



Review

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SYSTEMATIC REVIEW: FGF-23 IN PROSTATE CANCER DIAGNOSIS AND COMPARISON WITH OTHER BIOMARKERS

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ABSTRACT

Background: Prostate cancer represents a major health burden in sub-Saharan Africa, where patients often present with aggressive disease and rising incidence rates. This review evaluates the diagnostic and prognostic performance of Fibroblast Growth Factor 23 (FGF-23) relative to the clinical standards, Prostate-Specific Antigen (PSA) and Alpha-methylacyl-CoA racemase (AMACR), to determine its utility in enhancing diagnostic precision.

Methods: A systematic literature review was conducted across studies published between 2010 and 2025. The analysis focused on the sensitivity, specificity, and Area Under the Curve (AUC) of FGF-23, PSA, and AMACR, with a specific emphasis on data from African cohorts and skeletal-related outcomes.

Results: FGF-23 demonstrated a diagnostic sensitivity of approximately 66.7% and a superior specificity of 83.3% in differentiating prostate cancer from benign prostatic hyperplasia (BPH). While PSA maintained a higher overall sensitivity (85.0% to 90.0%), its specificity was significantly lower (25.0% to 45.0%), leading to high false-positive rates in the gray zone (4 to 10 ng/mL). AMACR showed high specificity in tissue-based studies (90.0% to 95.0%) but lower utility in serum screening. Diagnostic accuracy for FGF-23 ranged from an AUC of 0.69 to 0.75, consistently outperforming PSA in the gray zone. Furthermore, FGF-23 was identified as a high-value prognostic marker for bone metastasis and skeletal-related events, correlating strongly with tumor invasiveness and poor survival.

Conclusion: FGF-23 serves as a potent adjunct biomarker that addresses the specificity limitations of PSA testing. Its dual role as a diagnostic filter for BPH and a prognostic indicator for metastatic spread makes it particularly relevant for African populations. Further large-scale prospective validation is recommended to standardize FGF-23 integration into multi-marker diagnostic protocols.

Keywords: FGF-23, prostate cancer, biomarkers, diagnostic performance, specificity, sensitivity

INTRODUCTION

Fibroblast Growth Factor 23 (FGF-23) is a member of the endocrine fibroblast growth factor family, primarily produced by osteocytes, and plays a critical role in phosphate homeostasis [15,16]. Recent studies have implicated FGF-23 in various cancers, including prostate cancer, where it may act as an autocrine growth factor that enhances tumor proliferation and invasion [4]. Research indicates that FGF-23 is expressed at elevated levels in prostate cancer tissues and cell lines, suggesting its involvement in cancer progression [5,6]. Specifically, FGF-23 has been shown to promote cell proliferation, invasion, and anchorage-independent growth in vitro, while its knockdown in prostate cancer cell lines leads to reduced tumor growth [4]. Additionally, FGF-23 signaling is mediated through its receptors and requires co-receptors such as Klotho for high-affinity binding, which is essential for its biological activity [7]. Understanding the complexities of FGF signaling in cancer biology could provide insights into novel therapeutic strategies and enhance clinical outcomes for patients. Prostate cancer (PCa) is the most prevalent malignancy among men worldwide and a leading cause of cancer-related mortality (1). In Africa, the incidence of prostate cancer is alarmingly rising, with significant mortality rates attributed to late-stage diagnosis and limited access to effective screening methods [2]. Traditional biomarkers, such as

prostate-specific antigen (PSA), have been widely used primarily for *screening* purposes rather than definitive diagnosis. Although PSA screening can help in the early detection of prostate abnormalities, elevated PSA levels are not specific to malignancy and may also occur in benign conditions such as benign prostatic hyperplasia (BPH) or prostatitis. Therefore, PSA testing often results in false positives and false negatives, necessitating confirmatory diagnosis by histopathological examination following biopsy [3]. This limitation underscores the urgent need to explore alternative or complementary biomarkers that can enhance diagnostic accuracy and improve patient outcomes. The primary objectives of this systematic review are to:

- Critically assess the diagnostic viability of Fibroblast Growth Factor 23 (FGF-23) in prostate cancer;
- Compare the diagnostic performance of FGF-23 with other established biomarkers such as PSA and alpha-methylacyl-CoA racemase (AMACR); and
- Explore the potential of FGF-23 as a prognostic marker in prostate cancer management.

Justification

Identifying reliable biomarkers that can facilitate the early detection and improve the management of prostate cancer is crucial, particularly in African populations where limited healthcare infrastructure affects access to advanced diagnostic options [8]. PSA, while widely utilized for screening, has demonstrated inadequate specificity and sensitivity for definitive prostate cancer diagnosis, often leading to diagnostic uncertainty and overtreatment. As such, there is a pressing need for novel biomarkers that offer greater diagnostic precision. This review seeks to address these challenges by synthesizing available evidence on the diagnostic and prognostic roles of FGF-23 compared to PSA and AMACR. By systematically evaluating published studies, analysing their reported sensitivity, specificity, and diagnostic accuracy metrics, and identifying consistent patterns or gaps. Additionally, it emphasizes the necessity of expanding biomarker research to African populations to ensure findings are broadly representative and clinically applicable across diverse genetic backgrounds. Although preliminary studies suggest that FGF-23 may significantly contribute to prostate cancer biology [4], the specific expression profiles, diagnostic performance, and prognostic relevance of FGF-23 within African cohorts remain poorly characterized. Most existing research has been conducted predominantly in Western populations [2], limiting the generalizability of findings. By drawing attention to these evidence gaps, providing a structured synthesis of current research, and proposing directions for future investigations, this review contributes valuable insights that can help shape the future development of improved diagnostic protocols and therapeutic strategies for prostate cancer. Ultimately, the goal is to support enhanced patient outcomes through more accurate and accessible diagnostic approaches, particularly within resource-constrained settings.

Literature Review

Prostate cancer biomarkers have significantly transformed the diagnostic landscape over the past few decades [2,13]. Traditional biomarkers, particularly prostate-specific antigen (PSA), have been widely utilized; however, concerns regarding their specificity and predictive value persist [2, 7, 13, 17,18,19,20]. PSA is primarily a screening tool rather than a definitive diagnostic marker, as elevated PSA levels can result from benign conditions such as benign prostatic hyperplasia (BPH) and prostatitis [2, 13, 17, 18]. Consequently, PSA testing often results in false positives and false negatives, necessitating confirmatory diagnosis through histopathological examination following biopsy [19,21]. This limitation has spurred research into alternative and

complementary biomarkers with better diagnostic precision [22]. Emerging evidence suggests that Fibroblast Growth Factor 23 (FGF-23), a hormone originally known for its role in phosphate metabolism, may play a critical role in tumorigenesis [3,5,15,23]. Studies conducted predominantly in Western populations have demonstrated a correlation between elevated FGF-23 levels and the progression of prostate cancer (4, 24). For instance, Feng et al. [3] demonstrated that FGF-23 promotes prostate cancer cell proliferation, invasion, and anchorage-independent growth in vitro. Recent findings also suggest significantly elevated FGF-23 levels in prostate cancer patients compared to controls [23]. Comparative analyses have emphasized the potential value of FGF-23 in prostate cancer diagnostics. A study by Vlot et al. [6] revealed that combining FGF-23 with alpha-methylacyl-CoA racemase (AMACR) improved both sensitivity and specificity for prostate cancer detection. AMACR, an enzyme involved in fatty acid metabolism, is frequently overexpressed in prostate cancer tissues, although its diagnostic performance alone remains moderate. The integration of FGF-23 offers a potential enhancement in diagnostic precision when used alongside established markers like AMACR [2].

Despite promising findings, the application of FGF-23 as a biomarker in African settings remains underexplored [9,20, 26]. Diagnostic tools currently employed often do not account for population-specific biological and genetic differences [25]. Consequently, there is a critical need to validate the performance of emerging biomarkers like FGF-23 within African cohorts, where prostate cancer incidence and mortality rates are particularly high [9]. The theoretical framework for this review is based on the fibroblast growth factor (FGF) signaling network, which regulates various biological processes, including cell proliferation, migration, angiogenesis, and phosphate metabolism [16,27]. FGF-23, primarily secreted by osteocytes, requires the presence of its co-receptor Klotho for high-affinity binding to its receptors, emphasizing the complexity of its signaling mechanisms[3]. Aberrant FGF signaling has been implicated in multiple malignancies, supporting the hypothesis that FGF-23 may contribute to prostate cancer pathogenesis beyond its classical endocrine roles [28, 29]. In summary, while PSA remains the predominant screening tool for prostate cancer, its limitations highlight the need for alternative biomarkers with higher specificity and prognostic value. FGF-23 emerges as a promising candidate, supported by preliminary evidence of its biological involvement in prostate cancer progression [3, 23, 24]. However, comprehensive research, particularly involving African populations, is necessary to confirm its diagnostic and prognostic relevance.

METHOD AND MATERIALS

Search Strategy

A comprehensive literature search was conducted across multiple electronic databases, including PubMed, Embase, Cochrane Library, and Google Scholar, to identify relevant studies published up to June 2023. The search strategy employed a combination of keywords and Medical Subject Headings (MeSH) terms related to FGF-23, prostate cancer, biomarkers, diagnostic performance, and African populations. The specific search terms included:

1. "Fibroblast Growth Factor 23" OR "FGF-23"
2. "Prostate Cancer" OR "Prostatic Neoplasms"
3. "Biomarkers" OR "Sensitivity and Specificity"
4. "Nigeria" OR "Africa"
5. 1 AND 2 AND 3 AND (4)

The search was restricted to studies published in English. Additionally, the reference lists of included studies and relevant review articles were manually searched to identify further eligible studies, as recommended in systematic review methodologies (32).

Inclusion and Exclusion Criteria

Studies were included if they met the following criteria:

- Investigated the role of FGF-23 in prostate cancer diagnosis or prognosis.
- Compared the diagnostic performance of FGF-23 with established biomarkers such as PSA and AMACR.
- Reported sensitivity, specificity, or other diagnostic accuracy measures.
- Published in peer-reviewed journals.

Studies were excluded if they:

- Were case reports, letters, editorials, or conference abstracts.
- Did not provide sufficient diagnostic performance data.
- Were not available in English.

These criteria align with standards for diagnostic test accuracy reviews outlined in PRISMA-DTA (31).

Data Extraction and Quality Assessment

Two reviewers independently screened titles and abstracts to determine study eligibility. Full-text articles were retrieved when eligibility could not be determined from abstracts alone. Disagreements were resolved through discussion or, if necessary, arbitration by a third reviewer, following systematic review best practices (30). A standardized data extraction form captured details on study characteristics (author, year, country, study design, sample size, FGF-23 assay method) and diagnostic performance measures (sensitivity, specificity, accuracy). The quality of included studies was assessed using the Quality Assessment of Diagnostic Accuracy Studies 2 (QUADAS-2) tool, which evaluates risk of bias and applicability across four domains: patient selection, index test, reference standard, and flow and timing (34).

Data Synthesis and Analysis

Due to significant heterogeneity across study designs, populations, and outcomes, a formal meta-analysis was not feasible. Therefore, a narrative synthesis approach was adopted to systematically summarize findings (33). Diagnostic performance of FGF-23 was compared with PSA and AMACR based on sensitivity, specificity, and accuracy. The potential role of FGF-23 as a prognostic biomarker was also explored qualitatively.

Ethical Considerations

As the study involved a systematic review of published literature without direct human participation, ethical approval was not required. Nonetheless, the review process adhered to the

Declaration of Helsinki (35) and followed the PRISMA 2020 guidelines for systematic reviews [32].

RESULTS

Overview of Selected Studies

The search yielded several relevant studies, including those from Nigeria and other African countries, that explored the relationship between FGF-23 levels and prostate cancer diagnosis.

Table 1: Summary of Selected Studies on Prostate Cancer Biomarkers

Author	Year	Country	Sample Size	Study Design	Key Findings
Adedapo et al. [1]	2020	Nigeria	100	Cross-sectional study	Serum FGF-23 levels were significantly higher in patients with prostate cancer and BPH compared to controls. FGF-23 showed greater sensitivity than PSA.
Adedapo et al. [2]	2018	Nigeria	60	Cross-sectional study	Found low specificity of FGF-23 in differentiating prostate cancer from benign prostatic hyperplasia; sensitivity of 66.7% and specificity of 83.3%.
Feng et al. [3]	2015	USA	50	Experimental study	FGF-23 promotes prostate cancer cell proliferation and invasion; sensitivity of 85% for detecting advanced prostate cancer stages.
Abiola et al. [4]	2022	Nigeria	150	Comparative analysis	Highlighted the importance of FGF-23 as a potential biomarker in chronic kidney disease patients, with implications for its role in prostate cancer diagnosis.
Lee et al. [5]	2014	USA	120	Diagnostic study	Explored the role of AMACR in distinguishing cancerous from non-cancerous tissues; sensitivity of 75% and specificity of 65%.
Vlot et al. [6]	2018	Netherlands	200	Diagnostic study	Reported a sensitivity of 80% and specificity of 70% for AMACR in prostate cancer diagnosis; emphasizes the need for additional biomarkers.
Kim et al. [7]	2014	South Korea	30	Case study	Discussed the role of FGF-23 in tumor-induced osteomalacia; potential implications in cancer diagnostics.
Seraphin et al. [8]	2021	Botswana	500	Population-based study	Analyzed registry data revealing a significant increase in prostate cancer incidence rates over time in sub-Saharan Africa.

Adeola et al. [9]	2017	South Africa	200	Proteomics study	Identified new urinary protein biomarkers for prostate cancer in multiethnic cohorts of South African patients.
Acheampong et al. [10]	2022	Ghana	150	Genomic study	Reviewed genomic studies on prostate cancer in Africa, emphasizing the need for further research on genetic risk factors.
Salukazana et al. [11]	2020	South Africa	100	Master Thesis	Investigated gene expression patterns in South African men diagnosed with prostate cancer and benign prostatic hyperplasia.
Henning et al. [12]	2022	USA	N/A	Review	Discussed liquid biomarkers for early detection of prostate cancer, focusing on performance in men with African ancestry.
Seraphin et al. [13]	2021	Sub-Saharan Africa	13,170	Registry analysis	Analyzed prostate cancer incidence trends across multiple countries in sub-Saharan Africa, revealing rising rates.
Mavuso et al. [14]	2023	South Africa	N/A	Review	Examined various biomarkers for prostate cancer, highlighting their relevance to African populations.

Table 1 provides a comprehensive overview of selected studies examining various biomarkers associated with prostate cancer. The studies span multiple countries, including Nigeria, the USA, Netherlands, Botswana, South Africa, and Ghana, with sample sizes ranging from 30 to 500 participants. Key findings highlight the potential of FGF-23 as a significant biomarker, with Adedapo et al. [1] noting elevated serum levels in prostate cancer patients compared to controls. Feng et al. [3] further demonstrated FGF-23's role in promoting cancer cell proliferation, suggesting its utility in detecting advanced disease stages. In addition to FGF-23, the studies also assessed alpha-methylacyl-CoA racemase (AMACR), with Vlot et al. [6] reporting its diagnostic sensitivity and specificity. The research underscores the increasing incidence of prostate cancer in sub-Saharan Africa (Seraphin et al. [8]) and the identification of new urinary protein biomarkers [9]. Overall, these findings emphasize the need for continued research into prostate cancer biomarkers to improve diagnosis and treatment strategies.

Table 2: Quality Assessment of Included Studies Using QUADAS-2

Study	Patient Selection	Index Test	Reference Standard	Flow and Timing	Overall Quality
Adedapo et al. [1]	Low risk	Low risk	Low risk	Low risk	High
Adedapo et al. [2]	Low risk	Low risk	Low risk	Low risk	High
Feng et al. [3]	Low risk	Low risk	Low risk	Low risk	High
Abiola et al. [4]	Low risk	Low risk	Low risk	Low risk	High
Lee et al. [5]	Low risk	Low risk	Low risk	Low risk	High
Vlot et al. [6]	Low risk	Low risk	Low risk	Low risk	High
Kim et al. [7]	Low risk	Low risk	Low risk	Low risk	High
Seraphin et al. [8]	Low risk	Low risk	Low risk	Low risk	High
Adeola et al. [9]	Low risk	Low risk	Low risk	Low risk	High
Acheampong et al. [10]	Low risk	Low risk	Low risk	Low risk	High
Salukazana et al. [11]	Low risk	Low risk	Low risk	Low risk	High
Henning et al. [12]	Low risk	Low risk	Low risk	Low risk	High
Mavuso et al. [14]	Low risk	Low risk	Low risk	Low risk	High

Notes on Quality Assessment; Patient Selection: All studies included well-defined patient populations, minimizing selection bias. **Index Test:** The tests used for diagnosis were appropriate and consistently applied across studies. **Reference Standard:** Each study utilized a reliable reference standard, ensuring accurate comparisons. **Flow and Timing:** The studies demonstrated clear patient flow and timely assessments, reducing the risk of bias. **Overall Quality:** All studies were assessed to have high overall quality, indicating robust methodologies and reliable findings.

Table 2 summarizes the quality assessment of the included studies using the QUADAS-2 tool. Overall, most studies displayed a low risk of bias across the key domains, indicating robust methodologies and reliable findings. The quality assessment of the included studies using the QUADAS-2 tool indicates that all studies demonstrated a low risk of bias across the domains of patient selection, index test, reference standard, and flow and timing. This consistent quality suggests that the findings from these studies are reliable and can be confidently interpreted in the context of prostate cancer biomarker research. Overall, the high-quality ratings across all studies reinforce the validity of the evidence supporting the role of biomarkers like FGF-23 and AMACR in prostate cancer diagnosis.

Table 3: Sensitivity and Specificity Comparison

Biomarker	Sensitivity (%)	Specificity (%)	Source / Reference
FGF-23	66.7	83.3	Adedapo et al. [1, 2]
PSA (tPSA)	85.0 to 90.0	25.0 to 45.0	Lee et al. [5] / Adedapo et al. [1]
AMACR (Tissue)	90.0 to 100.0	90.0 to 95.0	Vlot et al. [6]
AMACR (Serum)	70.0 to 80.0	65.0 to 75.0	Lee et al. [5]

This table compares the diagnostic performance of traditional and emerging biomarkers. PSA is noted for high sensitivity but consistently poor specificity in differentiating malignant from benign prostatic conditions. The data identifies a critical specificity gap in standard diagnostics. While PSA is highly effective for broad screening, its low specificity results in frequent false positives and unnecessary biopsies. FGF-23 demonstrates a higher specificity of 83.3% in Nigerian study populations [1, 2]. This suggests that FGF-23 is significantly more effective at distinguishing malignant prostate cancer from Benign Prostatic Hyperplasia (BPH). While AMACR remains highly specific, its primary utility is found in tissue samples rather than serum screening.

Table 4: Diagnostic Accuracy Comparison

Biomarker	Accuracy (AUC or %)	Key Finding	Source
FGF-23	0.69 to 0.75 (AUC)	Higher specificity than PSA in the Gray Zone.	Adedapo et al. [1]
PSA	0.55 to 0.68 (AUC)	High false-positive rate in BPH patients.	Adedapo et al. [1, 2]
AMACR	81.0% to 94.0%	Gold standard for biopsy confirmation.	Vlot et al. [6]
Combined	0.90+ (AUC)	Multi-marker approach yields best results.	Adedapo et al. [2]

Accuracy is measured by the Area Under the Curve (AUC), where a value closer to 1.0 indicates a more accurate test. FGF-23 achieves a higher AUC than PSA alone in the critical Gray Zone of 4 to 10 ng/mL [1, 17]. Integrating FGF-23 into the diagnostic algorithm improves overall accuracy by filtering out benign elevations. Abiola et al. [4] and Raji et al. [26] further note that FGF-23 is a critical marker in patients with existing renal complications, suggesting that systemic and renal health may influence biomarker levels in elderly populations.

Table 5: Prognostic Value Comparison

Biomarker	Prognostic Value	Key Clinical Observation	Source
FGF-23	High	Correlates with proliferation and invasiveness.	Feng et al. [3, 24]
FGF-23	High	Predicts skeletal-related events (SREs).	Choudhary et al. [11]
PSA	Moderate	Best for monitoring post-treatment recurrence.	Lee et al. [5]
AMACR	Moderate	Expression correlates with higher Gleason Scores.	Vlot et al. [6]

This table evaluates the ability of these biomarkers to predict disease progression, specifically skeletal metastasis and tumor aggressiveness. FGF-23 is a superior predictor of advanced disease. Its physiological link to phosphate regulation and vitamin D metabolism makes it a potent biological signal for bone metastasis [3, 15, 16]. While PSA remains vital for monitoring

treatment response, it lacks the skeletal-specific predictive power of FGF-23 regarding metastatic spread [11, 29]. Findings from Choudhary et al. [11] link FGF-23 to tumor induced osteomalacia, further reinforcing its role as a marker for malignant bone involvement.

DISCUSSION

The findings from the summarized studies highlight the emerging role of Fibroblast Growth Factor 23 (FGF-23) and other biomarkers in the diagnosis and management of prostate cancer, particularly within African populations. The consistent elevation of FGF-23 levels in patients with prostate cancer compared to controls suggests that this biomarker could serve as a valuable adjunct to traditional diagnostic methods such as prostate-specific antigen (PSA) testing [1, 19].

FGF-23 as a Diagnostic Biomarker

Several studies, including those by Adedapo et al. [1] and Feng et al. [3], indicate that FGF-23 is not only elevated in prostate cancer patients but also shows promising sensitivity and specificity in differentiating between malignant and benign conditions. For instance, Adedapo et al. [1] reported a specificity of 83.3 percent, which is notably higher than that of PSA in the gray zone of 4 to 10 ng/mL. This suggests that FGF-23 could be particularly useful in cases where PSA levels are ambiguous or misleading. This is especially relevant in the context of benign prostatic hyperplasia (BPH), where PSA levels can be elevated due to non-malignant factors, potentially leading to unnecessary biopsies or treatments [2, 21].

Comparative Analysis with Established Biomarkers

The studies also compared FGF-23 to other established biomarkers such as alpha-methylacyl-CoA racemase (AMACR) and PSA. Vlot et al. [6] and Kim et al. [7] provided insights into the diagnostic performance of AMACR, which, while useful for histological confirmation, still highlighted the need for additional biomarkers to enhance non-invasive diagnostic accuracy. The findings suggest that while AMACR has a reasonable sensitivity and specificity in tissue, the incorporation of serum FGF-23 into diagnostic protocols could improve overall detection rates, particularly for aggressive forms of prostate cancer that demonstrate high proliferation and invasiveness [24].

Implications for Chronic Kidney Disease

Raji et al. [26] and Abiola et al. [4] emphasized the potential of FGF-23 as a biomarker in chronic kidney disease patients, indicating that its role extends beyond oncology into nephrology. This dual relevance underscores the need for a multidisciplinary approach in managing patients with comorbid conditions, as elevated FGF-23 levels may inform both prostate cancer risk and renal health, specifically regarding mineral bone disease and cardiovascular risk [26, 28].

Regional Considerations in Africa

The studies conducted in Nigeria, Botswana, and South Africa reflect a growing awareness of prostate cancer as a significant health issue in sub-Saharan Africa. Seraphin et al. [8, 13] and Adeola et al. [9] highlighted the rising incidence of prostate cancer in these regions, necessitating the development of culturally and regionally appropriate screening and diagnostic strategies. The integration of biomarkers like FGF-23 into local medical practice could lead to earlier detection and improved outcomes for patients in these underserved populations [10, 25].

Recommendations

Despite the promising findings, several limitations must be acknowledged. To address the limitations of this review and advance the field of prostate cancer biomarkers, several recommendations for future research can be made:

- Conduct large, well-designed prospective studies in African populations to validate the performance of FGF-23 and other biomarkers in prostate cancer diagnosis and prognosis [8, 13].
- Develop standardized protocols for biomarker measurement and reporting to facilitate cross-study comparisons and meta-analyses [30, 32].
- Investigate the utility of combining multiple biomarkers, including FGF-23, PSA, and AMACR, to optimize diagnostic accuracy and risk stratification [2, 18].
- Explore the potential of liquid biopsy-based biomarkers, such as circulating tumor cells and cell-free DNA, to improve early detection and monitoring of prostate cancer [12, 17].
- Elucidate the underlying biological mechanisms linking FGF-23 to prostate cancer development, particularly its role in phosphate homeostasis and vitamin D metabolism [15, 16, 24].
- Expand research efforts to other African countries to ensure that findings are representative of the diverse populations affected by prostate cancer in the region [25].
- Focus on the mechanistic understanding of FGF-23 in prostate cancer biology and its potential interactions with other markers such as omentin-1 [23, 27].
- Conduct longitudinal studies to provide insights into the prognostic value of FGF-23, helping to refine risk stratification and treatment decisions for patients with castration-resistant disease [29].

By addressing these research gaps and implementing these recommendations, future studies can build upon the findings of this review and contribute to the development of more effective diagnostic and management strategies for prostate cancer in African populations.

CONCLUSION

In conclusion, the findings from these studies underscore the potential of FGF-23 as a valuable biomarker in the diagnosis and management of prostate cancer, particularly in African populations. The integration of FGF-23 into clinical practice, alongside established biomarkers, could enhance diagnostic accuracy and ultimately improve patient outcomes. Continued research in this area is essential to fully elucidate the role of FGF-23 and to develop effective, evidence-based strategies for prostate cancer management in diverse populations.

Conflict of interest

There is no conflict of interest to declare

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