Dietary Patterns Affecting Prostate Cancer: Medical Education

Prostat Kanserini Etkileyen Beslenme Biçimleri

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ABSTRACT Prostate cancer is the most common male cancer. Studies show that prostate cancer is a preventable disease. The current studies suggest the role of dietary patterns in the prevention of prostate cancer. There are many epidemiological, clinical, case-control, prospective studies about dietary patterns and prostate cancer. These studies indicate that saturated fats, trans fatty acids, omega-6 fatty acids, meat, whole milk and dairy products, and calcium increase prostate cancer risk, whereas omega-9 fatty acids, omega-3 fatty acids, fruit and vegetables, lycopene, selenium, vitamin E, D, soy, pomegranate and green tea decrease the risk. Consumption of meat, trans fatty acids (margarine, fried foods), whole dairy products (whole milk, cheese, yogurt, or others) should be reduced and high calcium intake should be avoided to reduce prostate cancer risk. On the other hand, consumption of vegetables (such as broccoli, cauliflower, cabbage, kale, Brussels sprouts, and radish), lycopene containing foods (tomato and products), adequate amount of selenium (seafood, grains), vitamin E (vegetable oils, wheat germ, nuts, soybeans, sweet potatoes, and avocado), green tea, soy (soybeans, tofu, soy cheese, soy milk), and pomegranate juice is highly recommended. This study summarizes the association of food and increased/decreased dietary risk factors for prostate cancer and gives recommendations based on these associations.

Key Words: Prostatic neoplasms; diet

ÖZET Prostat kanseri erkeklerde en çok görülen kanserdir. Araştırmalar prostat kanserinin önlenebilir bir hastalık olduğunu göstermektedir. Son yıllarda gerçekleştirilen çalışmalar prostat kanserinin önlenmesinde beslenme biçimlerinin rolüne işaret etmektedir. Prostat kanseri ve beslenme biçimleri ile ilgili epidemiyolojik, klinik, olgu-kontrol, ileriye dönük pek çok çalışma vardır. Bu çalışmalarda doymuş yağların, trans yağ asitlerinin, omega-6 yağ asitlerinin, et ve yağlı süt ve süt ürünlerinin ve kalsiyumun prostat kanseri riskini arttırdığı, omega-9 yağ asitleri, omega-3 yağ asitleri, meyve ve sebzeler, likopen, selenyum, E ve D vitaminleri, soya, nar suyu ve yeşil çayın prostat kanseri riskini azalttığı gösterilmiştir. Prostat kanseri riskini azaltmak için et, trans yağ asitleri (margarin, yağda kızartılmış gıdalar), yağlı süt ürünleri (yağlı süt, peynir, yoğurt) tüketimi azaltılmalı ve aşırı kalsiyum alımından kaçınılmalıdır. Prostat kanserini önlemek için sebzeler (brokoli, karnabahar, kabak, karalahana, bürüksel lahanası ve kırmızı turp), likopen içeren besinler (domates ve ürünleri), yeterli selenyum (deniz ürünleri, tahıllar), E vitamini (bitkisel yağ, buğday tohumu, kabuklu kuruyemişler, soya fasulyesi, tatlı patates ve avakado), yeşil çay, soya (soya fasulyesi, tofu, soya peyniri, soya sütü) ve nar suyu tüketilmelidir. Bu çalışmada, beslenmenin prostat kanseri ile ilişkisi ve prostat kanseri riskini artıran/azaltan besinler özetlenmiş ve bu ilişkiler ile ilgili öneriler verilmiştir.

Anahtar Kelimeler: Prostat kanseri; beslenme

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Prostate cancer is the most common male cancer and the second or third leading cause of death from cancer among men.[1] In Turkey prostate cancer is the fifth most frequent cancer in men; about 6.1%

of cancer cases in the Turkish male population have prostate cancer.[2] The descriptive epidemiology and a number of studies suggest that prostate cancer is a preventable disease. Prevention does not only save lives, but also reduces the morbidity. The current literature supports the role of dietary factors in the prevention of prostate cancer. Scientific evidence suggests that variations in diet may influence the variability of prostate cancer rates in different countries and regions. Diet contributes to the development of prostate cancer, and dietary factors have been implicated in the declines in the declining incidence of this cancer.[3]

This review summarizes the established or probable associations of diet and increased/decreased dietary risk factors for prostate cancer, and gives recommendations based on these associations (Table 1).

DIETARY PATTERNS

Fat intake: A high fat diet stimulates increased testosterone levels, which is known to be related to prostate cancer growth.[4] The strong scientific evidence from epidemiological, ecologic, case-control, and cohort studies suggested that there was an as-

TABLE 1: Increased and decreased dietary risk factors for prostate cancer and recommendations.*

Dietary factors	Increase risk	Decrease risk	Recommendations
Fat			
Saturated fats	x		Reduce or eliminate consumption of meats and whole milk dairy products
Trans fatty acids	x		Avoid margarine, fried foods
Omega-9 fatty acids		x	Increase consumption of extra- virgin oil, canola oil, nuts
Omega-6 fatty acids	x		Avoid meat, butter, egg yolks, whole milk
Omega-3 fatty acids		x	Consume cold-water fish (salmon, sardines), flaxseeds, walnuts, pumpkin seeds, soybeans, and canola oil.
Specific foods			
Red meat	x		Moderate consumption of preserved meat and red meat
Dairy products	x		Limited to low- or non-fat milk rather than whole milk, cheese, yogurt, or other dairy items.
Fruit and vegetables		x	Consume vegetables, particularly cruciferous vegetables, such as broccoli, cauliflower, cabbage, kale, Brussels sprouts, collard greens, radish, and watercress
Antioxidants			
Lycopene		x	Consume tomato and products, such as tomato juice, spaghetti sauce, and ketchup as well as guava, grapefruit, papaya, and watermelon. Prefer cooked tomato products or juices
Selenium		x	Consume adequate selenium with food including seafood, enriched brewer's yeast, and grains Consume combination of selenium and vitamin E
Vitamin E		x	Due to the high fat content of many dietary sources, a supplement may be beneficial.
Green tea		x	Consume green tea daily
Soy		x	Consume one or more servings of soy daily
Pomegranate juice		x	Consume pomegranate juice
Calcium	x		Consume adequate amounts of vitamin D and
Vitamin D		x	calcium, but avoid high calcium intakes

NSA: No statistical association;

*According to the evaluation of the current epidemiological evidence done by the author.

sociation between dietary fat and prostate cancer. A comprehensive review indicated that 20 of 30 studies found positive associations between dietary fat intake and prostate cancer risk, but not all associations were statistically significant.[5]

Previous studies showed a positive correlation between saturated fat consumption from meat and dairy products (animal sources) and prostate cancer.[6,7] Intake of red meat and dairy products also appear to be associated with an increased risk of metastatic prostate cancer.[8,9] A prospective study examined the role of higher trans-fatty acid intake on prostate cancer risk, but the results remain inconsistent.[10] A case-control study suggested that each type of trans-fatty acid and total trans-fatty acid intake showed a statistically significant positive association with prostate cancer.[11]

The majority of recent studies indicate a slightly protective effect of omega-9 fatty acids for prostate cancer.[12,13] Newcomer et.al reported that a high intake of omega-6 fatty acids (linoleic acid, which can be converted to arachidonic acid) might stimulate the growth of prostate cancer cells.[14] Evidence indicates that a diet rich in omega-6 polyunsaturated fatty acids increases prostate cancer risk, whereas a diet rich in omega-3 decreases the risk.[15]

Consumption of meat, whole dairy products and hydrogenated fats is recommended to be reduced to prevent prostate cancer. Dietary sources should be rich in omega-9 fatty acids (nuts, extra-virgin olive oil, canola oil, macadamia nut oil, and balance between omega-6 fatty acids and omega-3 fatty acids).

SPECIFIC FOODS

Meat intake: The association between prostate cancer and high consumption of red meat is unclear. Initially, the finding was thought to reflect a high exposure to dietary fat, especially saturated fat, since meat and dairy products are the major contributors to fat intake in the western diet. However, because the findings on dietary fat and prostate cancer, as reviewed above, are inconsistent, other explanations for the association need to be considered. The association between meat intake and prostate cancer risk observed in epidemiological studies has lead to many further investigations.[16] The data on meat and prostate cancer are more consistent than those on fat. In a review summarizing results of case-control and cohort studies, sixteen of the 22 studies showed a positive correlation between meat intake and prostate cancer.[17] Healthy diets to avoid prostate cancer are recommended to limit the intake of red meat.

Dairy products: Calcium is a component of milk and milk products, which may be associated with prostate cancer risk.[16] Epidemiological studies suggest that higher intakes of calcium and dairy products, a major source of dietary calcium, increases the risk of prostate cancer. Although saturated fat is an obvious factor to consider in this regard, available evidence suggests that other factors may also be important.[18] A recent meta-analysis of prospective studies reported that high calcium intake was associated with a 39% increase in the overall risk of prostate cancer and a 46% increase in risk for advanced prostate cancer, and that high dairy product intake was associated with an 11% increase in prostate cancer risk.[19]

Studies that investigated individual types of dairy products suggested that a positive association might be limited to low- or non-fat milk rather than whole milk, cheese, yogurt, or other dairy items, but the explanation for this is unclear.[20-22] Recommendation is that daily calcium intake should come from low- or non-fat milk or equivalent milk products for adults.

Fruit and vegetable intake: Epidemiologic evidence indicates an association between high fruit and vegetable intake and a reduced risk for many cancers.[23] The results of epidemiological studies looking for a correlation between fruit and vegetable intake and prostate cancer incidence and mortality are controversial depending on the investigated population, the methods for estimating dietary intake, and the statistical evaluation of accumulated data.[16] A large case-control study indicated a significant inverse correlation between selected types of dietary fiber and prostate cancer risk. The association was stronger for cellulose, soluble and vegetable fibres.[24]

Recommendations for prostate cancer prevention are to consume vegetables, particularly cruciferous vegetables, such as broccoli, cauliflower, cabbage, kale, Brussels sprouts, collard greens, radish, and watercress.

ANTIOXIDANTS

Lycopene: The antioxidant properties of lycopene have stimulated an interest to investigate this carotenoid or its major source, tomatoes, in relation to cancers of the prostate gland, as well as other cancer sites The dietary studies, and the biomarker (lycopene) epidemiologic data suggest that intake of tomatoes and tomato products lower the risk of prostate cancer, especially the more aggressive forms.[25,26]

Recommendation to decrease the risk of prostate cancer is to consume dietary sources such as tomato and products, tomato juice, spaghetti sauce, and ketchup as well as guava, grapefruit, papaya, and watermelon.

Selenium: Selenium has consistently been reported to reduce the risk of prostate cancer. Selenium supplements have been shown to decrease the recurrence of prostate cancer by 63%.[27] Low plasma selenium is associated with a 4- to 5-fold increased risk of prostate cancer.[28] A recent nested case-control study found that the risk of advanced prostate cancer was reduced by one half to two thirds for men with the highest selenium status.[29] Vitamin E and selenium are the two most popular dietary supplements used to prevent prostate cancer. Some studies indicate that the combination of selenium and vitamin E may work synergistically in reducing the risk for prostate cancer.[30,31]

For the prevention of prostate cancer adequate amount of selenium should be consumed as well as foods including seafood, enriched brewer's yeast, and grains.

Vitamin E: Studies show that, vitamin E may reduce the risk of prostate cancer and inhibit prostate cancer cell growth.[32-34] Cancer incidence was reduced by 33% and death from prostate cancer was reduced by 41% in a 6-year follow-up study where men consumed 50-100 IU vitamin E daily.[35] Results suggest that long-term vitamin E (alpha-tocopherol) supplementation decreases serum androgen concentrations, which is related to a reduced incidence of and mortality from prostate cancer.[36] Some studies indicate that the combination of selenium and vitamin E may work synergistically in reducing the risk for prostate cancer.[30,31]

For the prevention of prostate cancer dietary sources of vitamin E including vegetable oils, wheat germ, nuts, seeds, soybeans, sweet potatoes, and avocado should be consumed.

Green Tea: Green tea contains phytonutrients known as polyphenols (flavonoids) that provide antioxidant and anticancer properties.[37] A case-control study has shown that men who regularly consume green tea have a lower incidence of prostate cancer.[38] Daily intake of a cup of green tea would likely be a healthy addition to the diet, but evidence suggests that three or more cups are needed for the cancer protective effects.[39]

Soy: Recent research has investigated the role of soy and the beneficial effects of the phytoestrogens (specifically the isoflavonoids) it contains on prostate cancer.[40] Soy has been suggested as one of the dietary components with a major role in the lower rate of prostate cancer in Asian countries. A recent meta-analysis found that the consumption of soy foods was associated with a lower risk of prostate cancer.[41] Previous studies investigated the results of epidemiological research suggesting a lower incidence of prostate cancer in populations with diets rich in soy products.[42]

Soy supplements or extracts are not recommended. Dietary sources include soybeans, tofu, soy cheese, soy nuts, soymilk, textured vegetable protein (TVP), and others.

Pomegranate juice: Pomegranate juice is a strong antioxidant that has recently been receiving increased research interest. It is a rich source of polyphenolic flavonoids, which are believed to be the reason for its potent antioxidant and anti-atherosclerotic properties.[41] Some studies suggest that pomegranate juice may have cancer-chemopreventive as well as cancer-chemotherapeutic effects against prostate cancer in humans.[43] Pomegranate juice

has been marketed as a product including a high level of antioxidants and laboratory research has been focusing on its potential impact on prostate cancer. Interestingly, studies have shown commercial juice to be high in punicalagins because industrial processing extracts some of the tannins present in the fruit rind.[44] Thus, any benefit from pomegranate is likely to come from consuming the juice and not the fruit and specifically juice that includes some processing of the fruit rind.

Calcium and Vitamin D: Calcium from dietary or supplemental sources has been linked to a higher risk of prostate cancer in several epidemiological studies.[19]

High intake of calcium reduces vitamin D production. Vitamin D is not technically a vitamin, but truly a steroid hormone. It is produced under the influence of the sun with further modification in the liver and kidney to active metabolic forms.[3] Preclinical studies show an antiproliferative, antimetastatic and differentiating effect of vitamin 1,25-dihydroxyvitamin D in prostate cancer. Epidemiological observations sparked the initial interest on the effect of vitamin 1.25-dihydroxyvitamin D and calcium on prostate cancer risk. First, men living in northern latitudes with less exposure to sunlight (which converts inactive to active vitamin D in the skin) have a higher mortality rate from prostate cancer. Second, prostate cancer occurs more frequently in older men in whom vitamin D deficiency is more common. Third, African-Americans, whose skin melanin blocks UV radiation thereby inhibiting the activation of vitamin D, have the highest worldwide incidence and mortality rates from prostate cancer. Clearly, however, many covariates influence this observations.[45] Recommendation for prostate cancer prevention is to consume adequate amounts of vitamin D and calcium, but to avoid high calcium intakes.

The interaction of geographical patterns and genetic polymorphisms with dietary patterns: implication for the dietary prevention of prostate cancer

Prostate cancer is diagnosed most commonly in the Northwestern Europe (Scandinavian countries) and North America, but rarely in East Asia (China, Korea, Japan).[46] Results of epidemiological studies, though not consistent, are generally suggestive of a greater risk of prostate cancer with higher meat intake and a diet high in dairy products.[16] Several studies have shown that in highly developed Western countries consuming diets rich in red and processed meat, saturated fat, and poor in fruits and vegetables, diet is a major factor that fosters the occurrence of prostate cancer.[47] Data from epidemiological studies suggest that the incidence of prostate cancer in the U.S. male population is similar to that in Western Europe but differs markedly from that found in men living in Asian countries.[48] Asian diets are characterized by lower fatty acid content and higher consumption of soy and soy-derived protein, fish and green tea.[47] Soy products are an important source of protein in East Asian countries with low rates of prostate cancer. A meta analysis of eight epidemiological studies from North America, China and Japan produced a summary risk estimate of 0.70 indicating a significant protective effect.[16] Tea is a very popular beverage, particularly in East Asia, where the incidence of prostate cancer is the lowest in the world.[16] Comparison of Japanese men consuming a traditional Japanese diet with Finnish men on a Western diet suggested that the dietary habits might play a role in the higher rate of prostate cancer in Finland compared with that in Japan.[48] Epidemiologic evidence increasingly demonstrates that nutritional factors, especially soy protein, vitamin E derivatives, selenium, vegetables and fruits may have a protective effect against prostate cancer.[48] Mediterranean diet is characterized by higher consumption of fruits and vegetables, whole grains, bread, nuts and it has positive effects on protection from prostate cancer.

Recent studies of genetic variability indicate that polymorphisms of manganese superoxide dismutase, the primary antioxidant enzyme in mitochondria, may have a role in susceptibility to prostate cancer. Among Finnish smokers, men homozygous for the alanine (A) allele (AA) had a 70% increase in total prostate cancer risk and 3-fold risk of high grade neoplasia, compared with those possessing the valine (V) allele (VVor VA). Interes-

tingly, AA frequency is more common in white Western population (50%) than in the Japanese population (12%), which may partly explain the difference in prostate cancer occurrence. However, possession of the AA genotype does not doom the men to prostate cancer; because the same genotype is particularly responsive to an antioxidant-rich diet.[16] Epidemiological studies may indicate certain associations with the consumption of particular foods and are especially helpful when the investigated populations are greatly divergent in their dietary habits and in the prevalence of particular chronic diseases. The low incidence of prostate cancer in Southeast Asia and Japan, increasing prevalence among the immigrants from those regions to Europe and North America, together with the recent rise in the incidence and mortality associated with a rapid transition from traditional diets to Western fast food in many Asian urban centers, provide the strongest argument for the importance of nutritional factors in the development of prostate cancer.[16] Multiple studies on the impact of lifestyle factors on the development of prostate cancer yielded controversial results. Further studies are needed on polymorphisms and mechanisms of action as related to dietary and other lifestyle interventions and prostate cancer carcinogenesis. Further identification of genes affected by dietary changes will enable more accurate lifestyle interventions on an individual basis. [49]

The results discussed in this review suggest that the lower incidence of prostate cancer in Asian and Mediterranean countries compared to that in Western countries is associated with the preventive effect of dietary patterns.

CONCLUSION

There are a many epidemiological, clinical, case-control, prospective studies on dietary patterns and prostate cancer. Comparison of these studies is hampered by differences in sample size, duration of follow-up, and extent of dietary evaluation. However, despite the plethora of confounding factors present in clinical studies assessing the effect of diet on cancer risk, the total sum of data remains compelling with regard to the potential for a variety of nutrients to prevent the development and progression of prostate cancer. Certainly, larger trials are needed to clarify the possible association between dietary fat and prostate cancer risk.

In this paper, associations between prostate cancer and dietary factors were reviewed. In conclusion, dietary patterns seem to play a significant role in the prevention and/or progression of prostate cancer and may help to explain the geographic variation of the incidence. Westernization of diet has led to health problems; thus, promotion of Mediterranean or Asian dietary practices worldwide is needed. Actually, the considerable effects of diet on cancer risk are of great public health importance.

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