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DISCOVERY SCIENTIFIC SOCIETY

Effect of increased body mass index on the risk of prostate cancer: Systematic review

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ABSTRACT

Introduction; Prostate cancer is the most common cancer in men. A variety of factors influence the progression of prostate cancer. Body mass index (BMI) has been associated with an increased risk of developing prostate cancer. This review focuses on summarizing recent research examining the relationship between elevated body mass index and the risk of developing prostate cancer. Methods: A systematic literature search from 2000 up to April 2025 was conducted via PubMed, Scopus, and Google Scholar databases with the following keywords ("body mass index," OR "BMI," OR "obesity," OR "overweight," AND "Prostate cancer," OR "prostate carcinoma"). Results: A total of 908 articles were identified in the databases, but only 8 fulfilled the criteria for inclusion in the final review. Seven studies showed a positive association between increased body mass index and the risk of prostate cancer. In contrast, only one study found a decreased risk of prostate cancer among obese patients. Conclusions: An increased level of BMI was associated with an increased risk of prostate cancer.

Keywords: Body mass index , BMI , obesity , overweight , prostate cancer , prostate carcinoma

1. INTRODUCTION

Prostate cancer is the most common cancer diagnosed in men, and it ranks as the fifth leading cause of cancer-related deaths globally. In 2018, global statistics reported around 1.2 million new cases of the disease and over 300,000 deaths (Bray et al., 2018). As it progresses to a more advanced stage, patients will be able to develop anemia, bone pain, or paralysis due to metastasis. Renal failure can also result from bilateral ureteral obstruction. Serum prostate-specific antigen (PSA) measurement and digital rectal examination (DRE) are key tools for early detection of prostate cancer. Over the past decade, various epidemiological studies have highlighted a significant correlation between obesity and an elevated risk of developing multiple cancer types, including prostate cancer, along with increased

cancer-related mortality (Calle et al., 2003). In the United States, approximately 40% of the population is classified as obese, contributing to what is often referred to as an "obesity pandemic." Although the percentage is still relatively low in some Asian countries like Korea and Japan—at about 10%—rates of obesity have risen steadily over the past decade (Wang et al., 2011).

Various reasons have been implicated in prostate cancer incidence and mortality, including advanced age, race, and a history of the disease in the family. Obesity has also been implicated as a reason. Various studies have proven that patients with higher body mass index (BMI) have higher lipid signaling, insulin resistance, elevated adipokine levels, and chronic inflammation, all of which can trigger the development of cancer (Tzenios et al., 2022). Other recognized factors for death from prostate cancer, including age, family history of cancer, and ethnicity, cannot be altered (Schatten, 2018). Elevated levels of lipids, lipid signaling, inflammation processes, insulin resistance, and adipokines have all been considered candidate pathways potentially responsible for explaining the link between obesity and cancer. Despite such hypotheses, however, it remains unclear how the cross-talk among these pathways leads to obesity-associated cancer (Lima et al., 2000).

The purpose of this review is to present an overview of the more recent evidence for the relationship between increasing body mass index and prostate cancer risk.

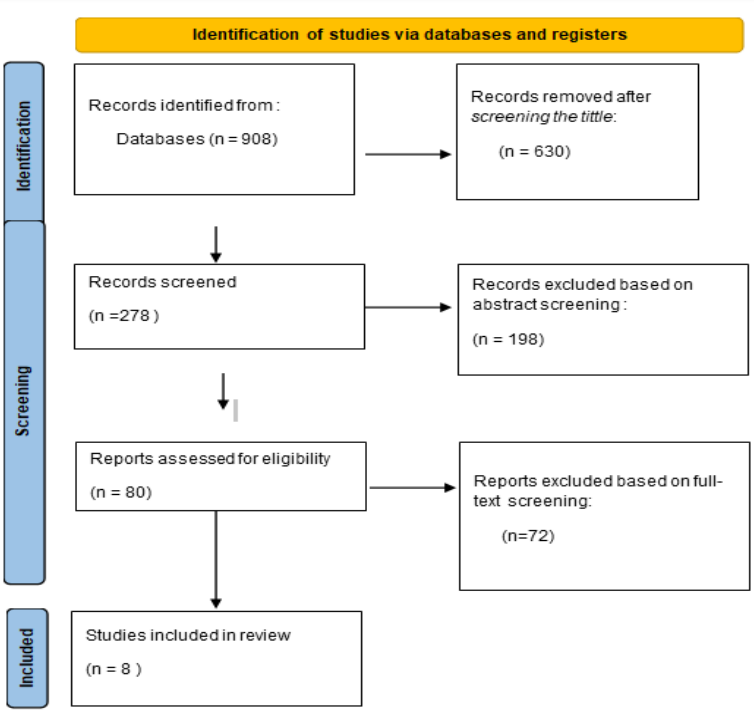

Fig 1. PRISMA flow diagram

2. REVIEW METHODS

Search strategy and study selection

The search of the study was done using PubMed, Scopus, and Google Scholar databases using keywords: body mass index, BMI, obesity, overweight, prostate cancer, and prostate carcinoma. Boolean operators (OR and AND) were used for better search results. The search was confined to articles published in the English language. Two independent researchers performed the article identification process. After an initial assessment of all potentially relevant articles by reviewing titles and abstracts, we excluded articles not related to the research topic and case reports. The selection of articles was conducted in accordance with the PRISMA guidelines (Fig. 1).

Inclusion criteria:

1. Articles specific to the topic
2. Studies in the English language
3. Adult patients >18 years
4. Case-control or cohort study and cross-sectional study

Exclusion criteria:

1. Case reports, conference abstracts
2. Animal studies

Analysis

A narrative approach was employed to analyze the data due to the heterogeneous nature of the research.

3. RESULTS AND DISCUSSION

Our search strategy identified a total of 908 articles from PubMed, Scopus, and Google Scholar databases. Primary title selection excluded 278 articles. After screening the abstracts, we selected eighty articles. Finally, eight articles were included after a full-text analysis. Figure 1 shows the process of identification and selection. These studies involved more than 1.8 million male participants from various countries, such as South Korea, the United States, the United Kingdom, Sweden, and the Netherlands.

Choi et al., (2016) conducted a large-scale, population-based cohort study in South Korea, including 139,519 men aged 40 to 64 years. The study investigated the relationship between body mass index (BMI) and prostate cancer. The results demonstrated a positive association between increasing BMI and prostate cancer risk. The hazard ratio (HR) for prostate cancer was 0.852 (95% CI: 0.734-0.990) for individuals with low or normal weight, 1.05 (95% CI: 0.985-1.119) for those with overweight, and 1.133 (95% CI: 1.067-1.204) for those with obesity.

Engeland et al., (2003) carried out an extensive prospective cohort study involving 951,459 men with a mean age of 44,5 years, followed over 21 years. The study evaluated the association between BMI and prostate cancer incidence using Cox regression models adjusted for age and BMI. The findings indicated a gradual increase in prostate cancer risk with higher BMI categories. The hazard ratio (HR) for prostate cancer was 0.92(95% CI 0.78-1.08) for underweight, 1.07 (95% CI 1.05-1.09) for overweight, and 1.09 (95% CI 1.04-1.15) for obese.

Dickerman et al., (2017) performed a prospective cohort study involving 5.158 men aged 40 to 75 years to evaluate the association between BMI and the risk of prostate cancer. BMI <25 kg/m2 = 1.00 (ref), 25-30 kg/m2 = 0.89 (CI:0.71-1.10) and >30 kg/m2 1.15 (CI:0.81-1.65). Stocks et al., (2010) demonstrated the relationship between BMI and the risk of prostate cancer, the hazard ratio (HR) for low or normal weight 1.06(95% CI:0.98- 1.15), overweight 1.11(95% CI:1.03- 1.19), and obese 1.05 (95% CI:0.97- 1.12)

Bonn et al., (2019) performed an extensive cohort study involving CARET data from 11.886 men. Eight hundred eighty-three cases of prostate cancer were identified. Men with BMI >35 kg/m2 had an increased rate of prostate cancer (HR 1.11, 95% CI:0.84- 1.47) compared to those with a BMI in the range of 18 to 24.9 kg/m2. Cantarutti et al., (2015) showed that males with a BMI of 30 had an increased rate of prostate cancer (HR 1.17, CI 0.96-1.43) than males with a BMI of 24; they were the reference group. Vidal et al., (2020) obtained results for overweight HR 1.16 (95% CI:0.84- 1.62) and obese HR 1.23 (95% CI:0.87- 1.73). Schuurman et al., (2000) found that the Hazard ratio for prostate cancer by BMI was normal weight HR 1.2(95% CI 0.84-1.73), overweight HR 1.35(95% CI 0.95-1.90), and obese HR 0.89 (95% CI 0.58-1.37)

Table 1. Characteristics of published studies on BMI and risk of prostate cancer

Investigators	**Study design**	**Country**	**Participants**	**Findings (BMI & Prostate Cancer Risk)**
(Choi et al., 2016)	Population-based cohort	Korea	139,519 Men	Positive association: HR = 1.05 (overweight), HR = 1.133 (obese) vs. HR = 0.852 (low/normal BMI)
(Engeland et al., 2003)	Cohort study	Norway	961,459 Men	Risk increased with BMI: overweight HR = 1.07 (1.05–1.09), obese HR = 1.09 (1.04–1.15)
(Dickerman et al., 2017)	Prospective cohort	USA	5,158 Men	With BMI ≥30 associated with higher risk: HR = 1.15 (0.81–1.65)

(Stocks et al., 2010)	Prospective cohort	Sweden	336,159 Men	Overweight HR = 1.11 (1.03–1.19); obese HR = 1.05 (0.97–1.12); BMI and WC linked to high-grade prostate cancer
(Bonn et al., 2019)	Cohort study	USA	11,886 Men	With BMI ≥35 associated with increased PC risk: HR = 1.11 (0.84–1.47) compared to normal BMI
(Cantarutti et al., 2015)	Cohort study	Sweden	3,161 Men	With BMI ≥ 30 increased the rate of PC HR = 1.17(0.96-1.43)
(Vidal et al., 2020)	Cohort study	USA	5,929 Men	Slight increase in PC risk in overweight (HR = 1.16), and obese (HR = 1.23) men vs. normal weight
(Schuurman et al., 2000)	Cohort study	Netherlands	58,279 Men	No significant association between BMI, and PC: Normal weight HR=1.2(0.84-1.73), overweight HR=1.35(0.95-1.90), and obese HR=0.89 (0.58-1.37)

Prostate cancer ranks as one of the most prevalent types of cancer affecting men, and is also the fifth leading cause of cancer mortality. Our systematic review combined evidence from eight scientific studies (Table 1). Based on selected studies, we have concluded that an increased level of BMI is associated with an increased risk of prostate cancer. All except one of the eight studies did not report a significant correlation between an increase in BMI level and cancer risk for prostate cancer. We also compare our findings with those of a meta-analysis (Ramadani, 2024) that yields the same results.

Elevated cancer risk among obese individuals could be due to changes in metabolic and hormonal pathways. It has also been proposed that hyperinsulinemia and/or hypoadiponectinemia in the obese contribute to the induction of aggressive neoplastic activity. Additionally, the free insulin-like growth factor (IGF-1) has been found in elevated levels, which could further promote prostate cell growth (Li et al., 2010). The second component involves hormonal and metabolic changes with obesity and, more specifically, levels of free testosterone. This hormone is crucial in maintaining the differentiation of prostate epithelial cells. Obese patients have been found to have low levels of free testosterone, which has been linked to high-grade prostate cancer risk. Such cancers are more virulent, characterized by poorly differentiated and hormone-refractory cancer cells (Dickerman et al., 2017).

The risk of high-grade prostate cancer was also evident in the family history of prostate cancer patients (Jochems et al., 2020). Obesity is a modifiable risk factor for the incidence and mortality of prostate cancer. However, other contributors like tobacco smoking, alcohol, and diet, particularly excessive intake of meat, eggs, fish, and dairy products, must be taken into account. In addition, the presence of comorbidities like diabetes mellitus is connected with an elevated risk of the occurrence of prostate cancer (Ha Chung et al., 2019). Abdominally obese subjects were associated with advanced cancer risk (Pischon et al., 2008). A few of the studies included in our review showed that there (Schwenzer et al., 2010) was a lower risk of occurrence of prostate cancer in obese subjects. This outcome contributes to significant heterogeneity in the overall analysis. A lower incidence of prostate cancer in obese patients is potentially explainable by detection bias.

Several hypotheses have been put forward for this phenomenon: dilution of prostate-specific antigen (PSA) secondary to increased blood volume in obese men, reduced sensitivity of digital rectal examinations (DRE), and increased prostate size in obesity, which may decrease the probability of cancer detection on biopsy. The Body Mass Index (BMI) is a generalized metric that fails to differentiate between fat-free mass and fat mass, thereby limiting its accuracy in assessing individual health status. Consequently, individuals, particularly men, with elevated muscle mass and minimal fat levels may be inaccurately classified as overweight or obese. Moreover, BMI does not consider the distribution of body fat, rendering it inadequate for distinguishing metabolically active abdominal fat, which has greater health implications, from other forms of fat accumulation (Schwenzer et al., 2010).

4. CONCLUSION

Our study showed a significant increase in the incidence of prostate cancer in patients with higher BMI, including overweight and obese patients. Although elevated BMI appears to be an essential risk factor for prostate cancer, there are still many unknowns, and thus further research on this topic is mandatory.

Author's Contributions

Conceptualization, M.W. and M.K.; Methodology, A.B. and M.B.; Software, M.K. and M.W.; Validation: M.L. and M.W.; Formal analysis: A.B. and K.S.; Investigation: J.B.K. and K.H.; Resources: K.S., A.Z. and F.K.; Data curation: P.K. and M.L.; Writing- Original-draft preparation: P.K. and M.L; Writing-review and editing: M.K. and A.Z.; Supervision: J.B.K. and K.H.; Project administration: M.W., M.K., J.B.K., A.B., A.Z., M.L., K.S., M.B., P.K., K.H., F.K.

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Informed consent

Not applicable.

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 associated with this work are present in the paper.

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