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Evaluation of prostate cancer characteristics in four populations worldwide

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Abstract

Introduction—Prostate cancer is common around the world, but rates of advanced disease differ substantially by race and geography. Although a major health issue, little is known about prostate cancer presentation in West Africa and India compared to the United States (US).

Objective—The aim of this study was to compare prostate tumor characteristics in four populations of men from the US, Senegal and India.

Materials and methods—We recruited prostate cancer patients from four hospital-based populations. The sample included 338 African-Americans, 1265 European-Americans, 222 Asian Indians, and 72 Senegalese. Questionnaire and medical record data were collected on each participant.

Results—We found significant differences in age at diagnosis, BMl, and PSA levels across the groups. Senegalese and Indian men had a higher probability of high stage (T3/T4) disease compared to US men. Gleason grade was significantly higher in Asian Indians compared to other populations. African-Americans, Senegalese, and Asian Indians had a significantly higher probability of metastatic disease compared to European Americans. The odds ratios (OR) for metastasis were consistently higher in Asian Indians compared to American cases. As only 19/72 Senegalese were assessed for metastasis, OR could not be determined for metastasis.

Conclusions—These results suggest that there are significant geographical and ethnic differences in the presentation of prostate cancer. Men in developing countries lend to present with advanced disease compared to US men. Identifying risk factors for advanced disease may help to decrease the rate of poor prostate cancer outcomes and associated mortality worldwide.

Keywords

ethnicity; prostate cancer; tumor characteristics; Senegal; India

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Introduction

Prostate cancer has one of the highest incidence and prevalence rates of any cancer in the world, and is second only to lung cancer as the most common non-cutaneous cancer diagnosed in men worldwide.[1] It is also a leading cause of cancer-related deaths among men. More than 600,000 new cases of prostate cancer are diagnosed each year, and approximately 200,000 deaths are attributed to prostate cancer worldwide.[1]

International prostate cancer incidence and mortality rates vary greatly by geographical location and ethnicity, Table 1. Variation in cancer rates may be influenced by genetics, culture, diet and/or other environmental factors.[2] The disease incidence and mortality rates tend to be higher in more developed nations compared to less developed nations.[1] Asians have among the lowest prostate cancer rates of any racial group.[3] In contrast, African-Americans have among the highest documented rates of prostate cancer in the world and tend to have more aggressive disease.[3] In addition, prostate cancer mortality rates for men of African descent in America and the West Indies are more than three to four times higher than mortality rates for men born of Eastern European, Mid-Eastern, and Asian descent.[1,4,3]

Prostate cancer incidence also is likely to be affected by prostate specific antigen (PSA) screening practices. The incidence of prostate cancer is highest in countries where PSA screening for prostate cancer is common and increases the detection of latent or asymptomatic prostate cancers. Those countries include the United States (Age-Specific Incidence Rate = 168/100,000, all races), Australia (76/100,000) and Scandinavia (55/100,000).[1,6,7] Accurate and comparable rate estimates in less developed countries are often unknown due to lack of screening, lack of medical care, and incomplete case reporting to tumor registries.[8,9]

With high prevalence of screening and resulting early detection, American men are at high risk for prostate cancer, but tend to be diagnosed with localized disease.[3] In contrast, Senegalese and Asian-Indian men have much lower incidence rates (7.5/100,000 and 4.6/100,000, respectively[1]), but are mostly diagnosed with advanced disease. PSA screening has not been systematically applied in most parts of the world, including India and Senegal, [10] which may explain at least in part the high relative rate of metastatic disease at presentation compared with the rates in Europe or North America.

Tumor characteristics in men of African, European, and Asian descent have been studied. Although PSA at diagnosis and tumor size may differ by ancestry/race, ethnic differences in tumor stage and grade may not be so profound when patients share similar characteristics related to screening and diagnosis, such as the same health system.[10-13] Although prostate cancer incidence and mortality tends to be low among Asian populations, tumor grade at diagnosis appears to indicate the presence of advanced disease in some Asians, such as Korean and Chinese prostate cancer patients in their native lands.[14,15] One study showed that among native West Africans, advanced prostate tumors and metastatic disease occurred more commonly than in American cases.[10] While prostate cancer is one of the most common tumors worldwide, relatively little is known about its presentation in non-African-American or non-European-American (Caucasian) men and in developing countries compared to other regions of the world. The objective of this study was to compare prostate tumor characteristics in sample populations from four diverse groups based on geography and ethnicity: African Americans, European Americans, Senegalese and Asian Indians.

Material and methods

Study subjects

We recruited prostate cancer patients from four populations. The sample included 338 African-Americans, 1265 European-Americans, 122 Asian Indians, and 72 Senegalese men. African-American and US European American participants were recruited from clinics at the Hospital of the University of Pennsylvania (HUP, Philadelphia, PA) and the Philadelphia Veterans Affairs Hospital between 1995 and 2007. These participants included cases from an ongoing case-control prostate cancer study at the University of Pennsylvania (described in[16,17]). Participants were excluded from this sample if they had a prior cancer history or reported current use of finasteride (Proscar/Propecia) or any use of Casodex. This criterion was necessary to 1) decrease the risk of drug-induced alteration of typical cancer sequelae in our cases and 2) make them more comparable to the Senegalese and Indian study samples. Proscar and Casodex were not used by any of the patients in those populations.

Using a similar protocol, we also recruited hospital-based prostate cancer cases from West Africa and India. African participants were recruited at Grand Yoff General Hospital in Dakar, Senegal. Asian Indian participants were all residents of the Uttar Pradesh State, North India. They were recruited through urology clinics of the Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPG1), Lucknow, between 2003 and 2005. Because prostate biopsies are rarely performed on the Senegalese and Asian Indian populations, prostate cancer was diagnosed primarily using information about lower urinary tract symptoms, clinical aspects of the prostate at the digital rectal examination, and high PSA level. Confirmation of diagnosis was obtained either from prostate biopsy or pathologic examination of the prostatectomy specimen.[10] In both the US and India, transrectal ultrasound probe guidance was used. Ten to 12 cores were biopsied in India and approximately 16 cores were biopsied in the US. Sextant digitally guided biopsies were performed on Senegalese patients.

Questionnaires were administered to each participant to obtain information about prostate cancer risk factors, demographic information and cancer history. Educational attainment was available for all populations except the Asian Indians. Patient eligibility and tumor characteristics (TNM stage, Gleason score, PSA level at diagnosis and presence of distant metastasis) were obtained from a review of medical records at each center. The assessment of distant metastasis in US patients was made at the Hospital of the University of Pennsylvania via bone scan and symptom evaluation. Asian Indians also were assessed for metastases via bone scans if the PSA at diagnosis was greater than 10 ng/ml. This reflected 93% of the cases in the Asian Indian sample. Senegalese patients who were assessed for metastasis underwent symptom evaluation, clinical examination, ultrasonography, plain x-ray, and computed tomography (CT) scans in some patients.[10] Only 19 of the Senegalese patients had this info available in the medical records. The others had not been assessed systematically for metastasis. Bone scans are not available in Senegal, so the only patients that receive bone scans are those that can afford to go to France for them. Otherwise, the patient's metastatic status remains unknown.

All data were collected under protocols approved by the Institutional Review Boards at each center.

Statistical analyses

Analyses were undertaken to compare the advanced tumor stage and Gleason scores and the presence of metastasis by sample population. Descriptive analyses for discrete traits were carried out using contingency table methods and the Fisher's Exact tests (FET) or chi-square statistics. Medians were used to summarize continuously distributed traits.

Unconditional logistic regression was used to examine population differences in the odds of having advanced disease at diagnosis. All analyses were adjusted for age. In addition, analyses were stratified by median age (≤ 62 versus > 62), family history of prostate cancer (present or absent based on self report), and PSA level at diagnosis. A two-sided p-value of 0.05 or less was considered statistically significant.

Results

Table 2 presents demographic and tumor characteristics for each of the four populations. The median age was 62 years for European Americans cases and 62 years for African-Americans. Median age of the Asian Indian sample was 66 years. Senegalese cases had a median age of diagnosis of 69 years and were significantly older than the other groups ($p < 0.001$). American cases were the youngest with a median age of 62 years. Median BMI was available for three of the groups. The Senegalese cases had a significantly lower BMI (23.0 kg/m^2) than either of the American groups ($p < 0.001$). The BMI for African-Americans was significantly higher than the other groups (28.1 kg/m^2, $p < 0.001$). Median PSA at diagnosis also differed significantly among the groups. PSA levels were lowest for European Americans (5.6 ng/ml) and highest for Senegalese (56.6 ng/ml, $p < 0.001$ compared to each of the other groups).

The percent of high stage (T3 and T4) cases was similar among the American groups (21%-26%), but was significantly higher for the Senegalese (48%, $p < 0.001$) and Asian Indians (99%, $p < 0.001$). Gleason scores greater than 6 were more common in the Asian Indian cases (72%, $p < 0.001$). Metastasis was rare in the American samples, but more common in African-Americans (2%) compared to European Americans (0.7%, $p = 0.033$). Seventy-one percent of Asian Indians presented with distant metastasis ($p < 0.001$). Only 19 Senegalese were assessed for metastasis, and all of them had prostate cancer that had spread to distant sites ($p < 0.001$). Patients with a known family history of prostate cancer were most common among Americans (36%-37%) and significantly less common among Senegalese (23%, $p = 0.015$ compared to European Americans) and Asian Indians (3%, $p < 0.001$). European Americans (67%) were more likely to have a college education compared to African-Americans (31%, $p < 0.001$) and Senegalese cases (21 %, $p < 0.001$).

Age-adjusted logistic regression models showed that Senegalese and Asian Indian men had higher tumor stages compared to American men, Table 3. Compared to European Americans, the odds ratio (OR) for Senegalese men was 2.9 (95% CI=1.8-4.7) and 344.7.0 (95% Cl=47.9-2482) for Asian Indians. This remained true for younger and older men alike, although OR could not be estimated for Asian Indians in some strata due to small numbers or uncollected data. Similar findings were observed for family history negative men. Tumor stage did not differ by ethnicity for family history positive men. African American men with low PSA (< 10 ng/ml) at diagnosis were less likely than European Americans to have high tumor stage (OR = 0.5, 95% CI = 0.3-0.8). Senegalese men with a low PSA at diagnosis were more likely than African Americans to have a high tumor stage (OR=17.0, CI=1.5-197). Asian Indian men with high tumor stage were more likely than other groups to have a high (≥ 10 ng/ml) PSA at diagnosis.

Asian Indian men were more likely to have higher Gleason grade (≥ 7) than any of the other groups. African Americans were less likely to have a high grade than European Americans if their PSA at diagnosis was low. However, among higher PSA Senegalese, the odds of a high Gleason grade was lower compared to African Americans (OR=0.4,95% Cl=0.2-0.8).

Odds ratios for metastasis could not be assessed for Senegalese due to sample size limitations. Compared to European Americans, African America ns (OR = 3.2, 95% CI =

1.1-9.2) and Asian Indian (OR=377.1, 95% CI=166-858) were more likely to have metastases. The findings were similar for those of younger age. There was no difference in the probability of having metastatic disease between older African Americans and European Americans. However, older men with metastasis were still more likely to be Asian Indian (OR=280.6 compared to the European American reference group). A similar pattern was observed among family history negative and family history positive men. No significant effects were observed for low PSA patients. Among high PSA patients, Asian Indian men were more likely than American groups to present with metastasis (OR=186.7, 95% CI=55.1-632 compared to European Americans and OR=54.3, 95% CI=15.7-187 compared to African Americans).

Discussion

The purpose of the present study was to compare tumor characteristics and factors associated with advanced disease in multiple populations from more developed versus developing nations. Tumor characteristics in four hospital-based samples of prostate cancer cases were examined from the United States, Senegal and India. We found stage and grade differences by population, with Senegal and India both being more likely to present with advanced disease. These differences were expected given the international differences in prostate cancer screening and diagnosis. Beyond the big differences in prostate cancer characteristics between United States and the developing countries, we also observed differences among African Americans and European Americans. Metastasis occurred at a higher frequency in African Americans compared to European Americans, specifically for younger men and men without a family history of prostate cancer. As noted above, these findings are not completely unexpected. African-American men are known to have worse outcome from prostate cancer compared to European-American men,[3,18,19] but the explanation for the presence of more aggressive tumors in African-American men remains unknown. Factors related to awareness, health care, treatment choice and timing, genetics or environment may also increase the aggressiveness of the disease and potential for metastasis in low PSA African-American cases.[2,18-20]

In spite of this difference between the American samples, the odds for metastasis were still substantially lower than what was seen in the Senegalese and Asian-Indian populations. It is common for cancer patients to present with advanced disease in developing countries such as Senegal and India.[21] Of interest is the fact that we also observed variability in the frequency of high tumor stage and metastasis in the developing nations. Asian-Indians were more likely to present with late-stage disease compared with Senegalese men.

Widespread screening is not commonplace in Senegal or India, so the finding of significantly different tumor characteristics must also reflect other factors including differences in cancer diagnostic practices, clinic referral patterns, prostate cancer risk factors, or biological differences in cancer etiology between these groups.

There are several strengths and limitations to our study. One of the strengths of this study is that we were able to compare the results of four separate patient samples that were recruited under a similar protocol. A recent study by Ravery et al[22] also investigated prostate cancer characteristics among four different populations of radical prostatectomy patients treated in France. European natives, North Africans, and Blacks from Central Africa and the French West Indies were compared. The study showed that Blacks had more advanced disease than the other groups and presented at a younger age. North Africans had lower Gleason scores, and a lower number of positive cores compared to the other. Unfortunately, that study was not able to stratify by country of residence, as some patients came from abroad to be treated while others were local residents. In addition to ethnicity, the diet, lifestyle, and

environmental conditions of the place of residence may contribute to differences observed in cancer progression.[22]

The sample populations in our study included two developing nations residing on different continents. Although not reflected in many international reports, prostate cancer is also one of the most prevalent urological malignancies in native Africans.[23] Cancer rate information in most developing nations is often outdated and likely to be grossly inaccurate because of lack of maintained tumor registries and inefficient reporting.[8,23-25] However, information from autopsy studies has provided some insight into the prevalence of prostate cancer and high grade prostatic intraepithelial neoplasia (HGPIN) in populations around the world. Rates of prostate cancer seem to be increasing in more recent years, as prostate collections from the 1960s and 1970s proved to contain less latent carcinoma and older age of onset compared to later collections.[26] We have learned from autopsy studies that around the world rates of HGPIN and carcinoma increase with each decade of life,[27,28] and African-Americans are most likely to develop more extensive HGPIN at younger ages.[29,30] Hungarian autopsies revealed a 39% prevalence of prostate cancer and an increase in Gleason scores and the prevalence of HGPIN with advancing age.[28] In contrast, in situ carcinoma is extremely rare in cultures like the lnuit of Alaska, Greenland and Canada, where an autopsy study revealed no latent carcinoma in 27 autopsies and a prevalence of invasive prostate cancer that was 2% in 61 deceased men.[31] Also of interest is that while high grade carcinomas may be more common in American populations, including lower risk Asian-American-groups, the risk of metastasis is greater in indigenous Asians compared to Asian-Americans.[29] Compared to American sub-populations, much less is known about HGPIN, clinical disease incidence and progression in developing nations like Senegal and India. However, based on our findings and similar reports, both appear to be populations that are at high risk for advanced prostate cancer and related mortality.[10,32,33]

Another strength of our study is that a common protocol was used to collect a hospital-based sample set in each location. This feature maximized the comparability of the groups and allowed us to readily check medical records for data accuracy and verification of tumor characteristics. However, clinic based studies tend to exclude prostate cancer cases who do not have access to medical care in a hospital setting. Therefore, these samples are not likely to be representative of the general population of these countries.

Our sample size for some of the groups was small and did not allow us to estimate odds ratios for some of the strata. Similar studies with smaller sample sizes than ours have been able to demonstrate significant differences in tumor characteristics by groups.[22] Nonetheless, increasing the sample size will be required to fully evaluate the differences among populations as well as to evaluate whether prostate cancer risk factors differ by geography.

There also may be significant international differences in referral patterns, access to care, and treatment options by population. In the US, European Americans tend to use surgical treatment more than African Americans.[34-36] Earlier work in this area demonstrated that while the majority of African-American men (62%) were treated with radical prostatectomy, the majority of Senegalese men (42%) were treated with orchiectomy.[37] As a result, there may be some differences in staging accuracy depending on whether or not the entire prostate was extracted and could be studied in pathology.[34]

Despite the apparent underestimation of true prostate cancer rates in Senegal and India, there appears to be higher prostate cancer incidence rates than previously reported in African and Asian regions.[8,38] These elevated rates may be the result of improved detection techniques becoming available in the developing world, as well as the emergence of an aging

population. An important yet understudied potential cause of increased prostate cancer incidence and/or severity includes lifestyle changes that increase obesity, decrease physical activity, and alter dietary habits may contribute to the overall increase of disease rates that occurs with the "westernization" of a given population.[39,40]

Currently in Senegal and India, PSA screening tests are rarely used to detect prostate cancer at an early stage of the disease. While PSA use, "overdiagnosis" and "overtreatment" of localized prostate cancer in the US remains controversial,[18,41] it remains to be determined whether wider use of PSA screening in select subsets of men in the developing world could lead to improved prostate cancer diagnosis and prognosis.

In the US, race remains an important predictor of prostate cancer progression, suggesting ethnic differences in prostate cancer awareness, health care access and quality, screening practices, and/or treatment. These are the same factors that effect delayed and sub-optimal treatment around the globe. Internationally prostate cancer rates are likely to rise as westernization of many nations continues and the populations of developing countries advance in age.[25] Clarifying the prevalence of and risk factors for advanced disease will help in targeting those at highest risk and provide ideas for disease interventions and optimal treatment options both in the US and in the developing world.

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References

1. Ferlay, J.; Bray, F.; Pisani, P.; Parkin, DM. GLOBOCAN 2002: Cancer incidence, mortality and prevalence worldwide IARC CancerBase No. 5, version 2.0. IARC Press; Lyon: 2004.
2. Reddy S, Shapiro M, Morton R Jr, Brawley OW. Prostate cancer in black and while Americans. Cancer and Metastasis Reviews. 2003; 22:83–86. [PubMed: 12716039]
3. National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch. SEER -- Surveillance, Epidemiology, and End Results Program. SEER*Stal Database: Incidence – SEER 17 Regs Limited-Use, Nov 2006 SUB (1973-2004 varying). www.seer.cancer.govreleased April 2007, based on the November 2006 submission
4. Wild SH, Fischbacher CM, Brock A, Griffiths C, Bhopal R. Mortality from all cancers and lung, colorectal, breast and prostate cancer by country of birth in England and Wales, 2001-2003. Br J Cancer. 2006; 94(7):1079–1085. [PubMed: 16523198]
5. Bunker CH, Patrick AL, Maharaj G, Keenan HA, Ramnarine S, Belle A, Richard JR, Dhir R. Prostate cancer risk is three-fold higher among men, aged 50-64, of African descent compared with men of Asian-Indian descent in Trinidad and Tobago. Ethnicity and Disease. 2002; 12:S3-30–S3-33.
6. Ries, LAG.; Melbert, D.; Krapcho, M.; Mariotto, A.; Miller, BA.; Feuer, EJ.; Clegg, L.; Horner, MJ.; Howlader, N.; Eisner, MP.; Reichman, M.; Edwards, BK., editors. SEER Cancer Statistics Review, 1975-2004. National Cancer Institute; Bethesda, MD: http://seer.cancer.gov/csr/1975_2004/, based on November 2006 SEER data submission, posted to the SEER web site, 2007
7. Parkin, DM.; Ferlay, J.; Hamdi-Chirif, M.; Sitas, F.; Thomas, JO.; Wabinga, H.; Whelan, SL., editors. Cancer in Africa: Epidemiology and Prevention. IARC; Lyon: 2003. IARC Scientific PublicationsNo. 153
8. Ekwere PD, Egbe SN. The changing pattern of prostate cancer in Nigerians: Current status in the southeastern states. J Natl Mai Assoc. 2002; 94:619–627.
9. Oliver SE, May MT, Gunnell D. International trends in prostate-cancer mortality in the "PSA Era". Int J Cancer. 2001; 92:893–898. [PubMed: 11351313]

10. Gueye SM, Zeigler-Johnson CM, Friebel T, Spangler E, Jalloh M, MacBride S, Malkowicz SB, Rebbeck TR. Clinical characteristics of prostate cancer in African Americans, American whites, and Senegalese men. Urology. 2003; 61(5):987–992. [PubMed: 12736021]
11. Kang JS, Maygarden JL, Mohler JL, Pruthi RS. Comparison of clinical and pathological features in African-American and Caucasian patients with localized prostate cancer. BJU Int. 2004; 93:1207–1210. [PubMed: 15180606]
12. Hong IL, Hong LI, Yong YANG, Chun-fat H. Comparisons of the incidence and pathological characteristics of prostate cancer between Chinese and Portuguese in Macau. Chin Med J. 2008; 121(4):292–294. [PubMed: 18304458]
13. Fukagai T, Namiki TS, Carlile RG, Yoshida H, Namiki M. Comparison of the clinical outcome after hormonal therapy for prostate cancer between Japanese and Caucasian men. BJU Int. 2006; 97:1190–1193. [PubMed: 16686710]
14. Song C, Ro JY, Lee M-S, Hong S-J, Chung B-H, Choi HY, Lee S-E, Lee E, Kim C-S, Ahn H. Prostate cancer in Korean men exhibits poor differentiation and is adversely related to prognosis after radical prostatectomy. Urology. 2006; 68:820–824. [PubMed: 17070360]
15. Chuang A-Y, Chang S-J, Homg C-F, Tsou M-H. Study of prostate cancer pathologic features in Chinese populations. Urology. 2007; 69:915–920. [PubMed: 17482934]
16. Rebbeck TR, Walker AH, Jaffe JM, White DL, Wein AJ, Malkowicz SB. Glutathione S-transferase-mu (GSTM1) and –theta (GSTTl) genotypes in the etiology of prostate cancer. Cancer Epidemiol Biomarkers Prev. 1999; 8(4 Pt. 1):283–287. [PubMed: 10207629]
17. Kelada SN, Kardia SL, Walker AH, Wein AJ, Malkowicz SB, Rebbeck TR. The glutathione S-transferase-mu and –theta genotypes in the etiology of prostate cancer: Genotype-environment interaction with smoking. Cancer Epidemiol Biomarkers Prev. 2000; 9(12):1329–1334. [PubMed: 11142418]
18. Brawley OW, Jani AB, Master V. Prostate cancer and race. Curr Probl Cancer. 2007; 31:211–225. [PubMed: 17543949]
19. Thatai LC, Banerjee M, Lai Z, Vaishampayan U. Racial disparity in clinical course and outcome of metastatic androgen-independent prostate cancer. Urology. 2004; 64:738–743. [PubMed: 15491712]
20. Zeigler-Johnson, C.; Gueye, SM.; Rebbeck, TR. Prostate cancer in Africa. In: Ly, A.; Khayat, D., editors. About Cancer in Africa. Springer-Verlag; France: 2006. p. 95-107.
21. Kehinde, EO. Trends in the incidence, presentation and treatment of prostate cancer in Africa: 1994-2004. In: Ly, A.; Khayat, D., editors. About Cancer in Africa. Springer-Verlag; France: 2006. p. 109-118.
22. Ravery V, Dominique S, Hupertan V, Rhouma SB, Toublanc M, Boccon-Gibod L, Boccon-Gibod L. Prostate cancer characteristics in a multiracial community. Eur Urol. 2007 doi:10.1016/j.eururo.2007.04.048.
23. Koulibaly M, Kabba IS, Cisse A, Diallo SB, Diallo MB, Keita N, Camara ND, Diallo MS, Sylla BS, Parkin DM. Cancer incidence in Conakry, Guinea: First results from the cancer registry 1992-1995. Int J Cancer. 1997; 70(1):39–45. [PubMed: 8985088]
24. Ukoli F, Osime U, Akereyeni F, Okunzuwa O, Kittles R, Adams-Campbell L. Prevalence of elevated serum prostate-specific antigen in rural Nigeria. Int J Urol. 2003; 10:315–322. [PubMed: 12757603]
25. Sim HG, Cheng CWS. Changing demography of prostate cancer in Asia. Eur J Cancer. 2005; 41:834–845. [PubMed: 15808953]
26. Shiraishi T, Watanabe M, Matsuura H, Kusano I, Yatani R, Stemmermann GN. The frequency of latent prostatic carcinoma in young males: the Japanese experience. In Vivo. 1994; 8(3):445–447. [PubMed: 7803732]
27. Sanchez-Chapado M, Olmedilla G, Cabeza M, Ruiz A. Prevalence of prostate cancer and prostatic intraepithelial neoplasia in Caucasian Mediterranean males: An autopsy study. Prostate. 2003; 54(3):238–247. [PubMed: 12518329]
28. Soos G, Tsakiris I, Sznnto J, Turzo C, Haas PG, Dezso B. The prevalence of prostate carcinoma and its precursor in Hungary: An autopsy study. Eur Urol. 2005; 48:739–744. [PubMed: 16203079]

29. Shiraishi T, Atsumi S, Yatani R. Comparative study of prostatic carcinoma bone metastasis among Japanese in Japan and Japanese Americans and whites in Hawaii. Adv Exp Med Biol. 1992; 324:7–16. [PubMed: 1283503]
30. Powell IJ, Meyskins FL Jr. African-American men and hereditary/familial prostate cancer: Intermediate-risk populations for chemoprevention trials. Urology. 2001; 57:178–181. [PubMed: 11295621]
31. Dewailly E, Mulvad G, Pederson HS, Hansen JC, Behrendt N, Hansen JPH. Inuit are protected against prostate cancer. Cancer Epidemiology, Biomarkers and Prevention. 2003; 12:926–927.
32. Osegbe DN. Prostate cancer in Nigerians: Facts and nonfacts. J Urol. 1997; 157:1340–1343. [PubMed: 9120935]
33. Dawam D, Rafindadi AH, Kalayi GD. Benign prostatic hyperplasia and prostate carcinoma in native Africans. BJU Int. 2000; 85:1074–1077. [PubMed: 10848698]
34. Robbins AS, Daixin Y, Parikh-Patel A. Differences in prognostic factors and survival among white men and black men with prostate cancer, California, 1995-2004. Am J Epidemiol. 2007; 166(1): 7l–78.
35. Lalini, Dm; Elkin, EP.; Cooperberg, MR.; Sadetsky, N.; DuChane, J.; Carroll, PR. Differences in clinical characteristics and disease-free survival for Latino, African-American, and Non-Latino white men with localized prostate cancer. Cancer. 2006; 106(4):789–795. [PubMed: 16400651]
36. Tewari A, Horninger W, Pelzer AE, Demers R, Crawford ED, Gamito EJ, Divine G, Johnson CC, Bartsch G, Menon M. Factors contributing to the racial differences in prostate mortality. BJU Int. 2005; 96:1247–1252. [PubMed: 16287439]
37. Spangler, E.; Zeigler-Johnson, C.; Jalloh, M.; Malkowicz, SB.; Gueye, S.; Rebbeck, T. Clinical characteristics of Senegalese and African-American prostate cancer cases; Abstract -- AORTIC conference; 2007;
38. Gupta NP, Ansari MS, Dass SC. Transrectal ultrasound guided biopsy for delecting early prostate cancer: An Indian experience. Indian J Cancer. 2005; 42(3):151–154. [PubMed: 16276016]
39. Parkin DM, Bray FI, Devesa SS. Cancer burden in the year 2000. The global picture. Eur J Cancer. 2001; 37:S4–S66. [PubMed: 11602373]
40. Desai SB, Borges AM. The prevalence of high-grade prostatic intraepithelial neoplasia in surgical resection specimens – An Indian experience. Cancer. 2002; 94:2350–2352. [PubMed: 12015759]
41. Brawley OW. Prostate cancer screening: clinical applications and challenges. Urologic Oncology: Seminars and Original Investigations. 2004; 22:353–357.

TABLE 1

2002 IARC age standardized incidence of prostate cancer by region

Region	Country of interest	ASR incidence per 100,000
Eastern Asia		3.8
South-Central Asia		4.4
South Central Asia	India	4.6
Northern Africa		5.8
South Eastern Asia		7.0
Western Africa	Senegal	7.5
Eastern Africa		13.8
Central/Eastern Europe		17.4
Western Africa		19.3
Southern Europe		35.5
Southern Africa		40.5
South America		47.0
Caribbean		52.4
Northern Europe		57.7
Western Europe		61.6
Australia		79.9
North America		119.9
North America	USA European American*	161.4
North America	USA African American*	255.5

*SEER registry data from 2000-2004

TABLE 2

Description of tumor characteristics among four populations of prostate cancer cases. (Percents provided are based upon number of individuals with data on specific outcomes)

	European-American (n = 1265)	**African-American (n = 338)**	**Senegalese (n = 72)**	**Asian Indian (n = 122)**
Median age (years, range)	62 (34-88)	62 (39-89)	69 (45-95)^{ab}	66 (44-92)^{abc}
Median BMI (kg/m^2, range)	27.1 (15.3-47.5)	28.1 (17.1-51.2)^{a}	23.0 (12.3-35.5)^{ab}	No data available
Median PSA (ng/ml, range)	5.6 (0.1-243)	6.1 (0.3-2300)^{a}	56.6 (0.5-6190)^{ab}	26.8 (7.8-1515)^{abc}
% T3/T4 stage (n)	26.4 (311)	21.3 (61)	47.9^{ab} (34)	99.2^{abc} (116)
% Gleason Grade ≥ 7 (n)	45.3 (533)	40.4 (116)	44.3 (27)	72.1^{abc} (88)
% Metastasis (n)	0.7 (8)	2.2^{a} (6)	100.0^{ab} (19)	71.1^{abc} (81)
% Family history positive (n)	37.3 (437)	35.6 (101)	22.9^{ab} (16)	3.3^{abc} (4)
% ≥ College educated (n)	67.0 (814)	31.0^{a} (92)	21.1^{a} (15)	No data available

^{a}Fisher's Exact two-sided p-value < 0.05 compared to European American

^{b}Fisher's Exact two-sided p-value < 0.05 compared to African-American

^{c}Fisher's Exact two-sided p-vale < 0.05 compared to Senegalese

TABLE 3

Comparison of age-adjusted odds of advanced disease status among prostate cancer cases, stratified by patient characteristics (OR, 95% CI)

Group	T3/T4 tumor stage				Gleason ≥ 7				Positive for metastasis			
	EA	AA	SEN	EI	EA	AA	SEN	EI	EA	AA	SEN	EI
Total sample	1.00	0.8 (0.6-1.0)	2.9 (1.8-4.7)	344.7 (47.9-2482)	1.00	0.8 (0.6-1.1)	0.9 (0.5-1.5)	2.9 (1.9-4.4)	1.00	3.2 (1.1-9.3)	*	377.1 (166-858)
		1.00	3.8 (2.2-6.7)	458.2 (62.6-3353)		1.00	1.1 (0.6-1.9)	3.5 (2.2-5.6)		1.00	*	118.0 (46.9-297)
			1.00	119.2 (15.8-902)			1.00	3.2 (1.7-6.0)			*	*
Age < 62	1.00	0.8 (0.5-1.3)	4.0 (1.5-10.9)	103.0 (14.0-756)	1.00	1.01 (0.7-1.5)	0.6 (0.2-1.9)	3.0 (1.5-5.9)	1.00	8.1 (1.5-44.6)	*	808.3 (167-3923)
		1.00	4.9 (1.7-14.1)	125.4 (16.6-947)		1.00	0.6 (0.2-1.9)	3.0 (1.4-6.2)		1.00	*	100.2 (29.0-346)
			1.00	25.5 (2.8-232)			1.00	4.7 (13-16.8)			*	*
Age ≥ 62	1.00	0.7 (0.4-1.1)	2.4 (1.4-4.4)	*	1.00	0.7 (0.5-1.0)	1.0 (0.6-1.9)	2.9 (1.7-4.9)	1.00	1.6 (0.3-8.0)	*	280.6 (104-759)
		1.00	3.7 (1.8-7.4)	*		1.00	1.5 (0.8-2.9)	4.2 (2.3-7.7)		1.00	*	176.1 (38.9-796)
			1.00	*			1.00	2.8 (1.3-6.0)			*	*
Family history negative	1.00	0.8 (0.5-1.2)	3.5 (1.9-6.2)	320.1 (44.4-2310)	1.00	0.7 (0.5-1.0)	0.8 (0.4-1.4)	2.5 (1.6-3.9)	1.00	4.7 (1.2-19.1)	*	443.8 (151-1303)
		1.00	4.2 (2.2-8.2)	388.0 (523-2880)		1.00	1.1 (0.6-2.1)	3.5 (2.1-5.9)		1.00	*	93.9 (31.7-278)
			1.00	92.1 (11.9-711)			1.00	3.2 (1.6-6.6)			*	*
Family history positive	1.00	0.6 (0.3-1.0)	1.1 (0.3-3.6)	*	1.00	0.8 (0.5-1.4)	1.2 (0.4-3.7)	*	1.00	1.1 (0.1-10.1)	*	220.3 (15.3-3181)
		1.00	2.0 (0.6-7.3)	*		1.00	1.5 (0.5-4.6)	*		1.00	*	198.9 (8.0-4939)
			1.00	*			1.00	*			*	*
PSA < 10	1.00	0.5 (0.3-0.8)	8.7 (0.8-97.6)	*	1.00	0.6 (0.4-0.8)	0.7 (0.1-7.6)	*	1.00	4.7 (0.9-23.6)	*	*
		1.00	17.0 (1.5-197)	*		1.00	1.2 (0.1-13.6)	*		1.00	*	*
			1.00	*			1.00	*			*	*

Group	T3/T4 tumor stage				Gleason ≥ 7				Positive for metastasis			
	EA	AA	SEN	EI	EA	AA	SEN	EI	EA	AA	SEN	EI
PSA ≥ 10	1.00	1.1 (0.6-1.9)	1.6 (0.9-2.9)	185.2 (25.3-1356)	1.00	1.4 (0.8-2.6)	0.5 (0.3-1.0)	1.7 (1.0-2.7)	1.00	3.4 (0.7-17.5)	*	186.7 (55.1-632)
		1.00	1.4 (0.7-3.0)	166.0 (21.7-1268)		1.00	0.4 (0.2-0.8)	1.2 (0.6-2.2)		1.00	*	54.3 (15.7-187)
			1.00	116.2 (15.1-895)			1.00	3.3 (1.6-6.7)			*	*

* Could not be estimated