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The Role of Prostate-specific Antigen Test in Early Detection of Prostate Cancer

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ABSTRACT

Background: *Prostate cancer (PCa) is among the most commonly diagnosed malignancies in men globally, with early detection playing a critical role in improving prognosis and guiding treatment strategies. The prostate-specific antigen (PSA) test is widely used for PCa screening; however, its utility varies across populations. This study aimed to evaluate the role of the PSA test in the early detection of prostate cancer in a Bangladeshi cohort.* ***Methods:*** *This cross- sectional observational study was conducted at Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka, Bangladesh, from July 2022 to June 2023. A total of 57 male patients who underwent PSA testing during the study period were included. Clinical records were reviewed to collect demographic and PSA data. Statistical analyses were performed using SPSS version 26.0 and MS Office tools, focusing on descriptive statistics and the relationship between PSA levels and prostate cancer detection.* ***Results:*** *This study evaluated prostate-specific antigen (PSA) testing for early prostate cancer detection in 57 men aged 50 and above. Biopsy-confirmed malignancy was observed in 80% of participants with elevated PSA levels (>10 ng/mL), 13.3% with borderline levels (4–10 ng/mL), and none with normal levels (<4 ng/mL). A positive family history significantly increased risk, with 71.4% of such cases diagnosed with cancer, highlighting PSA's role in early intervention.* ***Conclusion:*** *The study highlights the PSA test as a valuable tool for early detection of prostate cancer in the Bangladeshi population, emphasizing its role in improving patient outcomes. Further research is warranted to validate these findings and optimize screening protocols in this population.*

Keywords: *Benign prostatic hyperplasia, Early detection, Prostate cancer, Prostate-specific antigen*

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INTRODUCTION

Prostate cancer (PCa) remains a significant public health challenge, being the second most commonly diagnosed cancer and the fifth leading cause of cancer mortality among men worldwide [1]. Early detection of PCa is crucial for improving clinical outcomes and enabling effective treatment strategies. While various diagnostic modalities exist, the prostate-specific antigen (PSA) test is widely used as a non-invasive screening tool. It measures the level of PSA, a glycoprotein produced by both normal and malignant prostate cells, in the blood [2]. Despite its widespread application, the efficacy

of PSA testing in PCa detection has been a subject of ongoing debate. PSA levels can be elevated in conditions other than cancer, such as benign prostatic hyperplasia (BPH) or prostatitis, leading to false-positive results and unnecessary biopsies [3]. Conversely, some men with normal PSA levels may harbor aggressive cancers, contributing to false negatives [4]. Nonetheless, evidence suggests that PSA testing, when combined with other clinical parameters, can enhance early detection and reduce mortality [5,6]. Epidemiological studies indicate considerable variation in PCa incidence and outcomes across different populations. In high-income countries, organized screening programs have led to increased detection rates and improved survival outcomes [7]. However, in low- and middle-income countries, including Bangladesh, limited awareness, inadequate healthcare infrastructure, and the absence of systematic screening programs contribute to delayed diagnoses and poorer prognoses [8,9]. A study conducted in India reported that elevated PSA levels were significantly associated with PCa, underscoring the test's potential role in early detection in resource-limited settings [10]. The utility of PSA testing in the Bangladeshi population remains underexplored. Most available data on PCa in Bangladesh focus on hospital-based case series, with limited emphasis on screening and early detection [11]. Cultural factors, stigma, and lack of awareness often deter men from seeking timely medical care, further complicating the scenario [12]. Addressing these challenges requires robust evidence to guide the implementation of effective screening strategies tailored to the local context. This study aimed to evaluate the role of the PSA test in the early detection of prostate cancer in a Bangladeshi cohort. By assessing the correlation between PSA levels and the presence of PCa, the research seeks to contribute to the growing body of evidence supporting the test's diagnostic utility in low-resource settings. Additionally, the findings are intended to inform healthcare policymakers and practitioners about the feasibility and effectiveness of incorporating PSA testing into routine clinical practice for high-risk populations in Bangladesh.

METHODOLOGY

This cross-sectional observational study was conducted at Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka, Bangladesh, from July 2022 to June 2023. The study focused on evaluating the role of prostate-specific antigen (PSA) in the early detection of prostate cancer among male patients presenting with urinary symptoms. A total of 57 participants aged 50 years and older were purposively enrolled. Participants were recruited based on the following inclusion criteria: (1) males aged ≥50 years, (2) presence of urinary symptoms suggestive of prostate pathology, and (3) willingness to provide informed consent. Exclusion criteria included: (1) previous diagnosis of prostate cancer, (2) history of prostate surgery, and (3) other systemic illnesses likely to interfere with PSA levels, such as active infections or significant renal impairment. Data collection involved detailed clinical history, physical examination, and laboratory investigations. PSA levels were measured using chemiluminescent immunoassay technology, and values were classified: as normal (<4 ng/mL), borderline (4–10 ng/mL), and elevated (>10 ng/mL). Patients underwent digital rectal examination (DRE), and findings were correlated with PSA levels. Patients with elevated PSA or suspicious DRE findings were referred for further diagnostic confirmation through transrectal ultrasound-guided biopsy. Data analysis was conducted using SPSS version 26.0, where descriptive statistics were used to summarize participant characteristics, and inferential statistics assessed associations between PSA levels and biopsy results. Written informed consent was secured from all participants.

RESULT

A total of 57 male participants aged 50 years and above were included in this study to assess the clinical and laboratory spectrum of prostate-specific antigen (PSA) in detecting prostate cancer and differentiating it from benign prostatic hyperplasia (BPH). The mean age of participants was 65.2 ± 8.3 years, with the majority falling within the 61–70 age group (40.4%). Most participants (43.9%) presented with urinary frequency as the primary symptom, followed by

nocturia (38.6%) and weak urinary stream (31.6%). Hematuria was less commonly reported (10.5%). A positive family history of prostate cancer was identified in 12.3% of participants. PSA levels were stratified into three categories: normal (<4 ng/mL), borderline (4–10 ng/mL), and elevated (>10 ng/mL). Among the participants, 56.1% had normal PSA levels, 26.3% had borderline, and 17.5% had elevated levels. Biopsy results revealed that all participants with normal PSA levels (n=32) were free from malignancy, whereas 13.3% of those with borderline PSA levels and 80% of those with elevated PSA levels had biopsy- confirmed prostate cancer. BPH was more common in participants with normal and borderline PSA levels. Imaging findings further supported the clinical evaluation. Pelvic ultrasound showed normal findings in 93% of participants, while 7% showed nodular or hypoechoic lesions suggestive of malignancy, which was later confirmed through biopsy. Advanced malignancy was predominantly observed in cases with significantly elevated PSA levels (>10 ng/mL). The diagnostic findings informed treatment planning. Participants with confirmed prostate cancer underwent appropriate management, including surgery and hormonal therapy, while those with BPH were managed conservatively or surgically based on symptom severity. The findings underscore the critical role of PSA screening in identifying high-risk individuals and enabling early intervention. A positive family history of prostate cancer was a notable risk factor, with malignancy present in 71.4% of such cases.

Table 1: Demographic and Clinical Characteristics

Characteristics	**n**	**%**
Age Group (years)		
50–60	16	28.1
61–70	23	40.4
>70	18	31.5
Presenting Symptoms		
Urinary frequency	25	43.9
Nocturia	22	38.6
Weak stream	18	31.6
Hematuria	6	10.5
Family History of PC	7	12.3

PC: Prostate Cancer

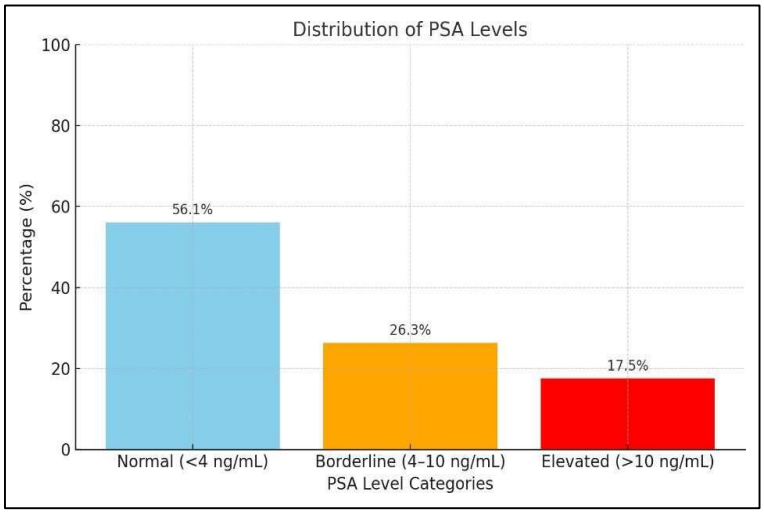

Figure 1: Distribution of PSA Levels

Table 2: Biopsy Results Based on PSA Levels

PSA Level	Prostate Cancer	BPH
(ng/mL)	(n, %)	(n, %)
<4 (Normal)	0(0)	32(100)
4-10 (Borderline)	2(13.3)	13(86.7)
>10 (Elevated)	8(80.0)	2(20.0)

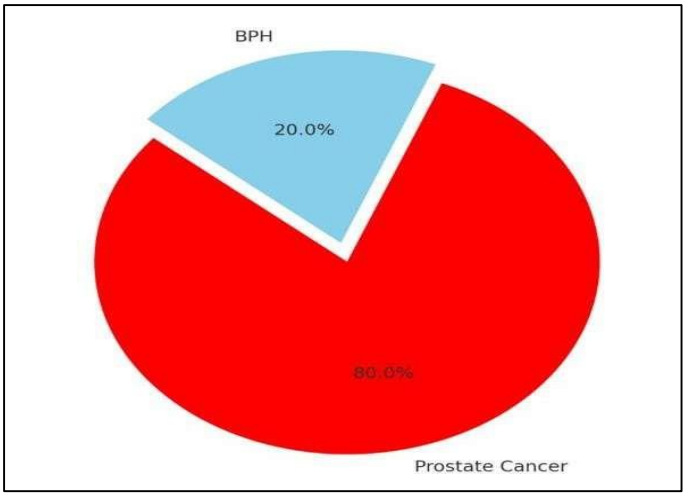

Figure 2: *Biopsy Outcomes among Participants with Elevated PSA Levels*

DISCUSSION

The findings of this study reinforce the utility of prostate-specific antigen (PSA) testing as a vital tool for the early detection of prostate cancer (PCa). The stratification of PSA levels into normal, borderline, and elevated categories, coupled with biopsy confirmation, underscores its role in distinguishing PCa from benign prostatic hyperplasia (BPH). The mean age of participants (65.2 ± 8.3 years) aligns with global data indicating that PCa incidence increases with age, particularly in men over 60 years [13,14]. The majority of participants fell within the 61–70 age group, consistent with other studies demonstrating a peak incidence in this demographic [15]. Urinary symptoms such as frequency (43.9%) and nocturia (38.6%) were common presentations in our cohort, similar to findings from other populations, where lower urinary tract symptoms (LUTS) are predominant in patients with prostate conditions [16]. In this study, 56.1% of participants had normal PSA levels (<4 ng/mL), while 26.3% and 17.5% had borderline (4–10 ng/mL) and elevated PSA levels (>10 ng/mL), respectively. The strong association between elevated PSA levels and biopsy-confirmed PCa (80%) aligns with prior research indicating a high likelihood of malignancy in individuals with PSA levels exceeding 10 ng/mL [17]. Conversely, the low malignancy rate (13.3%) among those with borderline PSA levels corroborates earlier studies suggesting that intermediate PSA levels often warrant further diagnostic evaluation [18]. The role of PSA testing in distinguishing BPH from PCa was further validated. Participants with normal and borderline PSA levels predominantly exhibited BPH, while elevated PSA levels were strongly predictive of PCa. These findings are consistent with previous studies that have highlighted PSA as a valuable marker for differentiating between these conditions [19,20]. However, variations in PSA levels due to other factors, such as prostatitis or recent urological interventions, remain a

limitation of this diagnostic approach [21]. Imaging findings in this study support the clinical and laboratory

spectrum. Pelvic ultrasound detected nodular or hypoechoic lesions suggestive of malignancy in 7% of participants, which were later confirmed via biopsy. This emphasizes the complementary role of imaging in PCa diagnosis, consistent with reports highlighting the diagnostic synergy of PSA testing and imaging modalities [22]. A notable finding in this study was the strong correlation between a positive family history of PCa and malignancy risk. Among participants with a family history, 71.4% were diagnosed with PCa, highlighting familial predisposition as a significant risk factor. This is in agreement with earlier studies that have established a genetic component in PCa etiology, with family history doubling or tripling the risk [24,25]. Despite the utility of PSA testing demonstrated here, limitations remain. False positives and negatives are intrinsic challenges, as PSA levels can be influenced by benign conditions, leading to potential overdiagnosis or missed diagnoses [21]. Additionally, the small sample size and single-center design may limit the generalizability of findings. In comparison to studies conducted in other countries, this research reaffirms the global relevance of PSA as a screening tool while highlighting population-specific differences in disease presentation and risk factors. For instance, while the malignancy rate in elevated PSA levels (>10 ng/mL) in this study was 80%, studies in Western populations report rates ranging from 70% to 90%, suggesting regional variations in disease biology and healthcare-seeking behavior [26,27]. This study underscores the importance of PSA testing in early detection and risk stratification for PCa, particularly in resource-limited settings like Bangladesh. Further multicenter studies with larger cohorts are necessary to refine screening protocols and optimize diagnostic accuracy for the population.

Limitation of the study:

The limitations of the study include a small sample size, single-center design, and potential selection bias. Additionally, PSA levels may be influenced by drug consumption, volume of prostate, infection and benign conditions of prostate, leading to false positives or negatives, which could affect the generalizability and accuracy of findings.

CONCLUSION & RECOMMENDATION

This study underscores the importance of prostate-specific antigen (PSA) testing in the early detection of prostate cancer, especially in individuals with elevated PSA levels or a family history of the disease. PSA testing effectively differentiates prostate cancer from benign prostatic hyperplasia, facilitating timely diagnosis and intervention. Despite its limitations, PSA remains a valuable screening tool. Further large-scale, multicenter research is essential to validate these findings and establish comprehensive screening guidelines for diverse and resource-limited populations.

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References

[1] Siegel, Rebecca L., et al. "Cancer statistics, 2023." CA: a cancer journal for clinicians 73.1 (2023): 17-48.

[2] Pinsky, Paul F., Philip C. Prorok, and Barnett S. Kramer. "Prostate cancer screening—a perspective on the current state of the evidence." New England Journal of Medicine 376.13 (2017): 1285-1289.

[3] Carter, H. Ballentine, et al. "Early detection of prostate cancer: AUA Guideline." The Journal of Urology 190.2 (2013): 419-426.

[4] Thompson, Ian M., et al. "Prevalence of prostate cancer among men with a prostate- specific antigen level≤ 4.0 ng per milliliter." New England Journal of Medicine 350.22 (2004): 2239-2246.

[5] Schröder, Fritz H., et al. "Screening and prostate cancer mortality: results of the European Randomised Study of Screening for Prostate Cancer (ERSPC) at 13 years of follow-up." The Lancet 384.9959 (2014): 2027-2035.

[6] Hugosson, Jonas, et al. "Mortality results from the Göteborg randomized population- based prostate-cancer screening trial." The Lancet Oncology 11.8 (2010): 725-732.

[7] Mottet, N., et al. "EAU–ESTRO–ESUR–
SIOG guidelines on prostate cancer." European Association of Urology (2018).

[8] Ferlay, Jacques, et al. "Global cancer observatory: cancer today." Lyon: International agency for research on cancer 20182020 (2020).

[9] Tewary, Shashi Kant, et al. "Abstracts- USICON 2019." Indian Journal of Urology
35. Suppl 1 (2019): S1-S49.

[10] Gupta, Manoj, et al. "Incremental value of 68-gallium-prostate-specific membrane antigen positron emission tomography/computed tomography in patients with abnormal prostate-specific antigen and benign transrectal ultrasound biopsy." Urology Annals 10.2 (2018): 150-
153.

[11] Hossain MS, Ferdous S, Karim-Kos HE. Prostate cancer in Bangladesh: trends, outcomes, and challenges. Cancer Epidemiol.

[12] Chowdhury, Mohammad Ziaul Islam, et al. "Cancer screening research in Bangladesh: Insights from a scoping review." Global Public Health 19.1 (2024): 2351186.

[13] Siegel, Rebecca L., et al. "Cancer statistics, 2023." CA: a cancer journal for clinicians
73.1 (2023): 17-48.

[14] Mottet, Nicolas, et al. "EAU-ESTRO- SIOG guidelines on prostate cancer. Part 1: screening, diagnosis, and local treatment with curative intent." European urology
71.4 (2017): 618-629.

[15] Ferlay, Jacques, et al. "Global cancer observatory: cancer today." Lyon: International agency for research on cancer 20182020 (2020).

[16] Gupta, Manoj, et al. "Clinical outcome of Lu-177 PSMA in metastatic castration- resistant prostate cancer: An initial experience from a tertiary care cancer hospital." Annals of Cancer Research and Therapy 28.2 (2020): 156-163.

[17] Schröder, Fritz H., et al. "Screening and prostate cancer mortality: results of the European Randomised Study of Screening for Prostate Cancer (ERSPC) at 13 years of follow-up." The Lancet 384.9959 (2014):
2027-2035.

[18] Carter, H. Ballentine, et al. "Early detection of prostate cancer: AUA Guideline." The Journal of Urology 190.2 (2013): 419-426.

[19] Goodman, Phyllis J., et al. "The prostate cancer prevention trial: design, biases, and interpretation of study results." The Journal of Urology 175.6 (2006): 2234-2242.

[20] Hugosson, Jonas, et al. "Eighteen-year follow-up of the Göteborg Randomized Population-based Prostate Cancer Screening Trial: effect of sociodemographic variables on participation, prostate cancer incidence and mortality." Scandinavian journal of urology 52.1 (2018): 27-37.

[21] Pinsky, Paul F., Philip C. Prorok, and Barnett S. Kramer. "Prostate cancer screening—a perspective on the current state of the evidence." New England Journal of Medicine 376.13 (2017): 1285-
1289.

[22] Tikkinen, Kari AO, et al. "Prostate cancer screening with prostate-specific antigen (PSA) test: a clinical practice guideline." Bmj 362 (2018).

[23] Akter, Sanjina. Pattern Of Cancer and Its Risk Factor In Chattogram. Diss. Chattogram Veterinary & Animal Science University, Khulshi, 2022.

[24] Islam, Md Wahidul, et al. "Differential Expression and Prognostic Significance of CDK1 and CDK6 in Breast Cancer: A Multi-Omics Approach." (2024).
[25] Chaudhury, Anasua Basu Ray, Pratnashree Basu, and Sohini Bose. Exploring India's Maritime Connectivity in the Extended Bay of Bengal. Observer Research Foundation, 2019.
[26] Roobol, Monique J., and Sigrid V. Carlsson. "Risk stratification in prostate cancer screening." Nature Reviews Urology 10.1 (2013): 38-48.
[27] Andriole, Gerald L., et al. "Mortality results from a randomized prostate-cancer screening trial." New England journal of medicine 360.13 (2009): 1310-1319.