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There are intra- and interracial differences in **prostate cancer** incidence and mortality rates worldwide. The environment and migration patterns seem to influence the disparities in **cancer** statistics. The lowest incidence rate is recorded in Chinese, followed by other Asians, South Americans, southern Europeans, and northern Europeans, in ascending order. However, people of African descent have the highest incidence so far. Until recently, African Americans in Alameda County (California) in the United States had the highest reported incidence (160/1000,000). An incidence of 314/100,000 recently was reported in African Caribbeans from Jamaica. These high rates contrast with the low incidence rates reported in continental (Sub-Saharan) Africa. Angwafo et al have reported higher age-adjusted incidence rates in Yaounde, Cameroon (93.8/100,000). They highlighted the importance of diagnostic methodology, availability of and access to diagnostic techniques and trained manpower, and adjustments for the age distribution of populations when comparing incidence rates between regions. The great disparity in **cancer** statistics over large geographic areas and races has oriented studies toward genes and gene products susceptible to environmental risk factors such as diet, ultraviolet rays, and **cadmium**, which may be associated with or causative of **prostate cancer**. Randomized studies on suspected risk factors and promoters of **prostate cancer** need to be conducted worldwide. However, caution is in order when inferences are made comparing populations with access to health care to those without.

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Migration and Prostate Cancer: An International Perspective

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Prostate cancer incidences are on the increase worldwide.¹ These increasing incidences have been attributed mainly to the widespread use of recent technologies for detection, such as serum prostate specific antigen determination, transrectal ultrasonography, biopsy of the prostate, and transurethral resection of the prostate.² There is considerable debate about the morbidity and mortality from prostate cancer. The contention stems from the observation that some patients die with, but not of, prostate cancer.^{3,4} A critical review of studies on Asian immigrants, first-generation Americans, and ethnic populations in the United States underscores the need to perform randomized international and cross-cultural epidemiologic studies.⁵

RACIAL AND GEOGRAPHIC VARIATIONS

Recent studies of racial and geographic variations in prostate cancer incidences and the effect of migration implicate the environment in the causality of this disease. The principal conclusions from these studies offer three postulates. First, vastly different incidence

rates among ethnic groups living in the same environment suggest that heritable factors may determine susceptibility to exogenous risk factors. Second, wide variations in incidence rates among the same ethnic groups in different areas of the world as well as changing rates in migrants in the United States suggest that prostate cancer risk factors are environmental. Third, substantial increases in incidence among first-generation immigrants suggest that environmental factors such as diet and lifestyle in later life may modify prostate cancer risk.⁶

There is a 120-fold differential in prostate cancer incidence when populations in the five continents are compared. The highest rates recorded in descending order are in North America and Northern Europe; intermediate rates in Israel, Southern Europe, and Latin America; and the lowest rates in Asia. That geography and environment are important factors are suggested by the high rates in western countries and low rates in the newly industrialized countries of Asia. The influence of geography is underscored when incidence rates between mainland Chinese, Hong Kong Chinese, and Chinese in California and Hawaii are compared: Chinese from the mainland have the lowest rates in the world (1.3 per 100,000); Hong Kong Chinese have a rate five times higher; and Chinese in the United States have a rate 16 times higher.⁷

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Kolonel⁵ has shown from ethnic studies that prostate cancer incidence rates steadily increase with migration from mainland Japan to Hawaii, and the US mainland in that order. In a similar study, Japan-born men in Brazil had twice the incidence rate of those in Japan. Duration of residence in the host country seems to influence incidence rates; foreign-born Chinese who have lived in the United States for >25 years have rates three times higher than those who have lived there <25 years.

These studies suggest that a change in environment, principally diet and other lifestyle factors, is the underlying risk factor. It is observed that as an individual moves from a developing to a more advanced society, there is increased consumption of animal fats and decreased intake of fiber and vegetarian diets.⁹

Sub-Saharan Africa traditionally has been regarded as a low incidence area.^{10,11} In 1966, world standard rates per 100,000 were 4.4 for Uganda, 9.4 for South Africa, and 9.4 for Nigeria.¹² By 1978, these incidence rates had risen to rates similar to those found in Scandinavia (northern Europe).¹³ The incidence rate in Bulawayo in 1980 was 32.3 per 100,000,⁷ and an age-adjusted rate of 93.8 has been reported in Yaounde.¹⁴ With such high incidences occurring over a rather short period, it can be questioned if these regions really had low incidence rates three decades ago. Some of these studies had design flaws and study populations were not comparable. Observed differences in incidence, mortality, and mortality to incidence ratios may have been due to differences in diagnostic procedure, access to care, availability of technical manpower, and necessary infrastructure within and between countries. It is possible that the disparity in reported rates reflected the variability in detection rates from one region to another, casting doubt on the comparability of prostate cancer statistics from country to country. Also, cancer registries, which were the basis for data collection, were absent in many areas. Further, when these registries were available, the data reflected the sum of clinical and latent cancer rather than clinical cancer alone.¹⁵

LATENT CANCER

The literature on latent cancer is confusing, with discordant conclusions, since operational terms (definitions and methods) differ widely. Latent prostate cancer is variously referred to as incidental carcinoma, small focal carcinoma, micro-carcinoma, nonin-

vasive cancer, invasive cancer, and proliferative latent cancer. Further, some authors make a distinction when large areas of the prostate are involved by latent cancer.¹⁶⁻¹⁹ There is no way to distinguish between indolent, truly latent cancers (ie, that would not progress to clinical disease) and those that have simply been detected early in the course of their progression. The prevalence rate of latent cancer was determined to be 20% from a mathematical model from age 45.²⁰ It is said that the incidence of latent cancer is the same among all races worldwide and that the disparity in incidence rates was due to variation in clinical cancer rates.^{17,18} This has been challenged because latent cancer prevalence rates do correlate positively with clinical cancer prevalence rates.¹⁹

Franks,²¹ in an autopsy study in England in 1954, reported a prevalence rate of 37.6%. In 1961, Karube²² reported a 10.9% prevalence in Japan. A prevalence rate of 8.8% was reported in the United States,²³ although another report showed that at age ≥ 50 years, the prevalence varied from (9% to 46% in the US population).¹⁹ In 1973, Akazaki and Stemmermann²⁴ reported an 8.7% rate in Japanese in Japan and a 19.1% rate in Japanese in Hawaii from their autopsy study. They made the distinction between focal noninvasive and invasive latent prostate cancer.

From the above studies, it can be deduced that the prevalence rate of latent prostate cancer ranges from 8.8% to 46% in England, Japan, and the United States. The prevalence rates also depend on the operational definition as demonstrated in the study by Akazaki and Stemmermann.²⁴

CLINICAL CANCER

In 1977, Jackson et al²⁵ reported on results of a comparative clinical and autopsy study of African-American men in Washington, DC, and African men in Accra, Ghana, and Ibadan, Nigeria. They observed a similar prevalence rate of micro-carcinoma (latent cancer), but there was a 10-fold differential in the clinical cancer rates. This study confirmed earlier reports on the rarity of clinical prostate cancer in Africans in Sub-Saharan Africa.^{10,11} Unfortunately, the clinical prostate cancer study was performed in nonrandomized populations that were not comparable in terms of access to diagnosis. Furthermore, they relied on digital rectal examination and prostatic acid phosphatase to diagnose clinical prostate cancer; both procedures are not sensi-

tive enough to detect early prostate cancer.²⁶ Due to differences in health delivery systems (case recruitment and sampling) and diagnostic inaccuracies, prostate cancer incidence rates among people across large geographic areas may have been spurious.

In 1977, Breslow et al¹⁶ performed blind microscopic evaluation of autopsy material from seven geographic areas with a wide variation in incidence rates of clinical cancer. The prevalence of small foci of latent prostate cancer was similar at 12% in all areas, whereas there was wide variation in the prevalence of latent cancers that involved large portions of the prostate. The dissimilarity in the prevalence of latent cancers that involved large areas of the prostate within these geographic areas correlated positively with the clinical prostate cancer incidence rates. Clearly, the conclusion that clinical cancer prevalence rates have little association with the prevalence of latent cancer is erroneous. With standardization of techniques, diagnostic criteria, selection of cases for autopsy, and a more precise histologic definition of the operational term "latent" cancer, a more meaningful study of the geographic epidemiology of prostate cancer could be undertaken.

DISEASE-SPECIFIC MORTALITY RATES

Disease-specific mortality rates are more accurate than incidence rates in assessing the burden or health impact of prostate cancer. Mortality rates for prostate cancer also have a significant geographic variation. However, the highest mortality rates are reported in people of African descent in the Caribbean islands of St Vincent and Grenadines, followed closely by Martinique and Bermuda.⁷ Caution must be exercised when interpreting mortality data. Disease-specific mortality, whether direct or indirect, is often difficult to ascertain. Improvements in health care may lead to early diagnosis and treatment, which can diminish mortality, while poverty may favor a high mortality rate. Notwithstanding the reservations, it appears that mortality from prostate cancer is highest for people of African origin irrespective of geographic location. Due to the dearth of tumor registries and autopsies in Sub-Saharan Africa, mortality rates from prostate cancer are not available.

In an attempt to uncover etiologic clues, Blair and Fraumeni²⁷ analyzed the geographic pattern of prostate cancer in the United States. Prostate cancer mortality was high in counties with a high percentage of residents of Scandinavian descent and in counties with metal-using and textile industries.

These counties were clustered in the north-central and northeastern states. Mortality among nonwhites was 50% higher than among whites, and it was suggested that this was related to consumption of high-fat foods. This trend has been confirmed in a more recent report wherein prostate cancer mortality in the United States exhibits a south-to-north trend, with higher rates in the north.²⁸

It has been postulated, therefore, that geographic distribution of ultraviolet radiation and prostate cancer mortality are inversely related, so that the areas with the greatest sunlight have the lowest rates. Indeed, Miller et al²⁹ have demonstrated that physiological concentrations of 1,25 vitamin D3 promote the differentiation of human prostate cancer cells in culture. They then postulated that a reduction in vitamin D synthesis in the skin may be linked to the higher rates of prostate cancer in black men. However, the reduction in vitamin D syntheses in the skin of black men has yet to be documented. Further, the risk of developing prostate cancer has been shown not to correlate with circulating levels of vitamin D and its metabolites.³⁰

SUMMARY

There are intra- and interracial differences in prostate cancer incidence and mortality rates worldwide. The environment and migration patterns seem to influence the disparities in cancer statistics. The lowest incidence rate is recorded in Chinese, followed by other Asians, South Americans, southern Europeans, and northern Europeans, in ascending order. However, people of African descent have the highest incidence so far. Until recently, African Americans in Alameda County (California) in the United States had the highest reported incidence (160/100,000). An incidence of 314/100,000 recently was reported in African Caribbeans from Jamaica.³¹ These high rates contrast with the low incidence rates reported in continental (Sub-Saharan) Africa. Angwafo et al¹⁴ have reported higher age-adjusted incidence rates in Yaounde, Cameroon (93.8/100,000). They highlighted the importance of diagnostic methodology, availability of and access to diagnostic techniques and trained manpower, and adjustments for the age distribution of populations when comparing incidence rates between regions.¹⁴

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environmental risk factors such as diet, ultraviolet rays, and cadmium, which may be associated with or causative of prostate cancer. Randomized studies on suspected risk factors and promoters of prostate cancer need to be conducted worldwide. However, caution is in order when inferences are made comparing populations with access to health care to those without.

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