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RESEARCH ARTICLE

Higher Body Mass Index Correlates with Increased Tumor Aggressiveness in Prostate Adenocarcinoma: Evidence From a Hospital-Based Cross-Sectional Study

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Abstract: Prostate cancer remains a major cause of cancer-related mortality in men and represents the most common urological malignancy. Age and obesity have long been recognized as important risk factors that may shape both tumor differentiation and progression. The Gleason scoring system, used to grade prostate adenocarcinoma, captures how differentiated the tumor cells are and helps estimate its level of aggressiveness. This study aimed to evaluate the association between age and BMI with the histopathological grade of prostate adenocarcinoma at Dr. Pirngadi General Hospital Medan. A cross-sectional analytical study was conducted using secondary data from medical records of 70 patients diagnosed with prostate adenocarcinoma. Statistical analysis was performed using Spearman's correlation test. The results showed that 6 patients (8.6%) were aged <60 years, 41 patients (58.6%) had BMI ≥23 kg/m², and 28 patients (40%) presented with Gleason scores of 8–10. There was no statistically significant association between age and histopathological grade ($p = 0.571$). A statistically significant but weak positive correlation was identified between BMI and histopathological grade ($p = 0.003$, $r = 0.347$). These findings indicate that BMI may influence the degree of tumor differentiation and should be considered in the pathological and clinical evaluation of prostate cancer.

Keywords: Age; BMI; Gleason Score; Prostate Cancer

INTRODUCTION

Prostate cancer is a malignant disease of the genitourinary system and a major contributor to male mortality. Data from the Global Cancer Observatory (GLOBOCAN) in 2020 show that it is the fifth leading cause of death among men in Indonesia with an incidence rate of 11.6 cases and a mortality rate of about 4.5 per 100,000 men.[1] In Indonesia, most prostate cancer cases are diagnosed at an advanced stage due to delayed detection.[2] Acinar adenocarcinoma is the most common type of prostate cancer, accounting for approximately 95% of all cases.[3]

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Age, ethnicity, family history of prostate cancer, and obesity are established risk factors that not only increase the likelihood of developing prostate cancer but also contribute to greater disease aggressiveness.[5] Individuals who are overweight or obese with aggressive prostate cancer tend to have a lower survival rate.[6] In Asia, particularly in countries such as China, Japan, and Korea, the prevalence of obesity and prostate cancer has risen sharply over the past few decades. The westernization of daily habits and dietary patterns has been identified as a major factor contributing to the rising prevalence of obesity.[7]

The Gleason score is used to assess prostate biopsy findings. It is derived from the histological analysis of prostate specimens obtained under transrectal ultrasound guidance. This scoring system evaluates the degree of tumor differentiation and is directly associated with tumor aggressiveness, prognosis, and treatment selection in prostate cancer.[4]

Body mass index (BMI) has a substantial impact on the occurrence of high-grade prostate cancer detected at biopsy, as shown in a retrospective study by F. Zhou et al.[8] Evidence from a local study in Lampung, Indonesia, showed that age and BMI were significantly associated with the histopathological grade of prostate cancer.[9] However, a study conducted at Hasan Sadikin General Hospital in Bandung found no significant association between BMI and Gleason score, with a p-value of 0.362.[10]

Due to the inconclusive evidence from prior investigations this study aims to contribute additional data to elucidate the potential association between age, BMI, and the histopathological grade of prostate cancer.

METHOD

This study used a retrospective cross-sectional design based on secondary data obtained from patient medical records. It was conducted at the Urology Department of Dr. Pirngadi General Hospital, Medan, using records collected between January 2018 and December 2022. A total of 70 male patients with histopathologically confirmed prostate adenocarcinoma were included. Inclusion criteria were patients with available Gleason scores in their medical records, while those with incomplete data or other malignancies were excluded.

Patient characteristics collected included age, body mass index (BMI), and histopathological grade. Age was classified into two groups: <60 years and ≥60 years, while BMI was categorized into <23 kg/m² and ≥23 kg/m². Histopathological grades were classified using the Gleason scoring system as low-grade (≤6), intermediate-grade (7), or high-grade (≥8).

Data were analyzed using univariate and bivariate methods, with Spearman's correlation test applied to evaluate associations between variables. Statistical analysis was performed using the SPSS software version 27.

RESULTS

A total of 70 patients were included in the analysis. Most patients were ≥60 years old (91.4%), while only 6 patients (8.6%) were <60 years (Table 1). BMI was dominated by

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the ≥23 kg/m² group (58.6%), whereas 29 patients (41.4%) had BMI <23 kg/m² (Table 2).

Table 1. Sample disribution based on age

Age	N	Percentage
<60y	60	8,6%
≥60y	64	91,4%
Total	**70**	**100%**

Table 2. Sample distribution based on BMI

BMI	N	Percentage
<23kg/m2	29	41,4%
≥23kg/m2	41	58,6%
Total	**70**	**100%**

Table 3. Sample distribution based on the histopathological grade of prostate cancer

Histopathological grade	N	Percentage
Well Differentiated	17	24,3%
Moderately Differentiated	25	35,7%
Poorly Differentiated	28	40%
Total	**70**	**100%**

Histopathological examination showed poorly differentiated prostate adenocarcinoma was the most frequent subtype (40%), followed by moderately differentiated (35.7%) and well differentiated (24.3%) (Table 3).

Tabel 4. Age distribution based on the histopathological grade of prostate cancer

Age	Histopathological grade					
	Well Differentiated		*Moderately Differentiated*		*Poorly Differentiated*	
	N	%	N	%	N	%
<60y	12	17.1%	10	14.3%	7	10%
≥60y	5	7.2%	15	21.4%	21	30%
Total	**17**	**24.3%**	**25**	**35.7%**	**28**	**40%**

Tabel 5. BMI distribution based on the histopathological grade of prostate cancer

BMI	Histopathological grade					
	Well Differentiated		*Moderately Differentiated*		*Poorly Differentiated*	
	N	%	N	%	N	%
<23kg/m²	12	17.1%	10	14.3%	7	10%
≥23kg/m²	5	7.2%	15	21.4%	21	30%
Total	**17**	**24.3%**	**25**	**35.7%**	**28**	**40%**

When stratified by age, poorly differentiated tumors were most often found in patients aged ≥60 years (35.7%) (Table 4). A similar pattern was seen in patients with BMI ≥23 kg/m², where poorly differentiated tumors were also the most common (40%) (Table 5).

Table 6. Spearman's correlation test between age and histopathological grade of prostate cancer

	Age
Histopathological Grade	*r* = -.069 *ρ* = 0.571 n = 70

Table 7. Spearman's correlation test between BMI and the histopathological grade of prostate cancer

	BMI
Histopathological grade	*r* = 0.347 *ρ* = 0.003 n = 70

Spearman's correlation test showed no significant association between age and histopathological grade ($p = 0.571$; $p > 0.05$). In contrast, BMI was significantly correlated with histopathological grade ($p = 0.003$; $p < 0.05$) with a weak, positive correlation ($r = 0.347$), indicating that higher BMI tended to be associated with higher Gleason grades.

DISCUSSION

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This study aimed to evaluate the relationship between age, body mass index (BMI), and the histopathological grade of prostate adenocarcinoma. The results demonstrated a statistically significant positive correlation between BMI and histopathological grade, whereas no significant relationship was observed between age and tumor differentiation.

The majority of participants were aged ≥60 years (91.4%). Consistent with the established epidemiological profile of prostate cancer, which predominantly affects older males, with peak incidence between 65 and 75 years.[1] Testosterone levels progressively decline with increasing age, beginning in the third decade of life and accelerating after the age of 60, accompanied by an increased peripheral conversion of testosterone to estrogen.[2] Testosterone is essential for the growth and differentiation of prostatic epithelium.[3] Aging also induces alterations in gene expression, such as glutathione transferase, which has been associated with inflammatory processes and increased susceptibility to prostate carcinogenesis.[4]

More than half of the subjects exhibited a BMI ≥23 kg/m² (58.6%), reflecting the rising prevalence of overweight and obesity, which parallels the increasing incidence of prostate cancer globally.[5] Excess adiposity is associated with hyperinsulinemia and decreased testosterone concentrations, indicating a hormonal and inflammatory pathway.[6] Chronic elevation of insulin levels has been shown to promote cellular proliferation and inhibit apoptosis in prostate tissue, thereby facilitating carcinogenesis.[7]

In this study, poorly differentiated adenocarcinoma represented the largest proportion (40%), followed by moderately differentiated (35.7%) and well-differentiated tumors (24.3%). In Indonesia, prostate cancer is frequently diagnosed at advanced stages due to delayed clinical presentation and limited access to early detection.[8,9] At Dr. Pirngadi General Hospital Medan, histopathological assessments are referred to external laboratories, which may further contribute to delayed diagnosis.

The Spearman correlation analysis revealed no statistically significant association between age and histopathological grade (p=0.551), indicating that chronological age alone may not determine tumor aggressiveness. Genetic, hormonal, and environmental factors may contribute to tumor differentiation.[11] In this study, three of six patients aged <60 years presented with poorly differentiated tumors, suggesting possible underlying genetic predispositions such as BRCA1 and BRCA2 mutations.[11] A study at Dr. Cipto Mangunkusumo General Hospital demonstrated a weak yet significant correlation between age and Gleason score, with younger patients more likely to present with high-grade disease.[12]

Analysis revealed a significant positive correlation between BMI and histopathological grade (p=0.003, r = 0.347), indicating that increased BMI was associated with more aggressive tumor differentiation. This finding is consistent

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with Feng et al., who reported a significant relationship between BMI and high-grade prostate cancer.[13] Similar results were obtained in a regional study conducted in Lampung ($p = 0.027$),[14] whereas a study from Siloam Hospital Kupang reported no significant association ($p = 0.764$).[15] Obesity-related metabolic dysregulation, including enhanced lipid metabolism and increased secretion of pro-inflammatory cytokines, may contribute to tumor proliferation, angiogenesis, and invasion.[16,17] The metabolic and hormonal interactions suggest a mechanistic link between obesity and prostate cancer aggressiveness.[18] The weak correlation observed ($r = 0.347$) suggests that BMI alone does not fully account for the variation in histopathological grade, as other factors such as genetic predisposition, dietary patterns, and lifestyle behaviors may also influence tumor grade.[19,20]

The association between higher BMI and more advanced histopathological grade underscores the importance of incorporating metabolic evaluation and weight management into prostate cancer prevention and clinical management. Future multicenter prospective studies are warranted to validate these findings and to elucidate the molecular mechanisms underlying obesity-related prostate cancer progression.

CONCLUSION

This study demonstrated that age was not significantly associated with the histopathological grade of prostate adenocarcinoma. In contrast, BMI showed a statistically significant but weak positive correlation with histopathological grade. These findings suggest that metabolic factors may influence tumor differentiation and should be considered in pathological assessment and clinical management of prostate cancer.

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