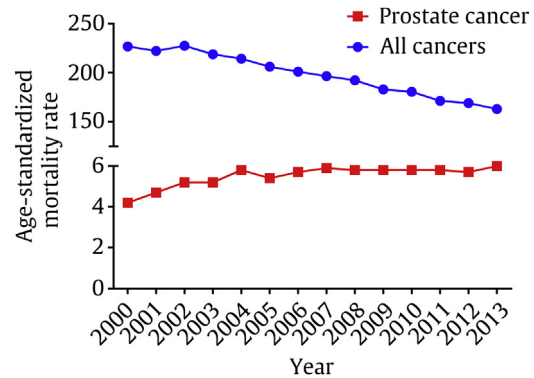
Discussion

Statistics indicate that PCa incidence in South Korea is increasing. In 2009, Choi and Park[9] reported that the prevalence of PCa is increasing more rapidly than that of all other major male cancers. The result of our analysis is in line with their results, adding that PCa incidence is especially high in the elderly Korean population. The chance of Korean men getting a cancer during their lifetime is 37.5%,[7] and PCa accounts for 8.2% of the total cancer diagnoses. Although the numbers are still lower than those of Western countries, one can expect further expansion in near future, considering the fast population aging that the world has ever faced.[10] In 2005, a mass screening program analysis reported that the estimated PCa detection rate in men aged 55 years or older was highest in Korea among Asian countries.[11] While PCa incidence varies significantly across the world, cancer-specific mortality is not significantly different between developed and underdeveloped countries.[8] Moreover, Asian population seems to exhibit a low PCa mortality rate than the populations of other regions/races. Thus, one can tell that PCa prevalence would not decrease but would increase in South Korea.

An age-group analysis showed that PCa incidence in men aged < 70 years increased much faster than those aged ≥ 70 years. This trend may reflect the change in PCa diagnosis pattern—from symptom based to PSA screening based.

The PCa mortality rate in South Korea did not decrease but increased during the last decade. Recently, Baade et al[12] reported that the rates in Asia-Pacific countries such as Singapore and Hong Kong have also increased by ~1% per year in the past decade. By contrast, the rate in Japan has decreased by 1% per year. Interestingly, the 5-year survival rate of PCa patients in South Korea improved dramatically from 55.9% (1993–1995) to 67.2% (1996–2000), 80.1% (2001–2005), 90.2% (2006–2010), and most recently, 92.3% (2008–2012).[13] This discrepancy between the trends of PCa survival rate and mortality rate may be explained by increases in early diagnosis and overall incidence.[14]

One of the limitations of this study is the lack of clinical/pathologic stage data. Currently, such information is not available in the national database. There are some reports on PCa stages from individual institutions, though. Song et al[15] reported that from 1997 to 2006, the rate of localize PCa diagnosed in a single institution increased from 56.8% to 75.4%, and clinical T1c disease increased from 26.4% to 31.6%. Similarly, Lee et al[5] reported that the rate increased from 67% in 2006 to 79% in 2010. Kim et al[6] studied the preoperative PSA, pathological stage, and Gleason score trends in a single institution, noting that all of them dropped significantly from 2000 to 2011. PCa is the most frequently diagnosed male cancer in many developed Western countries,[2] and it may become the future of Korea. Therefore, public policies and medical resource redistribution plans should be prepared to adapt to the anticipating changes.

Conflicts of interest

No conflict of interest exist.

References

1. Health Insurance Review & Assessment Service, National Health Insurance Service. *2013 National health insurance statistical yearbook* [Internet]. 2014 [cited 2015 Jan 1]. Available from: http://www.nhis.or.kr/bbs7/boards/B0075/12434.
2. Ferlay J, Soerjomataram I, Dikshit R, Eser S, Mathers C, Rebelo M, et al. Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. Int J Cancer 2015;136:E359–86.
3. Park SK, Sakoda LC, Kang D, Chokkalingam AP, Lee E, Shin HR, et al. Rising prostate cancer rates in South Korea. Prostate 2006;66:1285–91.
4. Jung KW, Won YJ, Kong HJ, Oh CM, Cho H, Lee DH, et al. Cancer statistics in Korea: incidence, mortality, survival, and prevalence in 2012. Cancer Res Treat 2015;47:127–41.
5. Lee DH, Jung HB, Chung MS, Lee SH, Chung BH. The change of prostate cancer treatment in Korea: 5 year analysis of a single institution. Yonsei Med J 2013;54:87–91.
6. Kim D, Choi D, Lim JH, Yoon JH, Jeong IG, You D, et al. Changes in prostate cancer aggressiveness over a 12-year period in Korea. Korean J Urol 2012;53:680–5.
7. Korea Central Cancer Registry, National Cancer Center. *Annual report of cancer statistics in Korea in 2012, Ministry of Health and Welfare* [Internet]. 2014 [cited 2015 Jan 1]. Available from: http://ncc.re.kr/english/infor/kccr.jsp.
8. Segi M, Tōhoku D, Nippon Taigan K. *Cancer mortality for selected sites in 24 countries* 1950, 6 v.
9. Choi KS, Park JK. Epidemiologic characteristics of prostate cancer detection. Korean J Urol 2009;50:1054–8.
10. Muramatsu N, Akiyama H. Japan: super-aging society preparing for the future. Gerontologist 2011;51:425–32.
11. Song C, Ahn H, Lee MS, Park J, Kwon TG, Kim HJ, et al. Mass screening for prostate cancer in Korea: a population based study. J Urol 2008;180:1949–52. discussion 52–3.
12. Baade P, Youlden D, Cramb S, Dunn J, Gardiner R. Epidemiology of prostate cancer in the Asia-Pacific region. Prostate Int 2013;1:47–58.
13. Statistics Korea [Internet]. Daejeon: Statistics Korea; 2014 ed. [cited 2015 May 19]. Available from: http://kostat.go.kr.
14. Kim S, Kim S. Incidence, epidemiology and patterns of progression of prostate cancer. J Korean Med Assoc 2010;53:92–7.
15. Song K, Song C, Ahn H. Continuing trends of the clinical parameter migration in patients with prostate cancer in Korea. Korean J Urol 2007;48:574–8.