Preventing Prostate Cancer in Ghana: A systematic Review

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ABSTRACT: *Background:* Prostate cancer is worldwide distributed and the most killer cancer of all diagnosed cancer cases among males. The situation in Ghana is not different, hence the need to determine the most appropriate preventive measures to curb this menace.

Purpose: This review seeks to assess the use phytochemicals to prevent development of prostate cancer in Ghana.

Method: Systematic literature review uses to search for review and research articles in PubMed and ScienceDirect databases. The research was restricted to January 2002 to December 2019 for open access review and research articles.

Principal Result: It revealed that, prostate cancer is the most diagnosed cancer among adult males in Ghana as documented globally. Poverty and poor health seeking behavior inhibit early detection of treatment. Plant foods and use of diet to prevent prostate cancer was researched as done in other countries, for recommendation. Cruciferous, Isoflavones and Lycopene phytochemicals have been established by this review that, their metabolic mechanism is prevent the growth of prostate cancer.
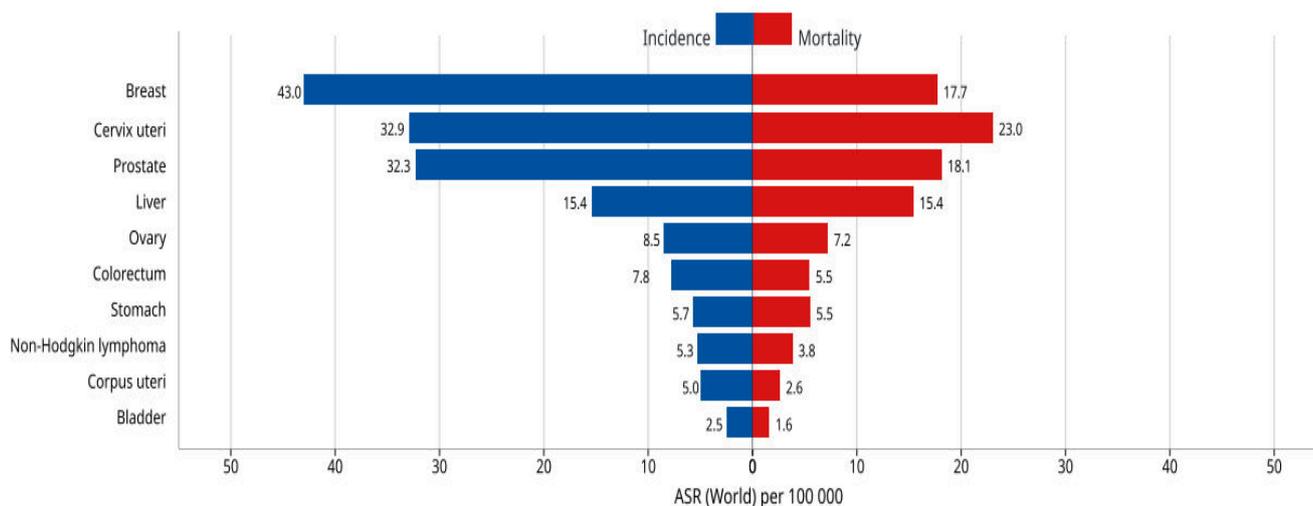
Conclusion: Globally, it is established that, prostate cancer is the leading cause of cancer deaths among male adults. However, research has shown that apart from chemotherapy and hormonal therapies, dietary fibers are critical in prevention of prostate cancer. Awareness creation about the use of phytochemicals like cruciferous, Isoflavones, lycopene and others plant foods curbing prostate cancer should be made in Ghana.

KEYWORDS: Prostate cancer, males, preventive measures, phytochemicals, chemotherapy, hormonal therapies, dietary fibers.

1   INTRODUCTION

Globally, it is estimated that, prostate cancer represent 7.1% (1276 cases) among all diagnosed cancer new cases and causes 3.8% (358989 deaths) of all deaths caused by all cancer cases. It is the leading diagnosed cancer among males [1-5] and the third among all cancer cases in the world, after breast and cervix uteri cancer. However, it kills more people (18.1%) than breast cancer (17.7%) among the top ten cancer cases [6, 7], as shown in figure 1.

Age-standardized (World) incidence and mortality rates, top 10 cancers

Fig. 1.   Age-standardized (world) incidence and mortality rates, top 10 cancers[8]

Prostate cancer is worldwide distributed (as shown in figure 2), and has strong affiliation to wealth and dietary factors related to riches. It is the most common diagnosed form malignancy male adults 50 years and above in developed nations [5, 9-11]. Migrants from low risk countries (Asian countries) [3, 12-15], to high risk countries are like to develop the disease. For instance people from Japan and Poland to USA have highly susceptible to develop the cancer. Moreover, modernization and western lifestyle has influence citizens in low risk nations, therefore stand the chance of acquire the disease even in their own countries[16].

Some risk factors associated with prostate cancer, are old age, family history, genetic predisposition, race and geographical location[10, 17], however, the main cause of prostate cancer is unknown[2]. Furthermore, the lifestyle and dietary choices of an individual also influence the development cancer [7, 18, 19]. These cause cells in the prostate to mutate and develop rapidly[20]. Nevertheless, there several known therapies used to treat this cancer, depending on the stage of cancer. Treatment alternatives include watchful waiting, surgery, radiation therapy, hormone and chemotherapy [5, 17], and recently human microbiota is gaining recognition in management of prostate cancer [21]. These treatments have been established to be efficacious but comes with adverse and toxic side effects [9].

Recently, phytochemicals (plant food) is used as chemoprevention method which uses photosynthetic compounds blocking cancers by focusing on particular steps in carcinogenic pathway[19]. A lot of dietary plant rich foods are recommended to reduce the risk of cancer, such as green tea, garlic, ginger, berries and lycopene[19]. Epidemiological studies have elucidate the association between prostate cancer incidence and diet [15, 22-26]. This fact has been establish elsewhere, however, this review seeks to contextualize the situation in Ghana.
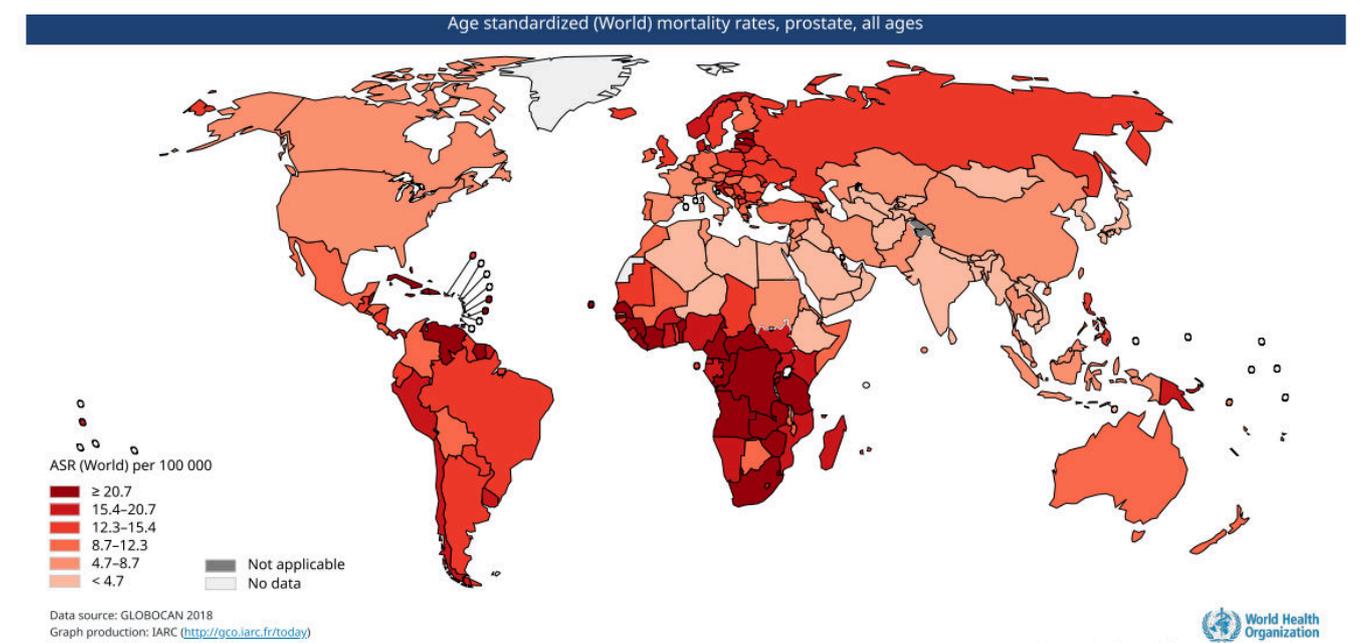
Fig. 2.   Age standardized (world) mortality rates of prostate among all age, depicting its global distribution [6]

1.1   SITUATION IN GHANA

The situation in Ghana is not different from the universal picture, it is the second diagnosed cause of cancer among males and the fourth ranked (7.9% of 1098 deaths) cause of death relation to new cancers cases, after breast, cervix uteri and liver cancers[8, 20].

A review done by Hinneh, recorded that, men between the ages of 56-85 years represent 86.6% of men with prostate-specific antigen (PSA) level above the normal value in Kumasi. A higher PSA level was identified among men in a similar screen exercise conducted in Accra [20]. Furthermore, Klufio's retrospective analysis as documented by Obu, shows from a frequency and pattern of genitourinary (GU) cancers seen Korle-Bu Teaching Hospital, prostate cancer accounted for 72.9% GU cancers in males[13] between 1980 and 1990. Another data he reviewed clearly state that, prostate cancer represented 17.35% of all cancer cases identified in both sexes in 1991[13].

More so, findings of Hsing et al was reviewed by Hinneh, indicating that, 48% of Ghanaian men within the age of 50-59 years, screened in Accra have in higher incidence of prostate. This affirms statistic from WHO that prostate cancer is ranked fourth and fourth cause of deaths among all diagnosed cancer cases in Ghana[8]. The worrying trend is that, prostate cancer is not detected early enough in for prompt treatment. It revealed by number of studies that, the condition is cure with detected early. About 99% and 95% survival rate among men diagnosed early is 5 and 10 years respectively[20]. Poor health seeking behavior and poverty restrict most Ghanaian to access early diagnoses of disease conditions. Men showing clinical manifestations of prostate cancer, like frequent urination, erectile dysfunction, just to mention a few[3], visit the "drug stores" for Over the Counter (OTC) drugs or resort in local concoctions and some traditional medicines (phytochemicals)[20]. These phytochemicals are cheap and no toxic effects [27].

The identification of phytochemicals (diet and dietary fruit and vegetables) to prevent this deadly cancer is a welcoming news in Ghana. Phytochemicals are earmarked as the novel anti-tumor alternative treatment in the near future [27]. Ghana is situated in a tropical zone with viable environment to cultivate most foods identified as source of phytochemicals like tomatoes and soy. The WHO recommendation of a daily consumption of at least eating variety of fruit and vegetables daily has been adopted by Ghana and efforts research and publish finding of importance of dietary plants have been enacted by ministry of health, Ghana[28]. In depth knowledge and awareness creation should be acquired and created respectively among Ghanaians

1.2   MECHANISM OF PHYTOCHEMICALS AGAINST PROSTATE CANCER FORMATION

It is projected that, 65% of citizens in globally, prefer herbal remedies for primary care needs to chemotherapies, out of which 80% in developing countries depend on traditional medicines, according World Health Organization (WHO) [9]. Poverty,

poor health seeking attitude and occurrence of resistance to cancer chemotherapy has propel scientist to research more into natural plant products and use of diet in preventing prostate cancer[23].

Also, hormone ablation techniques and palliative care are only treatment options for advances diseases. Therefore there is the need for exploration of new treatment and preventive measures are critical to stop the development to a hormone refractory state. Diet and natural products from plants, has been proven as one of the interventions used to prevent neoplastic events and reduces risk of acquiring cancer [23, 29]. The use of these synthetic compounds to reverse, inhibit, or prevent cancer by targeting specific steps in the carcinogenic pathway is gradually gaining admiration among health professionals[23]. Association between dietary plants with reduced threat of developing cancer has elucidated by a lot of studies. High intake flavonol from cocoa, improves denate gyrus' functioning in healthy adults[30]. Additionally, intake of antioxidant factors in vegetables and cruciferous has proven by epidemiological studies to limit risk of heart disease and some cancer like prostate [18, 31].

This discovery is inundating to the extent that, organizations such as National Research Council of Academy of Science, The National Cancer Institute and World Cancer Research Fund and the American Institute for Cancer Research have all recommended more intake of citrus fruits, cruciferous vegetable, green and yellow vegetable and Vitamin A and C food sources, in other to reduce cancer risk[16]. This necessitate the need for detail knowledge of how these plant diets function against development of prostate cancer.

1.3 CRUCIFEROUS

Cruciferous vegetable is commonly consumed in Asian and Western countries, however, due to westernization, most of these plants' foods find themselves in Ghana, and some are even cultivated by local farmers. For example, foreign ones like broccoli, Brussels sprouts, cauliflower and local ones like "Kontomire", cabbage, spring onion eggplant and so on. These vegetables contain *gluosinolates*, a natural plant chemical which give rise to bioactive species. The bind by endogenous plant enzyme *myrosinase* to produce phytochemicals containing anticancer functions [18].

1.3.1 MECHANISM OF CRUCIFEROUS

The anti-cancer functions of products of metabolites of glucosinolates- glucoraphanin and glucobrassicin, sulforaphane, and indole-3-carbinol have been studied extensively. Prostate cancer growth is prevented by sulforaphane and indole-3-carinol. This done by blocking initiation and suppressing the cancer development in vitro and in vivo[18]. These metabolites have the ability to also antagonize cell signaling pathways which dysregulate in prostate cancer. Currently, studies have shown that, the activities of enzymes controlling the epigenetic status of prostate cancer is control by sulforaphane and indole-3-carinol[18].

1.4 ISOFLAVONES

Isoflavones are mainly produce by leguminous plants like beans, which naturally occur as isoflavonoids and act as phytoestrogens in mammals. There is scientific evidence that, isoflavones can reduce the risk of breast and prostate cancer. It is found in plant foods like beans, soy beans, tofu, sesame seed, multigrain bread etc. Beans, soy beans and products of soy beans are readily available in Ghana.

A systematic review and meta-analysis done by Applegate and colleagues, shows that, there is a strong association between soy Isoflavones and prostate cancer risk. An observational in vitro, in vivo and ex vivo studies depict that, soy isoflavones and lycopene prevent development of prostate cancer growth[32]. Furthermore, if was identified that, both genistein and daizein (example of isoflavone) consumption were inversely associated with the risk of prostate cancer (p = 0.008 and p = 0.018, respectively) [12].

1.4.1 MECHANISM OF ISOFLAVONES

It observed that, more soy isoflavones, genistein and daidzein gather in human system after assimilation, and they are cytotoxic to cancer cells, in both hormonal and non-hormonal action. For instance, an experiment using mouse model, shows that, genistein upregulates tumor suppressor genes in prostate cancer cells. It also suppresses prostate carcinogenesis in an estrange receptor (ER) wild-type model, but different in mouse with knock-out estrogen receptor. Depending on the type of cell and concentration of estrogen present, isoflavones, act as a weak estrogen receptor (ER) agonists. Genistein bind to prostate tissues in a concentration of estrogen receptor beta (ER-β) with similar attraction to endogenous developed estrogen,

17 β-estradiol. Studies have shown that, 17 β-estradiol, and environmental estrogenic are controls body weight, obesity and formation prostate cancer[33]. Prostate cancer histological grade and multiplication of cells reduced, with increased level of ER-β. These mechanism by cause the level of prostate-specific antigen to reduce [12]

1.5 LYCOPENE

Analysis of data gathered by Health Professionals Follow Up (HPFU), was the first study known to have indicated a possible inverse association between intake of food containing lycopene and the risk of prostate cancer [7, 16, 26]. Lycopene belongs to carotenoid group of foods with natural pigments. They are foods synthesized by both plants and microbes, like flowers, fruits and vegetables. Absorption of light is their main function in plants and also protect plant cells against photo-oxidative damage during photosynthesis [7, 16].

In contrast, animals (humans) eat fruits and vegetables containing carotenoid because they can produce it. Beta-carotene found in vitamin A source foods, as an example of carotenoid, have a critical dietary role. Lycopene as a dietary factor gives the red color of tomatoes and other fruits like guava, watermelon, pink grapes and papaya [16, 25, 32, 34]. The largest source of lycopene is tomatoes which is harvest in large quantity in the northern sector of Ghana.

1.5.1 MECHANISM OF LYCOPENE

All carotenoids including lycopene has a conjugate structural bond which makes possible form to transfer molecules from atom to the other, creating room for more geometric isomerism. These isomers are commonly in raw foods. Nonetheless, processing of food like cooking and other methods can cause isomerization leading geometric isomerism. Absorption of light, exposure to heat or chemical reaction result in isomeric interconversion in biology. Lycopene is therefore in a higher level when cook or processed than in a raw state [16, 34].

In the human body, lycopene is digested and assimilated in a similar way like lipids. Appreciable amount of absorbed lycopene is found in liver, adrenal glands, testes and prostate gland and ranked 3rd after beta-carotene and lutein. The mechanism of cancer development is based on the function of oxidative damage to cellular protein, lipid and critically DNA. Free radicals are used to fight oxidative process or against cellular damage. The intrinsic mechanism by these free radicals includes enzymes glutathione peroxidase and superoxide dismutase. This the reason why there is high demand for exogenous source of antioxidants like vitamin E, A, selenium and lycopene source foods [7, 9, 16, 34].

For instance, a study review by Barber et al revealed that, high intake of tomatoes and its products decreased the risk rate of prostate cancer 35% and of high grade cancer by 53% [16]. Elsewhere, studies have shown strong association between dietary tomato products and reduced risk of prostate cancer[16].

2 METHOD

A systematic search was in done in PubMed and ScienceDirect for review and research articles with following key words; "Prostate cancer, Dietary fiber, Phytochemicals, Cancer in Ghana. The research were restricted to January 2010 to December 2019 for open access review and research articles. I also searched for bibliographies for original research and studies, especial those with outcomes for my meta-analysis.
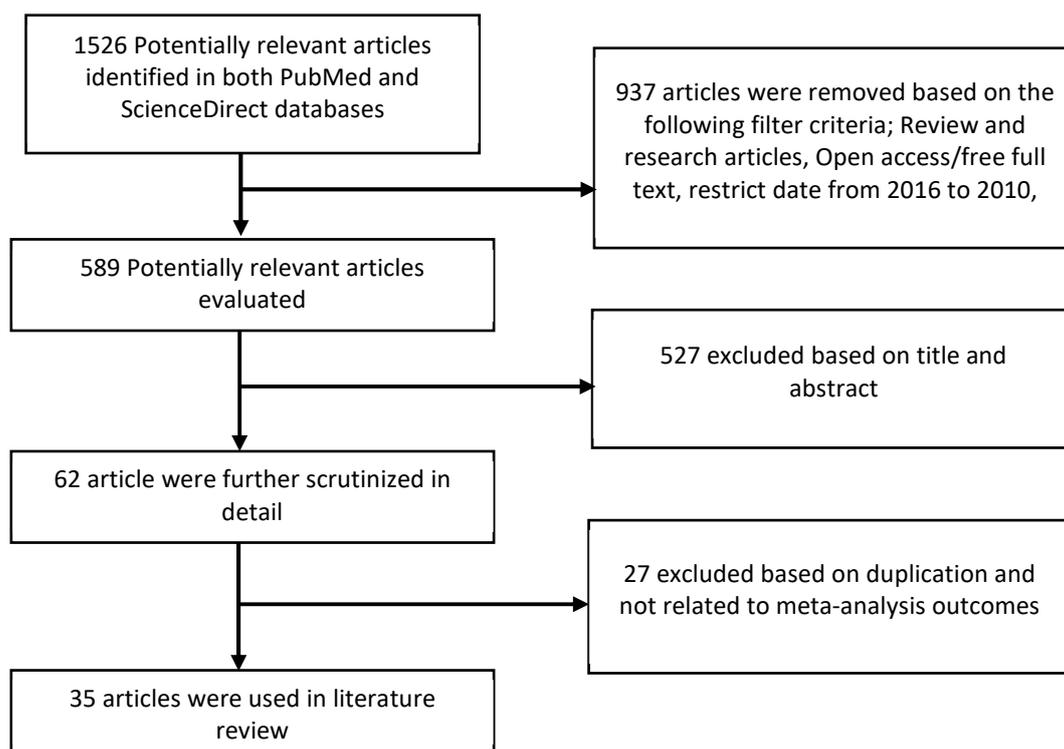
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│ 1526 Potentially relevant│          │ 937 articles were removed    │
│ articles identified in   │          │ based on the following filter│
│ both PubMed and          │─────────▶│ criteria; Review and research│
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│ 35 articles were used in │
│ literature review        │
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Fig. 3.   Algorithm for systematic review of articles

3   CONCLUSION

By and large, several phytochemicals have been identified my studies besides cruciferous, isoflavones and lycopene. They are proven to react against the growth of prostate cancer. A meta-analysis studies conducted by Guo, Y., et al, shows that, green tea (some made from leafy vegetables rich in xanthophylls) intake decrease the incidence of PCa with linear dose-response effect and reduced prostate cancer risk drastically with over 7 cups/day[19, 24]. Moreover, luteolin a type of flavone, found in green pepper, carrot and orange is depicted in human stusy model to be effective against development of cancers like prostate. A concentration of 30 µM is potent against lymph node carcinoma of the prostate (LNCaP) cells by inducing cell apoptosis. Luteolin prevent prostate-specific antigen expression through the down-regulation androgen receptor expression [24, 35]. Most plant foods also have the ability to target oxidative stress example isothiocyanate (found in broccoli), inflammation and androgen receptors signaling in prostate cancer. Others have are anti-cancer effect by controlling a number of molecular signaling pathways involved in tumorigenesis[11]. Food sources for these plant chemicals are found in Ghana, therefore, there is the need to create awareness of its importance among Ghanaians, to curb this killer among male adults.

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