Prostate Cancer and Environmental Exposure to Trace Elements in Different Ethnic Groups

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Abstract

In the Wellington region of New Zealand, a stratified random sample of men were taken from a larger community prostate study group of 1405 eligible subjects from three ethnic groups in order to examine ethnic differences in cadmium, selenium, and zinc exposure, as well as possible associations of blood levels of Cd, Se, and Zn with the prevalence of elevated serum Prostate Specific Antigen (PSA), a marker of prostate cancer. Diet, profession, and smoking were found to expose Maori and Pacific Island males to more Cd than New Zealand European men. However, there was no significant difference in mean blood Cd levels between ethnic groups. Men from the Pacific Islands exhibited much higher amounts of Se in their blood than both European and Maori men from New Zealand. Maori men exhibited much higher blood Zn levels than New Zealand European men and men from the Pacific Islands. Blood Cd and total serum PSA were found to have a favourable relationship. PSA levels were not linked to selenium or zinc levels. Prostate cancer mortality rates are greater among Maori and Pacific Island men than in New Zealand European males. Variations in disease progression rates, which are impacted by trace element exposure and/or deficiency, could contribute to ethnic differences in mortality. The findings, however, did not show a consistent ethnic pattern, highlighting the intricacy of the risk/protective mechanisms given by exposure factors. To determine if the relationships found between Cd and PSA levels are biologically significant or merely things to consider, more research is needed.

Keywords: Cadmium • Selenium • Zinc • Serum prostate specific antigen • Prostate cancer • Ethnicity

Introduction

It is widely acknowledged that genetic variation alone cannot account for observed disparities in prostate cancer incidence [1]. A 120-fold disparity in prostate cancer rates between countries demonstrates that there is significant heterogeneity in the occurrence of this illness and that environmental variables have a role [2]. The relevance of suspected environmental and dietary factors (such as low soil Se) in triggering prostate cancer is still uncertain, according to the Health Research Council of New Zealand [3]. It needs to be seen whether such environmental exposures are linked to higher prostate cancer rates or progression. There is significant ethnic heterogeneity in cancer incidence and death within the New Zealand population [4]. According to WHO age-standardized prostate cancer rates from 1998 to 1999, Maori males had the lowest incidence at 86.1 per 100,000, followed by Pacific Island guys at 115.2 per 100,000, and other (mostly New Zealand European) males at 118.9 per 100,000 [5]. In contrast, in 1998-1999, the prostate cancer WHO age-standardized mortality rates for Pacific Island and Maori men (52.3 and 39.3 per 100,000, respectively) were greater than the rates for other men (22.8 per 100,000) [6]. The ethnic gap in incidence and mortality is likely due to Maori and Pacific Island men's lower health-care utilisation, as well as underreporting in ethnic health data collecting in New Zealand [7,8,9]. According to recent study, the incidence of prostate cancer in Maori and Pacific Island males is estimated to be at least as high as in New Zealand European men [10]. The increased mortality rates observed among Pacific Island and Maori men could be attributed to health-care use concerns such as delayed diagnosis and treatment, as well as ethnic disparities in disease development driven by risk factors. Environmental variables have been linked to prostate cancer in research conducted all over the world. Because many environmental factors may be changed, they have significant implications for prostate cancer prevention. Cadmium (Cd), selenium (Se), and zinc (Zn) are three environmental trace elements that have been linked to prostate illness in the literature and are major elements in the New Zealand environment. Cd can be found in abundance in New Zealand soil. Watercress, shellfish, and offal meats are among the foods high in Cd in New Zealand. Zn is a nutritional element that is abundant in the prostate gland and is required for normal prostate function. Cd and Zn compete for protein ligand binding in tissues, and Zn reduces Cd toxicity. Both Cd and Zn have the potential to impact the amount of testosterone and dihydrotestosterone (DHT) in the prostate, which are necessary for the growth of both BPH and prostate cancer. Clinical trials employing dietary supplements are being conducted around the world to investigate the role of Se as a possible anti-carcinogen for prostate cancer. Both recent and cumulative exposures are reflected in blood Cd. As a result, the greater the blood Cd level, the older the person is. It's also been proposed that as people get older, their intake of Se and Zn drops due to dietary changes. Because the risk of prostate cancer rises with age, these variations in trace element exposure may increase prostate cancer risk even more. Due to an increase in environmental and industrial contaminants, the human body burden of Cd has increased during the previous 100 years. Cd pollution in the environment occurs in New Zealand as a result of a mixture of land contamination (fertilisers and sludge application) and water contamination (irrigation and industry), and is then passed through the food chain. The search for a relationship between Cd exposure and prostate cancer has yielded mixed results. In a number of occupational and laboratory research, Cd exposure has been linked to an increased risk of prostate cancer. Environmentally exposed people to Cd have not shown an elevated relative risk of cancer, according to research. Biological investigations, on the other hand, have discovered evidence of carcinogenic qualities in prostatic cells, as well as the possibility that Cd's carcinogenic effect is hormonally driven. Se is a trace element that can be found in different amounts in soil. Meats, eggs, dairy products, and bread are the main sources of Se in the diet. Se is also abundant in kidney, liver, and shellfish. Se is typically found as organic molecules in these foods. Prostate cancer mortality is inversely related to soil Se levels, according to ecological studies. Men who used Se supplements for five years had a 65 percent lower risk of prostate cancer, according to the Nutritional Prevention of Cancer Study. During a nine-year follow-up, another big trial (the Alpha-tocopherol, Beta-Carotene Cancer Prevention Study) revealed no link between baseline Se and prostate cancer. An inverse relationship between blood Se levels and prostate cancer incidence was discovered in a case-control study of 9345 Japanese-American men. The patients in this Japanese study had a lower risk of prostate cancer if their baseline blood Se was greater than 147g/L. The link was mostly found among current or former cigarette smokers. This supports the idea that Se could help to reduce the harmful effects of cigarette chemicals like Cd. The findings of a smaller (3059 males) case/control research in the United States corroborated this conclusion, reporting a continuous reduction in prostate cancer risk with serum Se >135g/L. Intakes vary widely because Se amounts in food are dependent on local soil conditions. Some populations in places of the world where domestic food production is important consume very little Se and are at risk of Se deficiency. Soil Se levels in New Zealand are low, notably in some sections of the South Island, and this is mirrored in low Se levels in some domestically cultivated foods. Thomson and Robinson concluded in a report that New Zealanders' Se status has improved from the early 1970s surveys. The enhanced Se status was linked to the increasing eating of fish and poultry, as well as the importation of Australian wheat and cereal due to its greater Se concentration. The dietary intakes of Se were found to be substantially below the recommended daily amounts in other nations in both the 1997/98 New Zealand Total Diet Survey and the 1997 National Nutrition Survey. Only two-thirds of the Australian recommended daily intake was estimated in the 1997 National Nutrition Survey. Recent investigations in younger New Zealand people continue to show insufficient Se intake for complete development of glutathione peroxidase (GPx), contradicting the 1996 findings. Furthermore, in the South Island, all of the wheat is grown in New Zealand, whereas in the North Island, between 50 and 100 percent of the wheat is imported. Red meat, poultry, grains, dairy, legumes, and vegetables all contain Zn, which is a homeostatically regulated necessary mineral. It's a part of a lot of metalloenzymes, and it's crucial for cell development and replication, as well as osteogenesis and immunology. In some cell types, Zn may also act as an antioxidant by stabilising membranes. Some studies have established a link between reduced Zn intake and specific malignancies in patients, while others have found no link. For the prostate, zinc is thought to be a 'cellular growth protector.' The normal human prostate stores the most zinc of any soft tissue in the body. The Zn level in prostate cancer cells, on the other hand, is significantly lower than that found in non-prostate tissues. Zn suppresses the development of human prostate cancer cells, potentially through the triggering of cell cycle arrest and death. The loss of a unique ability to retain high levels of zinc is hypothesised to play a role in the genesis and progression of malignant prostate cells. In-vitro Zn aids in the maintenance of testosterone and DHT intra-prostatic equilibrium. Zn levels would be expected to be inversely related to prostate cancer based on these cellular activities. The epidemiologic data for Zn and prostate cancer incidence and death, on the other hand, have been inconsistent. The evidence for a protective effect of zinc on prostate cancer incidence is currently in sufficient to justify randomised chemoprevention trials.

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