



Review Article

Worldwide Prostate Cancer Epidemiology: Differences Between Regions, Races, and Awareness Programs

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Abstract: Prostate cancer, according to the World Health Organization, is the second most common cause of cancer worldwide. With an estimated 1.1 million people affected by prostate cancer in 2012, composing 15% of all new cancer cases worldwide, this condition poses a significant burden of mortality and morbidity on society. Even though the burden of prostate cancer is present worldwide, there are disparities in mortality rates worldwide. While in Sub-Saharan Africa and Caribbean, the age-adjusted mortality rates are as high as 24 per 100,000, in Asia the age-adjusted mortality rates are as low 2.9 per 100,000. Specific countries in Sub-Saharan Africa like Uganda have a prostate cancer mortality rate as high as 38.8 per 100,000, which is close to the incidence rate of 48.2 per 100,000. Even though in the United Kingdom the incidence rate is much higher at 111.1 per 100,000, the mortality rate is comparable to that of Sub-Saharan Africa at 22.8 per 100,000. As demonstrated in this global review of prostate cancer, the age-adjusted incidence rate and mortality rate are closer together in Sub-Saharan Africa than in high income countries. Also, there are disparities in age-adjusted mortality rates of prostate cancer. There is plausibly a large gap in data on incidence and mortality rates of prostate cancer, leading to potential underreporting of incidence rates. There are also different awareness related gaps in developing and developed countries. Improved surveillance systems need to be established in order to improve early detection screening programs and prioritized interventions for evidence-based policy for prostate cancer in all countries.

Keywords: Prostate Cancer, Incidence, Global Health, Sub-Saharan Africa, Gleason Score, Prostate Specific Antigen, Awareness

1. Introduction

Prostate cancer is a disease that is becoming an important public health concern worldwide.¹⁻⁶ According to the World Health Organization, in 2012, prostate cancer was the second most common cause of cancer in men and fourth most cause of cancer in both genders worldwide.⁷⁻⁹ Among male cancers unrelated to the skin, prostate cancer is the most common cause of cancer in the Western world. In industrialized nations like the United States, Canada, Oceania, and the United Kingdom it is one of the most common causes of cancer deaths. In low and middle-income countries (LMIC), due to rapid industrialization and changing lifestyles, prostate cancer

is growing in prevalence.

The purpose of this review is to compare prostate cancer critical descriptive epidemiological measures of incidence and mortality in high income versus LMICs. The GLOBOCAN international data were complemented by data from SEER-13 and Canadian Cancer Society (CCS). A secondary goal is to identify different prostate cancer awareness gaps in high income and LMICs.

2. Methods

We identified credible sources of data from the International Agency for Research on Cancer from the World

Health Organization, Canadian Cancer Society, American Cancer Society, and the Cochrane Review Group in Prostate Diseases and Urologic Malignancies specialized registry (through November 2015). This data was supplemented with CI5-Volume 10 (cancer incidence in 5 continents) data. We included studies with reliable epidemiological data.

Microsoft Excel 2010 and IARC data analysis software was used to make the figures in order to compare incidence rates and mortality rates. GLOBOCAN 2012 public use data were obtained using an online analysis tool to generate age-adjusted incidence rate and mortality rate estimates after selecting cancer type (prostate, ICD-10-C61), age group (default values of 0 to 75+), gender (male), data type (incidence and mortality).

The GLOBOCAN 2012 prostate cancer age-adjusted incidence rate estimates were extracted from the IARC website. The age-adjusted incidence rate and mortality rate estimates represent a weighted mean of age-specific rates, standardized to the World Standard Population. The detailed methodologies and data sources used by GLOBOCAN to estimate cancer statistics for those nations included in its 2012 database are described in detail on the GLOBOCAN website.¹⁰ The GLOBOCAN 2012 estimates are provided at the level of the nation. Estimates from GLOBOCAN, 2012 reflect the most recent available data per nation, varying from two to five years previous to the GLOBOCAN 2012 release.

For the purposes of this research, a country with per capita Gross National Income (GNI) of less than or equal to \$12,615

US dollars was considered a LMIC. Even though LMICs and developing countries are used synonymously, this terminology does not imply that all countries have a preferential final stage of development. Any country with per capita GNI of greater than or equal to \$12,616 US dollars is considered high income. High income country will be synonymously used with the term developed country.

3. Results and Discussion

3.1. Global Overview of Trends in Prostate Cancer

In 2012, a total of 307,000 deaths was attributed to prostate cancer, making it the fifth leading cancer-related death among men.⁷ The highest mortality rates are in sub-Saharan Africa and Caribbean, where age-standardized rates are as high as 24 and 29 per 100,000 respectively.⁷ However, some individual countries in these regions have higher incidence and mortality rates than have been listed. Comparatively, mortality rates are intermediate in the Americas and Oceania and very low in Asia at 2.9 per 100,000, especially in South-Central parts. However, this risk increases if an Asian man moves to a Western country such as the United States or Canada.^{6-7,9} Researchers are conducting studies in the specific reasons and mechanisms behind why these varying levels of risk exist and change. The age standardized incidence and mortality rate per 100,000 in different parts of the world are outlined in Figure 1.⁷

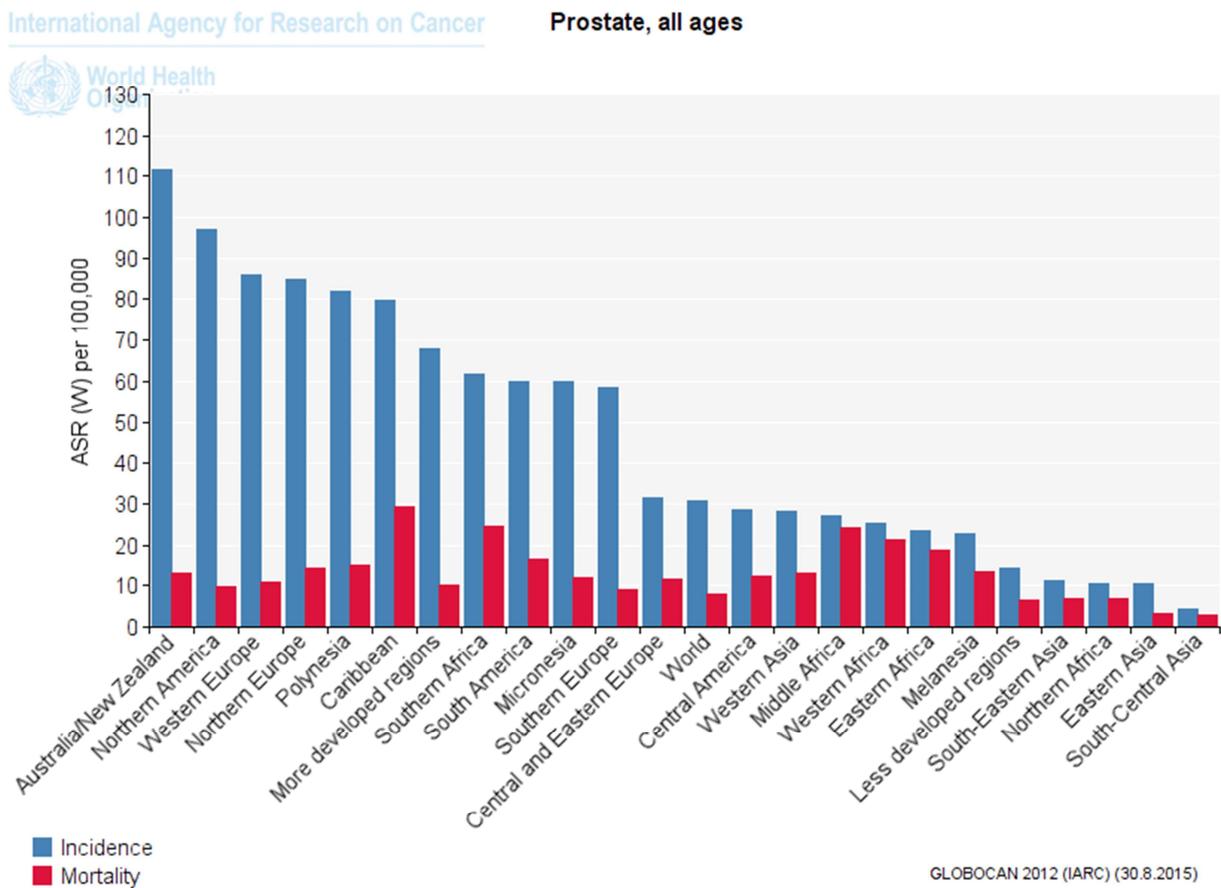


Figure 1. Age standardized incidence and mortality rate per 100,000 individuals in different parts of the world⁷. Graph created by IARC data analysis software.

3.2. High Income Country Prostate Cancer Epidemiology

In Europe, the incidence of prostate cancer varies according to each country. In all of Europe, according to the International Agency for Research on Cancer (IARC) in 2012, the age-standardized incidence rate of prostate cancer was 92.1 and mortality rate was 19.3 per 100,000.¹⁰ In the United Kingdom, the age-standardized incidence rate of cancer was 111.1 and mortality rate was 22.8 per 100,000. Furthermore, according to 2011 UK data, there were 41,736 new cases of prostate cancer and 10,837 deaths.^{7,10} The highest incidence rate of cancer was in Norway and Sweden.^{7,10} Out of all European countries, Lithuania had the highest rate of mortality at 36 per 100,000.^{4,10} Norway had the fifth highest mortality rate from prostate cancer among European countries.

Prostate cancer leads to high numbers of cancer incidence and deaths in the United States (as seen in Figure 2) and

Canada.^{11,12} Prostate Cancer is the most common non-cutaneous cancer in men in North America.¹³ In the United States and Canada, in 2012, prostate cancer is the fifth and the third leading cause of cancer death in men, respectively. Overall, the incidence rate is 138 per 100,000 men per year for all races in the United States and 99 per 100,000 men per year in Canada.^{11,12} While one in seven men in the United States is affected by prostate cancer, one in eight men in Canada are affected by prostate cancer.^{11,12} In the United States, in 2015, the number of estimated new cases of prostate cancer in males is about 220,800, and the estimated number of deaths in this population is 27,540.¹² Comparatively, in Canada, the number of estimated new cases of prostate cancer in males is about 24,000, and the estimated number of deaths in this population is 4,100. In 2012, in the United States alone, about 2.8 million men were alive who either once had prostate cancer or who had it at that time.¹²

International Agency for Research on Cancer Prostate, all ages

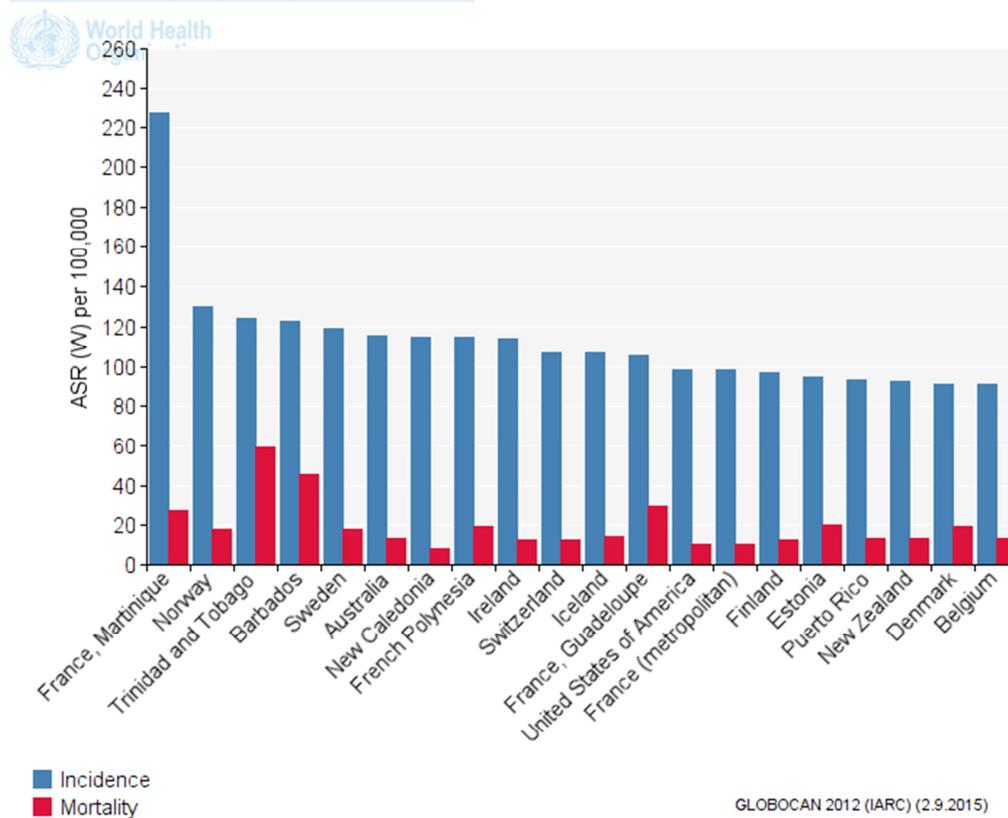


Figure 2. Age standardized incidence and mortality rate per 100,000 individuals in 20 highest prostate cancer incidence countries in the world.⁷ Graph created by IARC data analysis software.

3.3. Low and Middle Income Country Prostate Cancer Epidemiology

Prostate cancer epidemiology highlights in each country have been summarized in Table 1. In this table, developing and developed are categorized separately and ranked in descending order from high to low mortality rates. Among developed countries, prostate cancer mortality is highest in the

United Kingdom at 22.8 per 100,000. In developing countries, prostate cancer mortality rates are highest in Uganda. The disproportionately high mortality rate of 22.6 per 100,000 in Trinidad and Tobago demonstrates the high disease burden in the Caribbean. Sierra Leone is distinct that the mortality rate is higher than the incidence rate. This demonstrates the dire need for a proper surveillance system.

Table 1. Age standardized Mortality Rate and Incidence Rate of Prostate Cancer by Country. The Developed Countries and Developing Countries are Arranged by Decreasing Mortality Rate.

Country (Region)	Mortality Rate (per 100,000)	Incidence Rate (per 100,000)	Data Source
DEVELOPED COUNTRIES			
United Kingdom	22.8	111.1	IARC
United States	19.6	110.4	SEER-13
Canada	17	99	CCS
Norway (Europe)	11.4	27	IARC
Iceland	10.2	106.6	IARC
New Zealand	8.7	92.2	WHO
DEVELOPING COUNTRIES			
Uganda (Africa)	38.8	48.2	IARC
Lithuania	36	93.8	IARC
Sierra Leone*(Africa)	28.5	27.2	IARC
Zimbabwe (Africa)	25.9	37.3	IARC
Trinidad and Tobago	22.6	123.9	IARC
Burkina Faso	18.8	19.1	IARC

*Higher mortality rate than incidence rate.

Due to the more widespread introduction of prostate specific antigen (PSA) screening, the median age of diagnosing has been trending down over the decades.^{14,15} Due to aggressive screening and more knowledge about the genetic and lifestyle related etiology (as seen in Figure 3), only up to 10% of patients actually die from this disease. However, researchers are still perplexed and investigating more about the epidemiology and biology of the disease. In the United States, the median age at diagnosis of prostate cancer dropped from 72 in 1986 to 66 in 2012.¹⁶ Currently the median age of death due to prostate cancer in the US is 80. Current US SEER (The Surveillance Epidemiology and End Results program) data shows that nearly 80% of prostate cancer cases are diagnosed when they are still localized and have a 5-year survival of nearly 100%.¹⁶ There was a three-time increase of

prostate cancer incidence from 1977; and among UK men aged < 55 years, there was a nine-time increase in prostate cancer incidence.^{16,17}

In Africa, there is much variability in the incidence and screening of prostate cancer, throughout the continent (as seen in Figure 3). Even though, Sierra Leone has relatively lower incidence rate, the mortality rate is higher than the incidence rate, demonstrating the need for adequate screening programs. Incidence variability in Africa also can be seen in the region of this continent. For example, according to the IARC, the most commonly diagnosed cancer among men in Southern Africa was prostate cancer.^{10,18,19} The incidence rate in Southern Africa (i. e. Botswana, Lesotho, Namibia, South African Republic, and Swaziland) is seven times higher than the lowest rate in Northern Africa (i. e. Algeria, Egypt, Libya, Morocco, Sudan, Tunisia, and Western Sahara) and two times higher than the second highest rate in Western Africa (Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea-Bissau, Guinea, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo). Concurrently, parts of Southern Africa (Botswana (life expectancy of age 47) and Lesotho (life expectancy of age 49)) have life expectancies less than 50.^{18,19} Other theories are necessary to explain these epidemiological discrepancies of countries with lower life expectancy having higher incidence of prostate cancer.^{20,21} There may be a genetic susceptibility due to the observation by researchers that descendants in Jamaica do not undergo prostate-specific antigen testing, and yet have higher incidence rates of prostate cancer 40. Even in the United States, blacks have higher Gleason scores than white men, regardless of Caribbean or African descent.¹⁹ This demonstrates that genetics may play a major role in the epidemiology of prostate cancer.

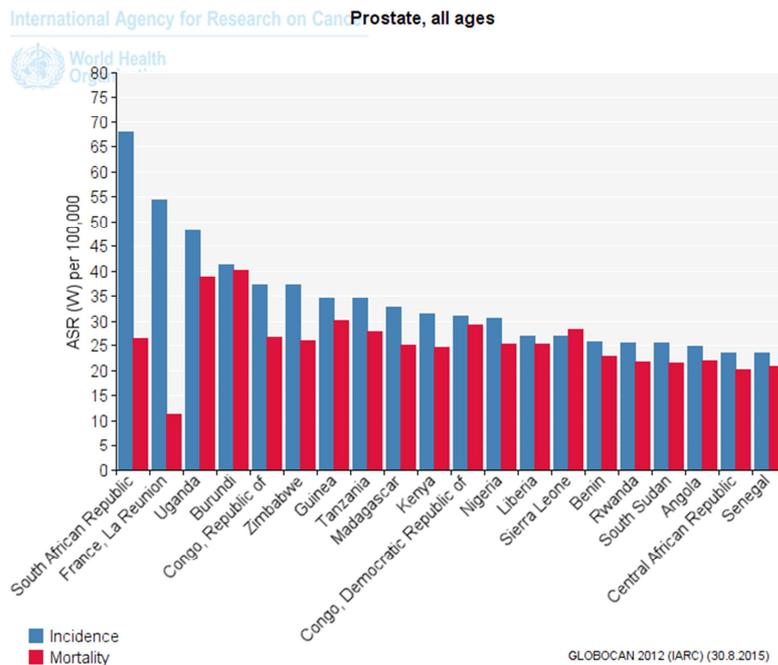


Figure 3. Age standardized incidence and mortality rate per 100,000 individuals in 20 most prostate cancer incidence countries in Africa.⁷ Graph created by IARC data analysis software.

In developing countries, more work must be done to establish a more robust public health infrastructure in order to screen for prostate cancer earlier and reduce prostate cancer related mortality. The paucity of data demonstrates the need to establish more robust surveillance systems in monitoring prostate cancer. With globalization and public health collaboration more robust data will allow practitioners to monitor and treat prostate cancer more effectively, worldwide.

3.4. Gaps in Knowledge in Low and Middle Income Countries

As reflected from the IARC data, Uganda has the highest prostate-cancer related mortality rate in developing countries. According to CI5-Volume 10 (cancer incidence in 5 continents), 2003-2007 data, age-standardized incidence rate of prostate cancer from Kampala (capital city) Cancer Registry is 42.5 per 100,000, making it the most common male cancer.²² This was up from 37.6 per 100,000 in 1998-2002. While this registry is a reflection of the Kyadondo County in Uganda, the incidence rate reflects major gaps in knowledge. Nakandi et al. Found that even though education and awareness was being propagated through the mass media, only 12.5% of the 324 subjects had actually heard of prostate cancer from health care providers.²³ Consequently, in focus group interviews, respondents did not know what the prostate gland was, did not know about PSA testing, and thought prostate cancer was something similar to gonorrhoea. Only one-tenth of the sample had proper knowledge of prostate cancer.

In other LMIC areas in Sub-Saharan Africa, there is a lack of awareness reflected by the close rates of morbidity and mortality rates in Burkina Faso. Kabore et al. found that out of 600 respondents, 62% had no knowledge about the prostate gland or prostate cancer.²⁴ Additionally, while 70% of the men were unaware of any diagnostic tests for prostate cancer, 12% of men cited too much sexual activity as a major risk factor of prostate cancer. Lack of adequate knowledge demonstrates needs to be addressed in order to improve diagnosis and adequate treatment of prostate cancer in developing countries.

3.5. Gaps in Knowledge in High Income Countries

In sharp contrast to LMIC areas, men in high income countries not overestimate the risk reduction from prostate-specific antigen (PSA) testing. Gigerenzer et al. found that men in eight European Union countries and Russia, 89% of the men overestimated the benefit of PSA testing.²⁵ Forty percent of men from Austria, Netherlands, Spain, and France overestimated the benefit of PSA testing. Men from Russia were the least likely to overestimate the benefit of testing. This overestimation causes lack of informed decisions on what type of treatment is the most sensible. There needs to be improved knowledge pertaining to PSA testing.

Even though there is an overestimation of the benefits of PSA testing in high income countries, in other countries, there is differential knowledge in minority subpopulations about prostate cancer. Additionally, during the treatment process

significant others play a significant role in the decision making process and thus must have proper knowledge. For instance, Owens et al. Found that in the United States, African Americans have misconceptions about prostate cancer being caused by homosexuality or the lack of sexual activity.²⁶ Additionally, there was a lack of knowledge about the prostate gland and the proper screening age. However, this group was aware of the role of lifestyle, some symptoms, and the high frequency of prostate cancer.

4. Conclusion

This data shows lower incidence rates and higher mortality rates of prostate cancer in African and Caribbean countries relative to developed western countries. In other words, most people in LMICs are diagnosed with more advanced disease when it is more challenging to treat the cancer and requires radical interventions. Among suggested reasons for higher rates of mortality in LMICs, are the different levels of prostate cancer awareness along with the adoption of a sedentary lifestyle and urbanization. Also, individuals in high income countries are more aware of PSA testing than in LMICs. In sharp contrast to very low levels of prostate cancer awareness, individuals in high income countries are misinformed about the prostate gland and the benefit estimation of PSA testing, indicating a need for better understanding of PSA testing. More spouses and significant others also are more aware and participate in the decision making process about prostate cancer in high income countries. There was no such evidence of the importance of spousal knowledge found in LMICs.

In order to address the paucity of data, policy needs to be developed in order to expand surveillance systems to monitor prostate cancer adequately. Additionally, mass media campaigns need to educate the population about the harmful effects and the importance of screening tests for prostate cancer in LMICs and high income countries. Globally, spouses and significant others need to be made aware of prostate cancer as well, since they play a role in the decision making process.

Conflict of Interest

None declared.

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