High Prevalence of Screening-detected Prostate Cancer among Afro-Caribbeans: The Tobago Prostate Cancer Survey[1]

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Abstract

Risk for prostate cancer is high among African Americans. We hypothesized that risk for prostate cancer is also high in other populations of African descent. Our objective was to determine the screening-detected prevalence of prostate cancer in the predominantly Afro-Caribbean population on the island of Tobago. Male residents, ages 40–79 years, were invited to participate in a population-based screening for prostate cancer using serum prostate-specific antigen (PSA) and digital rectal exam (DRE). Men with elevated PSA (≥4 ng/ml) or abnormal DRE were offered an ultrasound-guided sextant biopsy of the prostate gland. Men (2484), ages 40–79 years, underwent prostate cancer screening between September 1997 and June 2001. Mean age was 55.9, SD was 10.6 years, and median was 54 years. Mean serum PSA was 14.8 ng/ml, SD was 376 [excluding 4 values ≥ 2 SD above the mean (1,112, 1,317, 1,818, and 18,330 ng/ml) mean PSA was 5.5 ng/ml and SD was 29.6], and median PSA was 1.2 ng/ml. Elevated PSA and/or abnormal DRE were observed in 31% (759 of 2484) overall, and in age groups 40–49 (87 of 843, 10%), 50–59 (201 of 729, 28%), 60–69 (262 of 584, 45%), and 70–79 (209 of 328, 64%). Of 681 men biopsied, 259 (38%, or 10% of the 2484 screened) were diagnosed with prostate cancer. Age-specific rates of screening detected prostate cancer were: 1%, ages 40–79 years; 7%, ages 50–59 years; 18%, ages 60–69 years; and 28%, ages 70–79 years. These screening results indicate a very high screening-detected prevalence of prostate cancer in this population of West African descent. These data support the hypothesis that populations of African descent share genetic and/or lifestyle factors that contribute to their elevated risk for prostate cancer.

Introduction

Prostate cancer is a very serious personal and public health problem affecting African Americans more frequently than Caucasians. On the basis of 1990–1997 data from the U.S. SEER[4] of the National Cancer Institute (1), age-adjusted incidence of prostate cancer is 225 of 100,000 among African Americans compared with 149 of 100,000 among white non-Hispanics. The mortality rate from prostate cancer was >2-fold higher among persons of African descent (54 of 100,000) compared with white non-Hispanics (23 of 100,000). Incidence of prostate cancer in the United States increased dramatically in both groups between the late 1980s and 1993, reflecting the earlier diagnosis that occurred with the increasing use of serum PSA screening (1). An encouraging downturn in prostate cancer mortality rates was observed in both ethnic groups from 1993 to 1997 (1).

Established risk factors for prostate cancer include age, ethnicity, family history of prostate cancer, and high-fat or meat diet (2). Other factors suspected include hormone metabolism, (3, 4) vitamin D metabolism, (5) and a few occupational exposures (6). The relationships of a number of candidate genes to prostate cancer are under investigation with most published results limited to Caucasian populations (7, 8). The reasons for the higher risk for prostate cancer among African Americans are unknown.

Until recently, there has been little solid prevalence, incidence, or mortality data for populations of African descent outside the United States, although data published a few years ago in an annual summary of worldwide data suggested high rates of prostate cancer mortality in Martinique and Trinidad & Tobago (9). Glover *et al.* (10) reported high rates of prostate cancer incidence in the predominantly Afro-Caribbean population of Jamaica. Data regarding screening parameters and prevalence of prostate cancer in populations of African descent in the United States are sparse (11, 12) and virtually absent in other populations of African descent. However, a recent publication has estimated prostate cancer prevalence for 1994 among African Americans and Caucasians using a model based on incidence and survival functions calculated from the Connecticut Tumor Registry, 1940–1993, and applied to the SEER 1973–1993 populations. The prevalence proportion ranged from 7 of 100,000, ages 40–44 years, to 9,725 of 100,000, ages

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[4] The abbreviations used are: SEER, Surveillance, Epidemiology, and End Results; PSA, prostate-specific antigen; DRE, digital rectal exam.

75–79 years, in Caucasians, compared with 14 of 100,000, ages 40–44 years, to 10,945 of 100,000, ages 75–79 years, in African Americans (13).

We hypothesize that risk for prostate cancer is high among populations of African descent living in diverse environments. If so, this would lead us to hypothesize that populations of African descent share genetic and/or lifestyle factors that increase risk for prostate cancer.

On the island of Tobago, Trinidad & Tobago, we are conducting a population-based, longitudinal study of prostate cancer in the male population ages 40–79 years. In this report, we present data from the initial cross-sectional screening using serum PSA and DRE.

Materials and Methods

Population. The island of Tobago is about 7 × 26 miles in size. According to the 1990 census (14) of Trinidad & Tobago, the male population of Tobago, ages 40–79 years, numbered 5121. Ninety-two percent of Tobago residents reported that they were of African descent. Most healthcare is provided by a government-supported system through the Tobago Regional Health Authority that manages the 19 neighborhood health centers and one hospital. Some residents travel to Trinidad for specialized care under the government system. Some care is provided by private caregivers. PSA testing has been available but generally limited to symptomatic men seeking care in the private sector.

Recruitment. The recruitment goal was 4000 men, 80% of the male population of Tobago, ages 40–79 years. Currently, >3000 men are enrolled. Recruitment has been the result of word of mouth, informing by healthcare workers at the hospital and health centers, informing by private physicians, posters, flyers, public service announcements, and public presentations by oncologists and urologists from Trinidad and the United States.

Informed Consent. Consent was obtained using forms and procedures approved by the Institutional Review Boards of University of Pittsburgh Institutional Review Board and the Tobago Ministry of Health.

Data Collection. Data were collected by locally resident study staff at the study office located at the Tobago Regional Hospital. Data collected included ethnicity, education, occupation, smoking, medical history, personal and family cancer history, vasectomy, prostate symptoms, health screening history, alcohol intake, detailed occupational history, and height, weight, waist, and hip measurements.

Biological Sample Collection. A 15-ml plain vacutainer of peripheral blood was drawn from fasting subjects. Aliquots of serum were frozen at −20°C for later measurement of PSA.

DRE. A systematic DRE was performed by a physician trained according to the study protocol. This exam was scheduled after the blood draw to avoid an artifactual increase in serum PSA that may follow digital manipulation of the gland.

PSA Measurement. Serum PSA levels were measured at the University of Pittsburgh Central Pathology Laboratory using the automated Microparticle Enzyme Immunoassay, Abbot AxSYM PSA assay (Abbott Laboratories, Abbott Park, IL).

Criteria for Referral for Prostate Biopsy. Subjects were referred to the Tobago Regional Hospital for biopsy if the DRE was abnormal (except for simple enlargement without palpably abnormal areas) or if serum PSA was elevated (≥4.0 ng/ml).

Prostate Biopsy. Prostate biopsies were performed by urologists or by surgeons trained by urologists from the University of Pittsburgh Medical Center. *Trans*-rectal ultrasound guided biopsy was performed using an 18 gauge, 21-cm spring-loaded biopsy needle (Boston Scientific, Natick, MA). Sextant biopsies were obtained according to a standard protocol.

Prostate Pathology. The formalin preserved specimens were stored at room temperature and shipped to the University of Pittsburgh for histopathological examination. The specimens were examined for presence or absence of high-grade prostatic intraepithelial neoplasia, presence or absence of cancer, Gleason score of cancer, location of cancer, and perineural invasion.

Data Analysis. Age-specific prevalence rates (per 100 screened men) were calculated. Age-adjusted rates/100 and SE/100 were calculated by direct standardization (15) based on the age distribution (50–79 years) of the 1970 United States standard million population (1). Positive predictive value of the screening tests was calculated as number of men diagnosed with prostate cancer divided by the number of men with abnormal DRE and/or elevated PSA who underwent biopsy. All statistical calculations were performed using SPSS 10.0 for Windows (SPSS Inc., Chicago, IL).

Results

PSA and/or DRE screening was completed for 2492 men, ages 40–79 years, 49% of the total male population in this age group. Eight men who reported prior diagnosis of prostate cancer are excluded from these analyses. Among the 2484 men remaining, mean age was 55.9 years, SD was 10.6, and median was 54 years. Ninety-two percent of men reported three or four grandparents of African descent, whereas 5% reported one or two of African descent. Twenty-four percent had completed secondary school or higher education. Forty-two percent reported ever smoking, whereas 14% were current smokers.

The serum PSA range was 0.1–18,330 ng/ml. Mean serum PSA was 14.8 ng/ml and SD was 376. After excluding 4 values ≥2 SD above the mean [1,112, 1,317, 1,818, and 18,330 ng/ml], mean PSA was 5.5 ng/ml, SD was 29.6, median PSA was 1.2 ng/ml, and range was 0.1–602 ng/ml.

Elevated serum PSA levels (≥4 ng/ml) were observed in 452 of 2437 men (19%), ranging from 2% of men, ages 40–49 years, to 53% of men, ages 70–79 years. DRE was abnormal in 514 of 2074 men (25%). Frequency of abnormal DRE increased across age groups from 11 to 48%. Abnormal screening results (PSA ≥4 ng/ml and/or abnormal DRE) are shown in Table 1. PSA and/or DRE were abnormal in 759 of 2484 men (31%). Thus, a high proportion of the screened men was referred for biopsy: 10% of men, ages 40–49 years; 28%, ages 50–59 years, 45%, ages 60–69 years; and 64%, ages 70–79 years.

Of the 759 men referred for biopsy, 681 (90%) have undergone prostate biopsy. Prostate cancer was diagnosed in 259 (38%) men, 2 (1%) with Gleason grade 5, 142 (55%) with grade 6, 86 (33%) with grade 7, and 29 (11%) with grades 8, 9, and 10. The prevalence of prostate cancer among screened men was 10% (259 of 2484) among men ages 40–79 years, and 15% (250 of 1585) among men ages 50–79 years. The age specific results are shown in Table 1.

The high prevalence rate reported above reflects not only the high rate of abnormal screening results but also a high-positive predictive value for an abnormal screen: 12% of biopsied men ages 40–49 years were diagnosed with prostate cancer; 27%, ages 50–59 years; 45%, ages 60–69 years; and 53%, ages 70–79 years (Table 1).

Among 123 men reporting family history of prostate cancer, 117 reported one relative, 5 reported two relatives, and 1 reported three relatives with prostate cancer. The distribution of

Table 1 Screening and biopsy results in Tobago men by age group

Age group (yr)	Screened *n*	Abnormal DRE and/or PSA *n* (% of screened)	Biopsied *n* (% of abnormal)	Prostate cancer *n* (% of biopsied)	Prostate cancer prevalence (per 100 screened population)
40–49	843	87 (10)	77 (89)	9 (12)	9/843 (1)
50–59	729	201 (28)	188 (94)	50 (27)	50/729 (7)
60–69	584	262 (45)	240 (92)	107 (45)	107/584 (18)
70–79	328	209 (64)	176 (84)	93 (53)	93/328 (28)
Total age 40–79	2484	759 (31)	681 (90)	259 (38)	259/2484 (10)
Total age 50–79	1641	672 (41)	604 (90)	250 (41)	250/1641 (15)

relatives included 78 fathers, 65 brothers, 3 half-brothers, 8 uncles, and 2 grandfathers. Thirteen (10.6%) of 123 men reporting family history of prostate cancer were diagnosed with prostate cancer, compared with 246 (10.4%) men diagnosed with prostate cancer among 2361 men not reporting family history of prostate cancer.

Eight percent of men reported that a physician had told them they had benign prostatic hypertrophy. Waking to urinate more than once/night was reported by 51% of men (62% of men ages 50–79 years). The rate rose steadily from 33% among men ages 40–49 years to 86% among men ages 70–79 years. Within each age group, the rate was similar in cases and noncases.

Discussion

The screening detected prevalence of prostate cancer in this Afro-Caribbean population, ages 50–79 years, was about three to four times higher than rates reported from screening studies of predominantly Caucasian populations (16–18). These United States studies, which reported results by age group, were conducted between 1989 and 1992 when PSA screening was just beginning to be widely used in the United States. After direct age adjustment to the standard 1970 United States population, ages 50–79 years (SEER), screening-detected prevalence in Tobago men, ages 50–79, was 15.1 of 100, SE 0.9, compared with 3.8 of 100, SE 0.2, in a population of 6501 United States men (92% Caucasian, 3% African American, and 5% other), ages 50–79 years, reported by Richie *et al.* (18). Comparison of the age-specific screening-detected prevalence rates of prostate cancer in these two populations are shown in Fig. 1.

Factors that may influence the comparison of the screening results from these two populations include the biopsy protocol, the proportion of men with abnormal PSA/DRE who underwent biopsy, prior level of screening in the populations, and recruitment methods. In the study by Richie *et al.* (18), quadrant ultrasound guided needle biopsies were performed, whereas this study required sextant biopsies, which were likely to have resulted in some increase in the probability of detecting cancer if cancer was present (19). The biopsy rate among men with abnormal screening results was 90% in the Tobago study, compared with 69% in the study by Richie *et al.* (18). This higher biopsy rate increased the opportunity to ascertain cases. Thus, procedural differences may account for some of the increased prevalence rate among the Tobago men.

The United States population in the previously mentioned study (18) was screened in 1991–1992, a period during which the incidence of prostate cancer was rising sharply (1), reflecting increasing use of PSA testing. Thus, some prostate cancer

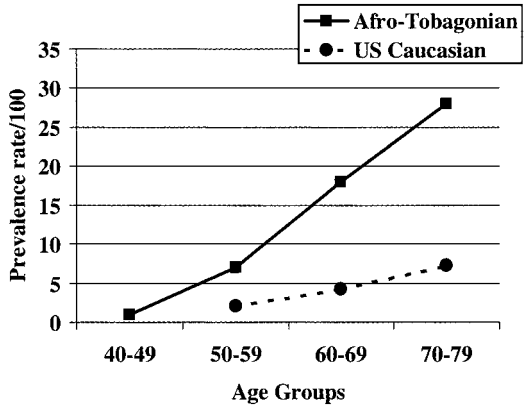

Fig. 1. Screening detected prevalence of prostate cancer among 6501 predominantly Caucasian United States men (18) and 2484 Afro-Tobagonian men.

cases may have been removed from this United States population by prior screening. However, 19% of the Tobago men, ages 50–79 years, reported a prior PSA test, suggesting that some level of screening had also been available in this Tobago population.

Both the United States (18) and the Tobago populations were self-referred. The Tobago population was recruited primarily by word of mouth. The United States population was recruited by advertisement. Among the United States population, 53% reported symptoms of prostatism. Sixty-two percent of Tobago men, ages 50–79 years, reported waking to urinate two or more times/night. If self-referral bias were to have a strong effect, one would have expected higher prostate cancer rates among men recruited earlier in the study compared with later. As shown in Fig. 2, this was somewhat true, particularly in the oldest age group among whom symptoms were more likely to be related to prostate cancer. Compared with the age-standardized rate of screening-detected prostate cancer (15.1%) among men ages 50–79 years in the total screened group, the rate based on the men recruited only in 2000–2001 was somewhat lower, 13.4%. Even after deflating the conservative 13.4% rate by the ratio of the biopsy rates in the two populations, the even more conservative estimate of the age-standardized rate of screening-detected prostate cancer of 10.3% is still almost 3-fold higher than in the United States population, Richie *et al.* (18).

Similar age-specific prevalence rates from screening of other populations of African descent have not been published.

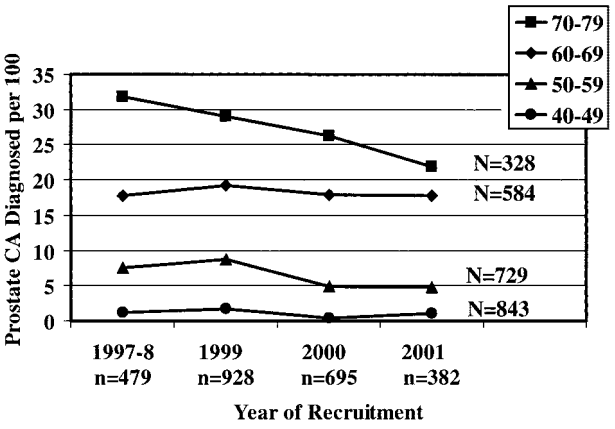

Fig. 2. Screening-detected prostate cancer prevalence rates by year of recruitment, Tobago.

Smith *et al.* (20) reported prostate cancer prevalence of 5.1% among 804 African-American men screened between 1991 and 1995 using serum PSA and DRE. Application of the Tobago prostate cancer rates to the reported age distribution in this African-American population yielded an expected rate of 12.4%, compared with the observed prevalence of 5.1%, suggesting that the Tobago rates are approximately twice those observed in the African-American population.

One of the known risk factors for prostate cancer is ethnicity, *i.e.*, African descent, although we do not know how this risk is mediated. One hypothesis is that genetic factors contribute to the high risk for prostate cancer among populations of African origin. If the Caucasian admixture rate in the Tobago population is indeed low, then this population may carry a higher burden of high-risk genes of African descent than the more admixed populations in the United States.

In conclusion, compared with Caucasian and other populations, the higher incidence of prostate cancer observed in populations of African descent, African Americans (1) and Jamaicans (10), and the very high screening-detected prevalence of prostate cancer observed in this study among Tobagonians support the hypothesis that these populations share ancestral genetic factors that increase susceptibility to prostate cancer. However, the variability in risk across these populations of African descent suggests an important influence of unknown environmental/lifestyle factors acting on prostate cancer risk in these susceptible populations.

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