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Comparing Multiparametric Magnetic Resonance Imaging findings to Histopathology for differentiating benign prostatic conditions from malignant prostate cancer

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Abstract

The aim of this study is to assess the diagnostic performance of multiparametric magnetic resonance imaging (mpMRI) for benign prostatic conditions and prostate cancer (CaP) diagnosis, and to compare it with the histopathological results. A total of 74 male patients age 50 and older, who had elevated PSA and abnormal digital rectal examination (DRE) were included. mpMRI and transrectal ultrasound (TRUS) guided biopsy was performed on all participants. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were used in assessing the diagnostic accuracy of mpMRI. The results revealed high sensitivity (95.56%) and good specificity (82.76%) of mpMRI with a PPV of 89.58% and an NPV of 92.31%. The Cohen Kappa score of 0.798 revealed high level of agreement between mpMRI and histopathology. The study also revealed that mpMRI was able to accurately detect clinically significant prostate cancer (csPCa) and distinguish it from other non-cancerous prostate conditions like BPH and prostatitis. However, there were always false positives and false negatives, especially in cases where there was a benign mimic or low-grade tumour. Despite these drawbacks, the results indicate that mpMRI can be applied as a valid noninvasive diagnosis technology, and offer supplementary information to histopathology for better patient management. This work provides a solid basis for implementing the use of mpMRI in clinical practice for prostate cancer diagnosis and staging, which could be enhanced with the development of new and more sophisticated technologies like radiomics and machine learning.

1. Introduction

Prostate cancer (PCa) is a significant public health problem worldwide, and one

of the most common forms of cancer in men, being a leading cause of cancer-related death among males (Launer et al., 2025; Carletti et al., 2026). In the future, the burden of PCa further grow with the combination of an aging population, lifestyle changes and through improved diagnostic attention (O'Toole et al., 2025). Being able to differentiate between benign prostatic conditions like benign prostatic hyperplasia (BPH) and inflammatory lesions from prostate cancer early and accurately is essential to avoid unnecessary invasive procedures, to make the best clinical decisions and to enhance the benefits for patients.

Prostate cancer diagnosis has been made in the past through prostate specific antigen (PSA) screening, systematic transrectal ultrasound (TRUS) guided biopsy and digital rectal examination (DRE) for histopathological confirmation (Carletti et al., 2026). While PSA screening is sensitive, its specificity is less, especially in older men, in whom increased PSA levels can be due to non-cancerous factors (O'Toole et al., 2025; Launer et al., 2025). Biopsy is the definitive diagnosis tool as it give both cell and architecture evidence of malignancy, the gold standard (Hanif et al., 2024). But prostate biopsy is not without risk—including the possibility of under or overdiagnosis, bleeding, and infection that may occur (Launer et al., 2025). These constraints have sparked interest in non-invasive imaging modalities in order to increase the precision of diagnosis before or instead of biopsy in some cases.

Over the past decade, multiparametric magnetic resonance imaging (mpMRI) has become a game-changer in the imaging landscape, significantly improving the detection, localization and characterization of prostate lesions (Sitharthan et al., 2024; Javed et al., 2024). In contrast to traditional MRI, mpMRI combines several MRI sequences (T2 weighted imaging, diffusion weighted imaging (DWI), and dynamic contrast enhanced (DCE) imaging) to yield anatomical and functional information regarding prostate tissue, which is superior in terms of tissue contrast and lesion characterization (Carletti et al., 2026). To assist in the standardization of interpretation and reporting of mpMRI, the Prostate Imaging Reporting and Data System (PI RADS) was developed, which classifies lesions into 5 levels ranging from very low likelihood (PI RADS 1) to very high likelihood (PI RADS 5) of significant cancer (PI RADS Steering Committee, 2019; Hanif et al., 2024). This structured approach has resulted in more uniformity in reporting and included into international guidelines suggesting the use of mpMRI for men with raised PSA or previous negative biopsy (Launer et al., 2025; Carletti et al., 2026).

The introduction of mpMRI into clinical practice has arisen from a combination of its potential to detect clinically significant prostate cancer (csPCa) and to decrease unnecessary biopsies and overdiagnosis of indolent cancer. Multiple recent meta-analyses and systematic reviews have shown that, compared to histopathological reference standards, mpMRI has demonstrated good sensitivity and specificity for the diagnosis of csPCa (Carletti et al., 2026; Meta analysis, 2025). A pooled diagnostic performance analysis showed estimates of sensitivity and specificity around 86% and 88% respectively, and a high area under the summary receiver operating characteristic curve (SROC), indicating a high level of diagnostic reliability of mpMRI (Bass et al., 2021). These results have firmly established the use of mpMRI as a triage tool prior to biopsy, especially in patients who have not had a biopsy before and for guiding biopsies of suspicious lesions (O'Toole et al., 2025; Launer et al., 2025).

While these advances have been made, there are still difficulties to overcome. The overall diagnostic accuracy of mpMRI is high, but it is not a perfect tool, with the ability to over diagnose and overtreat due to false positives when differentiating between benign mimics (prostatitis, focal atrophy, sclerotic nodules, or BPH) and malignant lesions (Javed et al., 2024; sIgva, 2024). However, false negatives can occur, especially in small and/or low-grade tumours and those that are invisible to MRI imaging, these may be missed due to limitations in spatial resolution or due to inter-reader variation (Sitharthan et al., 2024; Lovegrove et al., 2018). With this in mind,

association between mpMRI and clinical risk calculators and the PSA density (PSAD) and other mpMRI imaging biomarkers have been examined to improve the diagnostic pathway (Shetty et al., 2025; Pugliesi et al., 2026). For instance, integrating PI RADS scores with PSAD has been demonstrated to yield better sensitivity and specificity, thereby refining risk stratification and aiding in the decision-making process for biopsies (Shetty et al., 2025).

Comparative evaluations between multiparametric (mpMRI) and biparametric MRI (bpMRI) (which excludes the contrast sequence) have shown that bpMRI may be non-inferior to mpMRI for the detection of csPCa at the page level with comparable diagnostic performance and lower costs and time (de Oliveira et al., 2026; Ng et al., 2025). In many centres MPMRI is preferred however because of the wealth of functional data, and because it can be used in treatment planning and staging (de Oliveira et al., 2026; carletti et al., 2026). Further, recent studies of hybrid imaging modalities like the combination of mpMRI with prostate specific membrane antigen positron emission tomography (PSMA PET), indicated promising complementary improvements in local and systemic disease detection (Pugliesi et al., 2026; Sitharthan et al., 2024).

However, accuracy is variable across the local context, with a few studies finding slightly lower accuracy in certain populations, highlighting the need for context specific validation (Hanif et al., 2024). This is because of the different types of equipment, the different reading experience of readers and the different characteristics of patients.

However, the ability to achieve superior diagnostic accuracy with less harm is the clinical imperative and a critical assessment of the performance of mpMRI in differentiating benign and malignant prostate conditions is needed. Therefore, this study seeks to contribute to the growing body of evidence by evaluating the diagnostic value of mpMRI in men referred for prostate imaging and histopathological assessment for the assessment of the sensitivity, specificity, positive and negative predictive values, and overall agreement between mpMRI and biopsy.

To conclude, although mpMRI is a groundbreaking technique in prostate cancer diagnosis, it is essential to grasp the complex performance characteristics, particularly for distinguishing malignancy from benign prostate tissue, to ensure that it is used effectively in the care of patients and to minimize unnecessary interventions. Based on recent evidence this article aims to assess and understand the value and place of mpMRI in the current diagnostic pathway.

2. Literature Review

With the introduction of multiparametric magnetic resonance imaging (mpMRI), the management of prostate cancer diagnosis has changed dramatically and has brought imaging to a higher level of precision than the traditional methods used, such as digital rectal examination (DRE), prostate specific antigen (PSA) screening, and transrectal ultrasound (TRUS) biopsies. In the past, systematic TRUS biopsy was the most common method of diagnosis for prostate cancer; however, it has drawbacks such as sampling error, discomfort, and a risk of complications including infection and bleeding (Ahmed et al., 2017). These drawbacks led the research to focus on imaging methods that are able to detect and characterize prostate lesions without invasive procedures and at a higher resolution. The use of multi-parametric MRI (mpMRI) that incorporates both anatomical and functional imaging techniques like T2 weighted imaging (T2WI), diffusion weighted imaging (DWI), and dynamic contrast enhanced imaging (DCE) has become a cornerstone in the diagnosis of prostate cancer (Launer et al., 2025).

One of the key issues in the literature is the ability of mpMRI to increase detection of clinically significant prostate cancer (csPCa) over standard biopsy alone. mpMRI was also shown to have excellent diagnostic performance in a landmark paired

confirmatory study compared with TRUS biopsy, greatly improving the detection of significant disease and lowering the diagnosis of indolent tumours (Ahmed et al., 2017). This study set the stage for the use of mpMRI in the pathway of diagnostic procedures that uses an "MRI first" approach, particularly in biopsy-naïve patients. Current guidelines advise using mpMRI prior to biopsy to minimize unnecessary procedures and biopsy only suspicious areas to increase the yield and to decrease morbidity (Launer et al., 2025).

The importance of standardization of mpMRI interpretation for the achievement of reproducible and reliable diagnostic outcome has been crucial. Developed by international collaboration among experts in radiology, the Prostate Imaging Reporting and Data System (PI RADS) gives a structured score that classifies lesions according to the probability that they are malignant (Prostate Imaging Reporting and Data System Steering Committee, 2019). The implementation of the PI RADS v2.1 has created uniformity in the reporting of the imaging results and outcomes, thus allowing the comparison between imaging results and outcomes with respect to histopathology. High PI scores (4–5) are associated with malignancy and have been shown to be highly correlated with malignant pathology in recent studies, reflecting its value as a risk stratification system (Lin et al., 2016). A wide range of sensitivity and specificity (moderate to high) has been established in various clinical settings, depending on both clinical context and reader expertise, with the ability to predict validating in multiple settings.

The accuracy of mpMRI diagnosis is not perfect, however. Although most cases of false positives are limited, there are some cases, including those with benign conditions like prostatitis, focal atrophy, and benign prostatic hyperplasia (BPH), which can have similar imaging characteristics to cancer and are a significant concern (Ediz & Gunduz, 2021). This limitation further highlights the imperfect specificity of mpMRI as a modality, where it does a good job of detecting lesions, but may mistakenly label benign lesions as malignant and lead to unnecessary interventions. Small volume or infiltrative cancers, however, may not be evident or may be ambiguous on imaging and result in false negative results and underdiagnosis (Hausmann et al., 2025). These difficulties are compounded by inter-reader variability, including differences in the skills and experience of readers that impact on the diagnosis and treatment planning.

The differential diagnostic performance of mpMRI and simpler mpMRI strategies (biparametric MRI [bpMRI] has been an area of extensive research. The absence of a contrast sequence in bpMRI results in lower scanning time and no risk of contrast agent, and reduces the risk of contrast agents, while maintaining good diagnostic performance in some sub-groups of csPCa (Jin et al., 2025). Jin et al. (2025) found that both techniques, bpMRI and mpMRI, had similar overall accuracy, with mpMRI demonstrating slightly higher specificity in lower PSA ranges and bpMRI having benefits in higher PSA ranges. The results indicate that more specific imaging approaches based on clinical risk factors may achieve highest diagnostic yield while keeping down costs, time and resources.

Clinical parameters are also integrated with mpMRI metrics for further improving the diagnostic accuracy. The use of prostate specific antigen density (PSAD) in conjunction with the PI RADS scoring, for instance, in the discrimination of benign and malignant conditions. A recent diagnostic accuracy study showed that predictive performance is significantly improved when integrating PSAD with mpMRI scores, which could further enhance biopsy decision algorithms and potentially result in a hybrid model (Shetty et al., 2025). This type of integration can be used to help to minimize unnecessary biopsies, especially in patients with unclear imaging findings (PI RADS 3).

With the help of modern developments, mpMRI can also be used to significantly supplement the capacity of traditional imaging interpretation. A recent progress in the field of radiomics, which aims at extracting and quantifying high dimensional imaging

features, has become a powerful tool to capture subtle patterns in textural, morphological and intensity characteristics that may not be observed by the human eye. There is increasing research interest in machine learning models based on radiomics for the high accuracy differentiation of benign prostate conditions from malignant ones (Zhou et al., 2025). These models take advantage of quantitative imaging biomarkers to increase the predictiveness and provide interpretability through tools like SHapley Additive exPlanations (SHAP). The future of radiomics approaches is to complement or replace the traditional PI RADS interpretation, which eliminates subjectivity in reading and improves the intercenter reproducibility.

The literature also underscores the implications for prognosis, clinical management of mpMRI. There is correlation between the visibility of lesions and imaging biomarkers and histopathological features like the Gleason grade and tumor aggressiveness. A number of studies indicate a correlation between increased PI RADS scores and increased disease burden and/or increased grade of the lesions, which can direct biopsy selection and treatment planning and/or active surveillance approaches. Through its ability to detect more than just cancer, but to give a full picture of the disease, the utility of mpMRI has been expanded to include evaluation of extraprostatic extension, seminal vesicle invasion and local staging.

Meta-analytic evidence brings together the wide spectrum of the performance of mpMRI. Systematic reviews show pooled sensitivity and specificity values indicate the strength of the modality in detecting csPCa but there is heterogeneity among studies, arising from the use of different imaging protocols, readers, and patient cohorts. In 2025, a detailed meta-analysis was published showing that mpMRI continues to be a valuable triage tool that can help reduce over diagnosis and/or identify significant disease. These positions further strengthen the role of the modality within the current diagnostic algorithm and validate the role of the modality in clinical decision making.

Local and/or regional studies provide context-specific evidence to the global evidence by assessing the level of the performance of mpMRI in various patient populations. For instance, one study in Pakistan found that the accuracy of the diagnosis of PI RADS in identifying malignant from benign prostate disease was high, which is similar to the results from international studies in a non-Western clinical setting (Hanif et al., 2024). These studies highlight the generalizability of mpMRI in a healthcare setting and confirm the clinical application of mpMRI in other areas with varying disease frequency and practices.

To conclude, the literature has confirmed the important place of mpMRI in the diagnostic process of prostate cancer, enabling a non-invasive risk stratification to complement the traditional diagnostic approach through biopsy. Empirical evidence shows that mpMRI enhances the ability to detect clinically significant cancers, enhances clinical risk factors, and also standardizes reporting of the findings in the form of PI RADS. Despite these advances, issues like the problem of false positives, inter-reader variability, and limitations in lesion characterization remain, and these are the areas of research that continues today with the use of radiomics, machine learning and hybrid imaging procedures. Future advances in imaging methods and models of diagnosis should bring more benefits in delineating benign from malignant prostate disease and ultimately facilitate more accurate and patient-centred cancer treatment.

3. Methodology

The study design was a cross-sectional analytical study, using multiparametric magnetic resonance imaging (mpMRI) for the differentiation of benign prostatic conditions and prostate cancer. This study was done at Brigadier Shafiq Ahmad Khan Niazi Memorial Trust Hospital, Bhakkar from 1st June to 30th November over 6 months. 74 male patients with age 50 years and older were included in the study. Participants were included in the study if they had a PSA level > 4 ng/mL, abnormal Digital Rectal Examination (DRE) and had both mpMRI and histopathological biopsy

reports available. Patients were excluded from the study if they had any contraindications to MRI (including metallic implants and pacemakers), poor quality mpMRI reports, proven metastatic prostate cancer, or a history of prostate surgery or radiation therapy. All patients gave informed written consent before participating in the study. The study was conducted in compliance with the ethical guidelines specified by the Institutional Review Board (IRB) of Superior University and data was anonymous and used only for research purposes.

Data collection included examination of the clinical records of participants to collect clinical information and results from the mpMRI and histopathological tests. A knowledgeable radiologist interpreted the mpMRI results, using the Prostate Imaging Reporting and Data System (PI RADS v2.1). Histopathological reports were obtained using biopsy procedures based on transrectal ultrasound (TRUS) examination, and confirmed by a pathologist. The data collected were analyzed statistically by using SPSS version 26. Demographic and clinical data were summarized with descriptive statistics; continuous variables like age and PSA level were reported as mean and standard deviation while categorical variables like PI RADS scores and biopsy results were reported as frequencies and percentages. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and overall accuracy of mpMRI were calculated to assess its diagnostic performance. Furthermore, Cohen's Kappa was calculated to evaluate the level of agreement between the mpMRI assessment and the histopathology to gain insights into the reliability and diagnostic value of mpMRI in discriminating benign from malignant prostate conditions. This approach allowed a thorough analysis of the accuracy of mpMRI vs. histopathology, thereby validating the accuracy of mpMRI as a valuable prostate cancer detection tool.

4. Data Analysis

The data collected from 74 patients was analyzed using the software SPSS version 26, to assess the diagnostic accuracy of mpMRI in differentiating between benign prostate conditions and prostate cancer. Demographic and clinical characteristics of the patients were summarized by descriptive statistics, such as means, standard deviations for continuous variables (e.g., age, prostate-specific antigen [PSA]). The categorical variables (PI-RADS scores and biopsy outcomes) were presented as percentages and frequencies.

Descriptive statistics.

Demographic data (age, PSA) were analyzed and presented in the following table:

Variable	Mean ± SD	Median	Range	CV
Age (years)	65.01 ± 8.32	64.00	50–84	0.128
PSA (ng/mL)	14.20 ± 4.95	13.25	7.1–28.9	0.348
Tumor Size (mm)	49.06 ± 18.97	46.50	15.0–90.0	0.387
Gleason Score	4.47 ± 1.22	5.00	1.0–6.0	0.273
Gleason Grading	8.08 ± 1.11	8.00	6.0–10.0	0.137

The mean age of the study participants was 65.01 years (SD = 8.32), and PSA levels ranged from 7.1 to 28.9 ng/mL with a mean of 14.20 ng/mL (SD = 4.95). There was significant variation in the size of the tumor (mean = 49.06 mm, SD = 18.97) and in the Gleason score which was (mean = 4.47 ± 1.22) ranging from 1 to 6.

Diagnostic Performance of mpMRI

Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy were used to evaluate the performance of mpMRI in detecting prostate cancer compared to histopathology. The outcomes of which can be summarized in the following table:

Diagnostic Metric	Value
Sensitivity	95.56%
Specificity	82.76%
PPV	89.58%
NPV	92.31%
Accuracy	90.54%

The sensitivity of mpMRI was determined to be 95.56%, which means that it can easily detect patients with prostate cancer and identify it as malignant. Specificity of 82.76% suggests the moderate accuracy of distinguishing the benign lesions. When mpMRI diagnosed a lesion as malignant, the positive predictive value (PPV) was 89.58%: This indicates that there was an 89.58% probability that the diagnosis was correct. The negative predictive value (NPV) was 92.31%, suggesting that the mpMRI is very effective in excluding malignancy in the event of a negative test.

Agreement between the mpMRI and histopathology

Cohen's Kappa was used to quantify the agreement of mpMRI and histopathology. With a kappa of 0.798, there is a significant agreement between the two diagnostic methods. This strengthens the validity of mpMRI as a non-invasive imaging technique to differentiate benign from malignant prostate disease.

Cohen's Kappa	Value
Kappa Value	0.798

Statistical Tests

Independent samples t-tests were used for continuous variables (age, PSA, tumor size) and chi-square tests of independence were used for categorical variables (PI-RADS score, biopsy results) to further assess differences between malignant and benign lesions identified by mpMRI versus histopathology. The results revealed that there were statistically significant differences between the two groups.

Test	Statistic	p-value
Independent t-test (Age)	5.87	<0.001
Independent t-test (PSA)	4.56	<0.001
Chi-Square (PI-RADS)	16.43	<0.001

Results of the independent t-tests for age and PSA level showed significant differences between the benign and malignant groups, suggesting that both age and PSA levels are related to the risk of malignancy. A significant relationship between PI-RADS scores and histopathological findings was found by the chi-square test, which further underscored the importance of mpMRI to detect clinically significant prostate cancer.

5. Discussion of Findings

The purpose of this study was to assess the performance of multiparametric magnetic resonance imaging (mpMRI) in distinguishing benign prostate conditions from prostate cancer. The results showed that the sensitivity of the mpMRI was high (95.56%) and the specificity was good (82.76%) which indicates the utility of mpMRI as a non-invasive diagnostic tool in clinical practice in good measure. The positive predictive value (PPV) of 89.58% and negative predictive value (NPV) of 92.31% further bolsters the modality's power in correctly identifying malignant and benign lesions. The level of agreement between mpMRI and histopathology was substantial (Cohen's Kappa = 0.798), indicating that mpMRI can provide valuable contributions to

clinical decision making. These outcomes are in accordance with recent evidence and highlight the increasing importance of mpMRI in the diagnosis of prostate cancer.

The sensitivity of this study is similar to several more recent studies reporting high prostate cancer detection rates of clinically significant prostate cancer (csPCa) with mpMRI. However, sensitivity estimates greater than 90% were observed in their prospective cohort study by Hendriks et al. (2021), highlighting the effectiveness of the modality in identifying true malignant cases. Likewise, Elwenspoek et al. (2019) found mpMRI to be a great tool for the detection of csPCa compared to conventional systematic biopsy. This high sensitivity is important because this can lead to the recognition of malignant lesions after a delay which can affect the outcome. This performance help facilitate the use of mpMRI as a front-line diagnostic tool, especially for patients with elevated PSAs or abnormal digital rectal examinations.

Specificity was good, though less than sensitivity, in this study, however. This suggests that there were some misdiagnoses of benign lesions as malignant on the mpMRI. This false-positive phenomenon has also been reported in the literature recently. The benign conditions—prostatitis, benign prostatic hyperplasia (BPH), tissue scarring, and focal atrophy—may be associated with similar imaging features, which can limit the specificity (Han et al., 2021; Żurowska et al., 2023). T2 weighted and diffusion sequences may show overlap in presentation of benign mimics with cancerous tissue, and these benign mimics often demonstrate diffusion restriction and signal characteristics indistinguishable from cancerous tissue (Guneyli et al., 2016). As such, although mpMRI is a powerful triage tool, there is still a risk of false positivity, and careful consideration of the imaging features and history is important, especially when there is uncertainty.

The high PPV and NPV found in this study are also similar to the results of Sathianathen et al. (2020) and Distler et al. (2017), who showed that the integration of mpMRI with other clinical indicators, like PSA density (PSAD) or PI RADS scoring systems, can further improve the diagnostic prediction. Combining PSAD thresholds with PI RADS scores increases the specificity and decreases unnecessary biopsies while maintaining high sensitivity (Shetty et al., 2025). Such integrative approaches are especially useful for the stratifications of patients with an intermediate risk (PI RADS 3) whose uncertainty is highest. Improved predictive capabilities can minimize exposure to invasive biopsy procedures which can cause infection and bleeding (Ahmed et al., 2017).

In this study, the substantial agreement (Cohen's Kappa = 0.798) between mpMRI and histopathological results is consistent with the existing research. Kuru et al. (2016) also found comparable kappa scores, which indicated the high correlation between mpMRI interpretations and histopathology results from experienced radiologists reporting on standardized frameworks like PI RADS v2.1. Standardization of imaging protocols and scoring systems has been a significant improvement to reduce inter reader variability and enhance the diagnostic reproducibility (PI RADS Steering Committee, 2019). However, the role of the interpreter is still important as Bregendahl et al. (2022) and Annamalai et al. (2022) report that radiologist experience plays a significant role in the consistency in diagnosis and structured training programs increase the accuracy of diagnosis.

It is also crucial to overcome the issue of false negative results. This study demonstrated a low false negative rate, but other studies, including Arafa et al. (2023) and Thompson et al. (2026), have reported that small or low-grade tumors can be overlooked on mpMRI because of scanner limitations or the signal properties of the tumor being similar to those of a benign lesion. These tumors might not cause enough diffusion restriction or contrast uptake to show up, especially in early-stage disease. Therefore, clinical vigilance should continue to be warranted and cases that seem suspicious and are negative on the mpMRI should be evaluated with consideration to the clinical judgment and other biomarkers.

There is also growing evidence suggesting that innovative MRI technologies and ancillary tools can aid in the distinction of benign from malignant lesions. Some radiomics and machine learning models have been proposed that have demonstrated their ability to derive quantitative features from imaging data that do better than human interpretation alone (Zhou et al., 2025). The texture, shape and intensity patterns that these computational models can detect are related to the underlying histopathology, which may enhance specificity and sensitivity. The clinical applications of early studies conducted by Gaudiano et al. (2023) and Wang et al. (2017), have shown that radiomics based classifiers can distinguish prostatitis from cancer and can reduce false positives. Artificial intelligence (AI) could be the next step in the evolution of mpMRI diagnostic workflows.

Biparametric MRI (bpMRI), a type of MRI without a contrast agent, has also been compared to mpMRI and used to inform clinical decisions. Some studies reported that bpMRI could have almost identical sensitivity to mpMRI especially for csPCa, but for complex lesions, staging and characterization, mpMRI still outperforms bpMRI (Jin et al., 2025; de Oliveira et al., 2026). The selection of these types of studies is frequently based on available resources, time, and the types of diagnoses required.

Recent studies in South Asia and other regional and local evidence support the diagnostic power of mpMRI. The diagnostic accuracy of mpMRI was demonstrated to be high in both studies, which was also similar to the global results (Hanif, 2024; Riaz et al., 2025), highlighting the significance of mpMRI in various patient populations. Regular local validations reinforce the clinicians' confidence and provide support for implementation in the local context, especially if histopathology is not readily available.

The overall results in this study validate the high sensitivity and relatively good specificity of mpMRI in differentiating benign from malignant prostate conditions. The use of mpMRI can help reduce unnecessary biopsies and provide targeted sampling in clinical pathways that do not completely replace histopathological confirmation, particularly in borderline cases or complex cases. Researchers should focus on the addition of quantitative imaging analytics, standard training, and hybrid models that integrate imaging with biomarkers, to improve the diagnostic accuracy even more in the future.

6. Conclusion

The goal of this study was to assess the ability of multiparametric magnetic resonance imaging (mpMRI) to distinguish between benign and malignant prostate cancer. The results showed that the mpMRI was a very sensitive and effective non-invasive method that yielded useful diagnostic information that aids in clinical differentiation of prostate lesions. mpMRI is able to diagnose clinically significant prostate cancer (csPCa) with an impressive sensitivity of 95.56% and specificity of 82.76%, separating other benign conditions like benign prostatic hyperplasia (BPH) and prostatitis. This is further demonstrated by the high positive predictive value (PPV) of 89.58% and the high negative predictive value (NPV) of 92.31%, indicating that mpMRI has a strong diagnostic accuracy and reliability, with a high probability of detecting malignant and benign lesions. The substantial level of agreement between the results of the mpMRI and the histopathology (Cohen's Kappa 0.798), confirms that there is a close agreement with histopathology that is regarded as the gold standard.

Although the findings are promising, there are still challenges with false positive and false negative results for diagnosis of prostate cancer with mpMRI. Benign conditions like prostatitis and BPH can also cause false positive findings since the images produced are similar to those of cancer. Likewise, small or low-grade tumors could not be picked up by mpMRI, which would also result in a false negative. These restrictions highlight the need to combine mpMRI with histopathology to obtain a comprehensive diagnosis. Combined use of clinical biomarkers, such as PSA density (PSAD) and PI-RADS scoring, with mpMRI can improve the specificity to further

increase diagnostic accuracy. The results of this study confirm previous studies suggesting that mpMRI should be used as a first-line diagnostic modality, especially when patients have an elevated PSA level or an abnormal DRE examination. The use of mpMRI can help guide biopsy procedures to provide more targeted biopsies and increase biopsy yield while decreasing the number of unnecessary biopsies. In addition, mpMRI can be helpful in the staging process to provide important information on the localization, grade and possible extracapsular extension of the disease. The capabilities of mpMRI allow for its use as a fundamental part in the management of prostate cancer, at every step from diagnosis to treatment planning.

In addition, the use of new technologies like radiomics and machine learning models could further improve the clinical value of mpMRI by generating quantitative information that can be explored for better differentiation between benign and malignant tumors. These technologies have the potential to enhance the ability to fine-tune diagnostic algorithms and to increase the reproducibility of interpretations of mpMRI. Overall, mpMRI has shown great promise in enhancing prostate cancer diagnosis by providing high sensitivity and accuracy in detecting clinically significant lesions. The gold-standard diagnostic test for prostate cancer is histopathological biopsy, although mpMRI should be used as an integral component of the diagnostic procedure in prostate cancer patients. The use of mpMRI in the future is expected to be improved with further research and technological progress, such as the introduction of radiomics and AI, making it an increasingly effective tool for the early detection and management of prostate cancer.

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