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Nutritional Factors: Protein and Fat Intake Influence Prostate Cancer Risk

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ABSTRACT

Prostate cancer (PCa) is one of the most diagnosed cancers in the world. Diet is one of the modifiable factors that may affect PCa risk and progression. The article summarizes the known correlations between dietary fat and protein intake and prostate cancer (PCa) development. Additionally, it describes the impact of nutritional modifications on prostate cancer (PCa) prevalence and potential clinical outcomes. Individualized nutritional strategies may contribute to more effective oncological prevention. Nevertheless, further studies are required to validate our findings.

Keywords: prostate cancer, diet influence, cancer prevention

1. INTRODUCTION

PCa remains the second most common cancer among men, with expectations to increase in the future (Bergengren et al., 2023). Numerous factors (e.g., genetic, environmental, and lifestyle) influence the occurrence and progression of PCa. Diet, described as a modifiable factor, may affect the oncological outcomes of PCa. Many researchers continue to investigate the relationship between various dietary factors and their impact on prostate cancer (PCa) risk and development. Dietary fats are crucial for proper nutrition, energy production, and steroid synthesis (e.g., hormones). However, their impact on PCa remains questionable.

According to some studies, high dietary fat intake correlates with an increased risk of PCa (Ohwaki et al., 2012; Aronson et al., 2010; Liss et al., 2019), but other findings question this association (Bidoli et al., 2005; Park et al., 2007; Wallström et al., 2007; Crowe et al., 2008). Protein intake has attracted significant attention in PCa research. Animal protein sources have been examined for their probable role in the initiation and progression of PCa. Growth factors present in cow milk and other dietary components (eggs, poultry, and choline) raised concerns about the role of dairy products in developing cancer. Some research suggests a potential link between egg and poultry intake and progression of PCa, while choline, a nutrient

found in eggs, has been associated with PCa initiation. Red and processed meat consumption has been extensively studied for its risk of PCa development. Recent findings suggest their role in increasing the risk of prostate cancer (PCa) occurrence. However, opposite results make it difficult to make definitive conclusions.

This review summarizes and compares the current findings on the impact of dietary fats and proteins on PCa development. Moreover, it facilitates a clearer understanding of the relationship between diet and PCa, highlighting areas for future research in PCa prevention.

2. METHOD

A literature search was conducted using PubMed and Web of Science databases on January 2025, to identify all studies evaluating dietary fat and protein influence on PCa risk and development. The following search terms were used: “prostate cancer” AND “diet” AND “fat” AND “protein”. The article screening process adhered to the PRISMA guidelines (Figure 1).

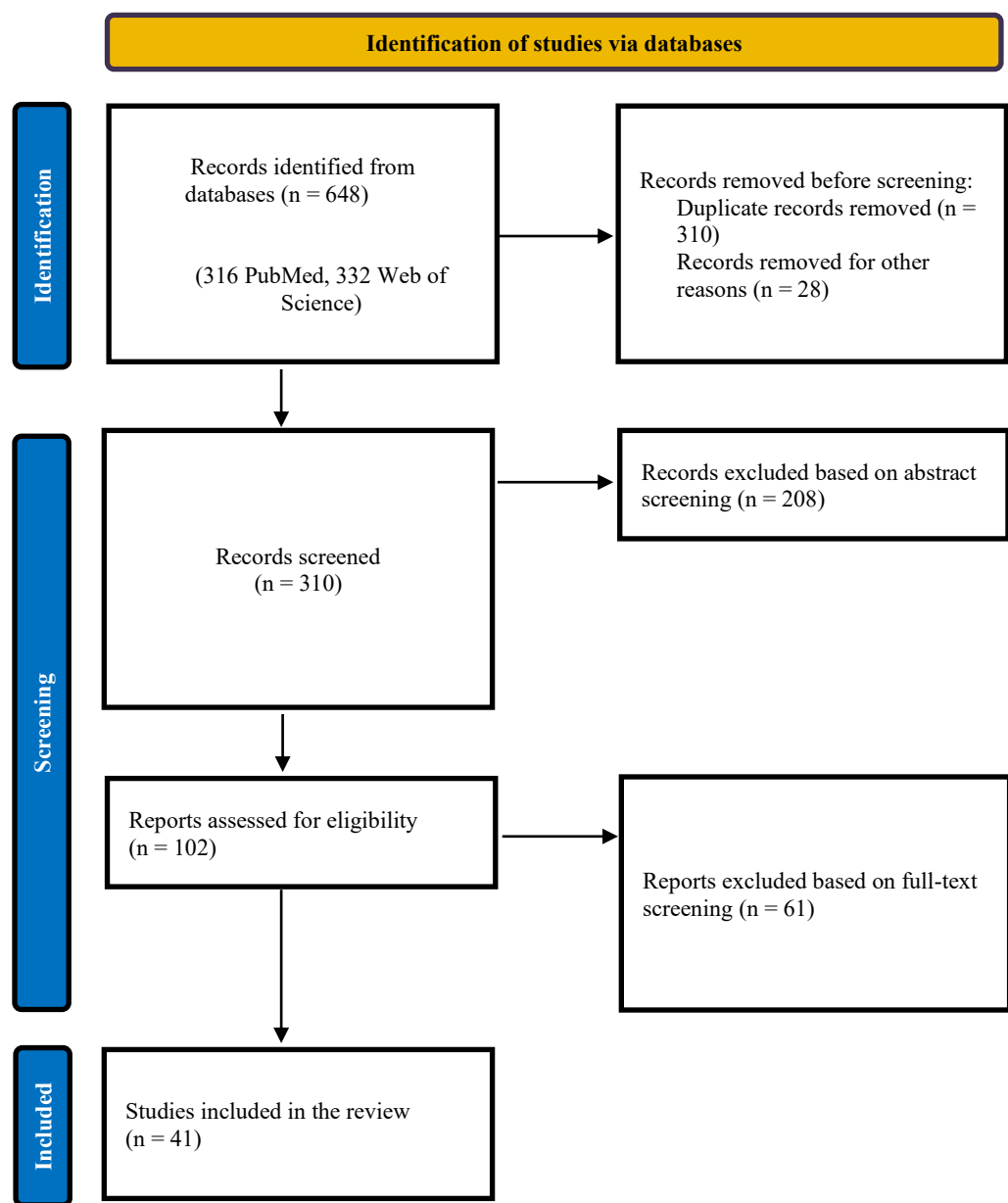


Figure 1. PRISMA flow diagram

3. RESULTS AND DISCUSSION

PCa is one of the most common cancers in the world. The effect of dietary fat on PCa is not entirely clear, and studies on its association with the risk of developing PCa have shown inconsistent results. A summary of the impact of dietary factors on prostate cancer (PCa) risk is presented in Table 1.

Fat

The correlation between total consumption of dietary fats and PCa is unclear (Oczkowski et al., 2021). Numerous studies showed that an increased intake of dietary fats is linked to a higher risk of PCa (Ohwaki et al., 2012; Aronson et al., 2010; Liss et al., 2019). However, other studies observed no such connection (Bidoli et al., 2005; Park et al., 2007; Wallström et al., 2007; Crowe et al., 2008). The survey by Liss et al., (2019) (n = 229 diagnosed with PCa) revealed that intake of saturated fatty acids and trans fatty acids correlates with a higher risk of PCa development (HR=1.19; 95% CI 1.07-1.32 and HR=1.21; 95% CI 1.08-1.35, respectively). Gathirua-Mwangi et al., (2014) also reported that total fat and saturated fat intake correlate with a higher risk of advanced PCa.

Protein

Mao et al., (2018) found that animal protein did not impact PCa risk. The study analyzed twelve studies (eight cohort, three case-control, and one randomized clinical trial). The relative risk (RR) of the highest versus the lowest protein intake in relation to PCa incidence was 0.993 (95% CI, 0.930–1.061). There was no significant correlation between the risk of PCa and animal protein consumption (RR=1.001; 95% CI 0.917–1.092) or vegetable protein (RR=0.986; 95% CI 0.904–1.076) (Mao et al., 2018). Moreover, Al-Zahrani et al., (2022) found no association between animal or plant protein intake and increased risk of PCa. The researchers also observed a correlation between dairy protein intake and PCa ($p = 0.04$).

Dairy

Dairy consumption was identified as a potential prostate cancer (PCa) risk factor. Ludwig and Willett (2013) presented concerns about dairy consumption and the potential risk of stimulating tumor growth. Other studies have supported these claims, demonstrating that cow milk can promote the growth of human PCa cells. However, alternative dairy substitutes like almond milk have shown suppressive effects on cancer cell development (Tate et al., 2011). Increased PCa incidence among Japanese men post-World War II, associated with rising dairy consumption, has encouraged researchers to investigate the connection between dairy consumption and PCa (Ganmaa et al., 2003).

Aune et al., (2015) further supported these findings, revealing that high intakes of dairy products correlate with an increased PCa risk [RR=1.03 (95% CI 1.02-1.12)]. In the study of Gao et al., (2005) the researchers observed that men with the highest amount of dairy products in their diet had a higher risk of developing PCa (RR=1.11; 95% CI 1.00-1.22) compared to those with the lowest intake (RR=1.39; 95% CI 1.09-1.77). Alzahrani et al., (2022) noticed that an increased risk of PCa was associated with high consumption of dairy protein daily (≥ 30 g/d) (RR=1.08; 95% CI 1.0-1.16). However, Huncharek et al., (2008) described no association between dairy intake and risk of PCa (RR=1.06; 95% CI 0.92-1.22 and RR=1.06; 95% CI 0.91-1.23, respectively). Tat et al., (2018) observed that among individuals who consumed more than four servings per week of whole milk compared to those consuming 0–3 servings per month, there was a 73% higher risk of PCa recurrence after a median follow-up of 8 (4.0-10.0) years (HR 1.73; 95% CI 1.00-2.98). Moreover, they reported that low-fat milk consumption did not correlate with PCa recurrence. Downer et al., (2017) studied the Swedish population and claimed that the consumption of high-fat milk was not related to PCa-related mortality (HR=1.28; 95% CI 0.78- 2.10). Additionally, among patients with localized PCa diagnosis, those who consumed at least three servings per day of high-fat milk had a higher risk of PCa-related mortality compared with those who consumed <1 serving per day (HR=6.10; 95% CI 2.14-17.37). On the other hand, low-fat milk consumption showed a marginally significant decrease in PCa-related death in patients with localized PCa. However, these associations were unclear in patients diagnosed with advanced-stage PCa.

The study by Torfadottir et al., (2012) indicates that frequent milk consumption during adolescence correlated with an increased risk of developing advanced PCa (HR=1.29; 95% CI 0.97-1.73). They also compared daily vs. less than daily milk consumption, which was linked to a 3.2 times higher risk of advanced PCa (95% CI 1.25-8.28). Petterson et al., (2012) observed that men with the highest whole milk intake had an increased risk of PCa progression compared to those with the lowest consumption (HR=2.15; 95% CI 1.28–3.60). Moreover, after PCa diagnosis, dairy and milk consumption did not correlate with a higher risk of PCa-related mortality. The study by Song et al., (2013) observed that the intake of dairy products was connected to an increased prevalence of PCa (HR=1.12; 95%

CI 0.93–1.35). The consumption of low-fat milk positively correlated with the risk of low-grade PCa. However, full-fat milk intake was connected with fatal PCa (HR=1.49; 95% CI 0.97–2.28).

Eggs, poultry, and choline

Choline, a compound found in eggs in high concentrations, was described as potentially significant in PCa development. Elevated choline levels in the blood correlated with an increased risk of PCa initiation (Johansson et al., 2009). The connection between egg and poultry consumption and PCa progression was studied by Richman et al., (2010) Higher consumption of eggs correlated positively with a 2-fold increased risk of PCa recurrence and progression (HR=2.02; 95% CI 1.10-3.72). Moreover, a higher intake of poultry was also related to a less favorable oncological prognosis (HR=2.26; 95% CI 1.36-3.76). Another study involved men diagnosed with early-stage PCa. It examined the impact of egg consumption on PCa progression and the implications of choline intake on PCa mortality. Patients with the highest intake of choline had a 70% increased risk of fatal PCa (HR=1.70; 95% CI 1.18-2.45) (Richman et al., 2012).

Wu et al., (2016) showed that a greater intake of eggs and poultry was significantly associated with a higher risk of advanced and fatal PCa [≥25 vs. <g/day of eggs consumption, and advanced and fatal PCa (RR=1.14; 95%CI1.01-1.28 and RR=1.14; 95%CI 1.00-1.30, respectively), and ≥45 vs. <5 g/day of poultry, and advanced and fatal PCa (RR=0.83; 95% CI 0.70-0.99 and RR=0.69; 95% CI 0.59-0.82, respectively)]. Another study by Richman et al., (2011) showed that patients who consumed two and a half or more eggs per week, roughly an egg every three days, faced an 81 % increased risk of PCa-related death (HR=1.81; 95% CI 1.13-2.89). They also suggested that poultry consumption may correlate with an increased risk of progression of non-metastatic PCa (≥3.5 vs. <1.5 servings per week – HR=1.69; 95% CI 0.96-2.99).

Meat

Alexander et al., (2010) found no significant association between red meat consumption and PCa risk. There was no difference in PCa risk between high and low red meat consumption (summary relative risk estimate (SRRE) = 1.00; 95% CI 0.96–1.05). Additionally, no correlation was observed between red meat intake and advanced prostate cancer (PCa) (SRRE=1.01; 95% CI 0.94–1.09). Punnen et al., (2011) identified a potential link between high consumption of well- or very well-cooked meat and more advanced PCa (OR=2.30; 95% CI 1.39–3.81). The comparison of no consumption vs. both high and low consumption of well-/very well-cooked meat revealed ORs of 1.51 (95% CI 1.06–2.14) and 2.04 (95% CI 1.41–2.96), respectively. Several studies further support an association between increased grilled meat consumption and higher PCa risk (Tang et al., 2007; Cross et al., 2005; Cruz-Lebrón et al., 2025).

The analysis by Di Maso et al., (2013) also suggests that PCa risk is higher for men consuming roasted or grilled meat (OR=1.31; 95% CI 1.12–1.54). Bylsma and Alexander (2015) revealed a weak association between red meat consumption and PCa [SRRE=1.02 (95% CI 0.92–1.12) for total red meat consumption, 1.06 (95% CI 0.97–1.16) for fresh red meat, and 1.05 (95% CI 1.01–1.10) for processed meat, respectively]. Nouri-Majd et al., (2022) indicated that higher consumption of processed meat may correlate with an increased risk of PCa and advanced PCa (RR=1.06; 95% CI 1.01–1.10 and RR=1.17; 95% CI 1.09–1.26, respectively). They emphasize the need for cautious recommendations for meat consumption to outline the significance of potential risks associated with processed meat consumption.

Table 1. Summary of the impact of dietary nutrients on PCa risk.

Study	Dietary nutrient	Key results
Ganmaa et al., 2003	Dairy	High dairy intake increases the risk of PCa
Bidoli et al., 2005	Fat	No association between fat intake and PCa risk
Gao et al., 2005	Dairy	High dairy intake increases the risk of PCa
Cross et al., 2005	Meat	High meat intake increases the risk of PCa
Park et al., 2007	Fat	No association between fat intake and PCa risk
Wallström et al., 2007	Fat	No association between fat intake and PCa risk
Tang et al., 2007	Meat	High meat intake increases the risk of PCa
Crowe et al., 2008	Fat	No association between fat intake and PCa risk
Huncharek et al., 2008	Dairy, milk	No association between dairy and milk intake and PCa risk
Johansson et al., 2009	Eggs, poultry	High eggs, and poultry intake increases the risk of PCa

Aronson et al., 2010	Fat	High fat intake increases the risk of PCa
Richman et al., 2010	Eggs, poultry	High eggs and poultry intake increases the risk of PCa
Alexander et al., 2010	Meat	Weak/no association between red meat consumption and PCa risk
Tate et al., 2011	Dairy	High dairy intake increases the risk of PCa
Richman et al., 2011	Eggs, poultry	High eggs, and poultry intake increases the risk of PCa
Punnen et al., 2011	Meat	High meat intake increases the risk of PCa
Ohwaki et al., 2012	Fat	High fat intake increases the risk of PCa
Torfadottir et al., 2012	Milk	High milk intake increases the risk of PCa
Pettersson et al., 2012	Eggs, poultry	High eggs, and poultry intake increases the risk of PCa
Richman et al., 2012	Eggs, poultry	High eggs, and poultry intake increases the risk of PCa
Song et al., 2013	Dairy	No association between dairy intake and PCa risk
Di Maso et al., 2013	Meat	High meat intake increases the risk of PCa
Gathirua-Mwangi et al., 2014	Fat	High fat intake increases the risk of PCa
Aune et al., 2015	Dairy	High dairy intake increases the risk of PCa
Bylsma and Alexander, 2015	Meat	Weak/no association between red meat consumption and PCa risk
Wu et al., 2016	Eggs, poultry	High eggs, and poultry intake increases the risk of PCa
Downer et al., 2017	Milk	High milk intake increases the risk of PCa
Mao et al., 2018	Protein	High protein intake increases the risk of PCa
Tat et al., 2018	Dairy	High dairy intake increases the risk of PCa
Liss et al., 2019	Fat	High fat intake increases the risk of PCa
Alzahrani et al., 2022	Protein	High protein intake increases the risk of PCa

The impact of diet on the progression of PCa

PCa is often characterized by slow disease progression and its association with severe side effects from traditional treatment methods (e.g., chemotherapy, radiotherapy, and surgery). The most common approaches in non-invasive PCa are “watchful waiting” or “active surveillance”. This period presents an opportunity to assess whether dietary and lifestyle changes could play a role in PCa prevention. The study by Ornish et al., (2005) involved a group of 93 men diagnosed with PCa who had opted against conventional treatment due to the relatively slow progression of the disease and serious side effects associated with standard therapy. The study subjects were assigned to two groups: a control group (n=49) that received no specific diet or lifestyle advice beyond their physician’s recommendations, and a study group (n=44) that began treatment with a vegan diet and supplements (e.g., soy, fish oil, selenium, vitamin C and E), along with regular physical activity. The control group exhibited a 6% increase in PSA level, and the intervention group demonstrated a 4% reduction in PSA level after a year of observation. These effects were connected to dietary and lifestyle modifications.

Further analysis of biopsies taken before and after the intervention revealed profound genetic changes, with more than 500 genes showing altered expression patterns (Ornish et al., 2008). In the year following the study, patients in the control group witnessed substantial cancer growth, leading to 10% requiring radical prostatectomy due to cancer progression. None of the participants in the plant-based diet group needed an invasive treatment (Frattaroli et al., 2008). Recognizing the challenges of adopting a whole plant-based diet (Blanchard et al., 2008). Carmody et al., (2012) explored a more flexible dietary approach for PCa patients. Instead of eliminating animal products from their diet, participants attended special nutrition classes to modify their animal-to-plant protein ratio toward a more plant-based diet. Even this non-invasive adjustment was associated with a reduction in tumor progression.

4. CONCLUSIONS

High protein and fat consumption may correlate with PCa development. Several studies suggest that specific dietary choices increase PCa risk, while other researchers do not find any association. Studies emphasize that a general nutritional approach may not universally apply to all patients with PCa. The effects of dietary modifications on various patient groups require further exploration. The personalized nutritional recommendations could contribute to developing advanced oncological care and more effective PCa prevention and treatment.

Author's Contributions

Conceptualization, Karolina Hanusz (K.H.); Methodology, K.H., Marta Borecka (M.B.), Przemysław Kwiatka (P.K.); Software, K.H., Anna Bieda (A.B.), Arkadiusz Zaremba (A.Z.), Karolina Stachyra (K.S.); Validation, K.H., Julia Krasnodębska (J.K.), Mateusz Leśniewski (M.L.), Maciej Wyskok (M.W.), Michał Kluska (M.K.); Formal Analysis, K.H., M.B., P.K., A.B., A.Z., K.S., J.K., M.L., M.W., M.K.; Investigation, K.H., M.B., P.K., A.B., A.Z., K.S., J.K., M.L., M.W., M.K.; Resources, K.H., M.B., P.K., A.B., A.Z., K.S., J.K., M.L., M.W., M.K.; Data Curation, K.H., Marta Borecka (M.B.), Przemysław Kwiatka (P.K.), Anna Bieda (A.B.), Arkadiusz Zaremba (A.Z.), Karolina Stachyra (K.S.), Julia Krasnodębska (J.K.), Mateusz Leśniewski (M.L.), Maciej Wyskok (M.W.), Michał Kluska (M.K.); Writing – Original Draft Preparation, K.H., M.B., P.K., A.B., A.Z., K.S., J.K., M.L., M.W., M.K.; Writing – Review & Editing, K.H., M.B., P.K., A.B., A.Z., K.S., J.K., M.L., M.W., M.K.; Supervision, K.H., M.B., P.K., A.B., A.Z.; Project Administration, K.H., K.S., J.K., M.L., M.W., M.K.

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Informed consent

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Ethical approval

Not applicable.

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Conflict of interest

The authors declare that there is no conflict of interest.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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