Global, Regional and National Burden of Prostate Cancer, 1990 to 2015: Results from the Global Burden of Disease Study 2015

Farhad Pishgar, Hedyeh Ebrahimi, Sahar Saeedi Moghaddam, Christina Fitzmaurice and Erfan Amini*

From the Non-Communicable Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute (FP, HE, SSM) and Uro-Oncology Research Center, Tehran University of Medical Sciences (FP, EA) and Department of Biostatistics, Faculty of Paramedical Sciences, Shahid Beheshti University of Medical Sciences (SSM), Tehran, Iran, and Institute for Health Metrics and Evaluation and Department of Medicine, Division of Hematology, University of Washington (CF), Seattle, Washington

Abbreviations and Acronyms

ASDR = age standardized death rate

ASIR = age standardized incidence rate

DALY = disability adjusted life-year

GBD = Global Burden of Disease

PCa = prostate cancer

PSA = prostate specific antigen

SDI = sociodemographic index

YLDs = years lived with disability

YLLs = years of life lost

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* Correspondence: Uro-Oncology Research Center, Department of Urology, Tehran University of Medical Sciences. Tehran, Iran (telephone: +98 21 66903063; FAX: +98 21 66903063; e-mail: amini.erfan@gmail.com and e-amini@sina.tums.ac.ir).

Purpose: Data on the incidence, mortality and burden of prostate cancer as well as changing trends are necessary to provide policy makers with the evidence needed to allocate resources appropriately. This study presents estimates of prostate cancer incidence, mortality and burden from 1990 to 2015 by patient age, country and developmental status using the results of the Global Burden of Disease 2015 study.

Materials and Methods: Data from vital registration systems and cancer registries were used to generate mortality estimates. Cause specific mortality served as the basis for estimating incidence, prevalence and disability adjusted life years. The global number of incident cases, deaths and disability adjusted life years attributable to prostate cancer are reported as well as age standardized rates.

Results: Incident cases of prostate cancer increased 3.7-fold from 1990 to 2015. The age standardized incidence rate also increased 1.7-fold during the study period and in 2015 it reached 56.71/100,000 person-years (95% uncertainty interval 45.86-78.45). Global estimates of the age standardized death rate decreased slightly to 14.24 deaths (95% uncertainty interval 11.8-17.95) per 100,000 person-years in 2015. The decline in the age standardized death rate was more prominent in high income countries. Disability adjusted life years attributable to prostate cancer increased by 90% during the study period.

Conclusions: The prostate cancer mortality rate is decreasing in high income countries. However, the incidence and burden of disease are steadily increasing globally, resulting in further challenges in the allocation of limited health care resources. The current study provides comprehensive knowledge of the local burden of disease and help with appropriate allocation of resources for prostate cancer prevention, screening and treatment.

Key Words: prostatic neoplasms, prostate-specific antigen, global burden of disease, incidence, mortality

Prostate cancer, the leading non-cutaneous cancer among men, imposes a high burden and associated costs on health systems. The lifetime risk of diagnosis is 15%.[1] The lifetime risk of dying of disease is 3% and death usually occurs after age 75 years.[1] Large differences between the risk of

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developing PCa and the risk of death from the disease have questioned the importance of screening, and the survival benefit associated with PSA based screening remains controversial.[2] However, PCa is still the third leading cause of cancer death in men and any change in screening, diagnosis and management strategies has substantial public health consequences.[3]

Comparing PCa metrics among different locations and changing trends are valuable to determine how various health policies and screening protocols might affect the outcome of PCa. Moreover, precise and reliable reports on patterns and trends of diseases in different geographical areas provide policy makers with the evidence needed to allocate resources appropriately.

Yearly estimates of incidence, prevalence, mortality and DALYs have been produced as part of the GBD study for 249 diseases and 195 countries from 1990 to the most recent year. Using GBD 2015 results[4,5] we present estimates of PCa incidence, mortality and DALYs from 1990 to 2015 by patient age, country and developmental status.

MATERIALS AND METHODS

The GBD study is a collaboration of more than 2,000 international researchers which seeks to provide high quality estimates of disease burdens and underlying risk factors. Methodological details of GBD-2015 have been described previously.[4–7] We briefly review the methods of estimating the burden of PCa.

The starting point of disease specific estimates is cause specific mortality, which serves as the basis for estimating incidence, prevalence, YLDs, YLLs and DALYs. The data used for mortality estimation were vital registration system data. In addition, cancer registry incidence data were transformed to mortality estimates using separately modeled mortality-to-incidence ratios. Data were gathered at the most detailed levels and went through several data processing steps to make them comparable. Furthermore, data were mapped to the GBD cause list of 249 diseases. CODEm (Cause of Death Ensemble model) was used to estimate mortality using the covariates health system access, education, lagged distributive income, sociodemographic status and animal fats,[8] which informed the model in data sparse areas. Moreover, single cause mortality estimates were adjusted to fit into the separately modeled all cause mortality estimates using an algorithm called CoDCorrect.[4] Final mortality estimates were transformed to incidence by dividing them by the mortality-to-incidence ratio.

PCa survival was modeled using a mortality-to-incidence ratio based scaling factor addressing differences between location and age groups during the study years. The 10-year prevalence was then calculated for each incidence cohort. The total prevalence of PCa was divided into 4 sequelae addressing different levels of disability, including diagnosis and treatment, remission, and metastatic and terminal stages. The duration of diagnosis and treatment, and metastatic and terminal stages was assumed to be constant in all countries during the study period. The remaining prevalence was attributed to the PCa remission stage. YLDs were calculated by multiplying the prevalence of each sequela by its disability weight and by adding the procedure related morbidity associated with PCa treatment.[5] YLLs due to PCa were calculated using normative global life expectancy and the number of deaths by age.[4,5] PCa DALYs were calculated by summing YLDs and YLLs.

Two scenarios were used to study the contribution of population aging, including population growth and changes in age specific incidence rates, to the absolute changes in the PCa incidence.[5] In the first scenario population age structure and age specific incidence rates among men in 2005 were applied to the population size of 2015. In the second scenario age specific PCa incidence rates in 2005 were applied to the 2015 age structure and population size. Differences between the number of incident cases in these 2 scenarios were attributed to the changes in age structure during these years. The difference between incident cases of the second scenario and the reported incidence in 2015 was due to changes in age specific incidence rates. Differences between the first scenario and incident cases in 2005 were due to population growth. Contributions of these factors are reported as the percent of the total increase in incident cases between 2005 and 2015.

Age standardized rates, including ASIR and ASDR, were calculated using the GBD world population standard.[9] All rates in this study are reported per 100,000 person-years. Moreover, the 95% uncertainty interval of all estimates is reported next to each point estimate.

To assess the relationship of incidence, mortality and burden of disease with sociodemographic status the new variable SDI was created for the GBD 2015 study. The variable was based on the geometric mean of 3 measures, including average years of education in individuals older than 15 years, income per capita and total fertility rate. Each component was weighted evenly and rescaled to a range of 0—lowest educational level, lowest income and highest fertility rate between 1980 and 2015 to 1—highest educational attainment, highest income and lowest fertility rate.

Countries were grouped based on SDI into 5 SDI quintiles, including low, low-middle, middle, high-middle and high. Incidence, mortality and PCa DALYs were compared between the SDI quintiles.

RESULTS

Prostate Cancer Incidence

Incident cases of PCa increased from 436,858 person-years (95% uncertainty interval 324,778-535,401) in 1990 to 1,618,087 (95% uncertainty interval 1,320,887-2,221,902) in 2015, a 3.7-fold increase. Moreover, the PCa ASIR showed a similar trend, increasing from 32.93/100,000 person-years (95% uncertainty interval 24.3-40.47) to 56.71 (95% uncertainty interval 45.86-78.45) during the study period. PCa ranked first with the highest ASIR in 2015 among all cancers in men in 13 of 21 GBD regions.