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RESEARCH ARTICLE

Impact of patient preparation on the diagnostic quality of prostate multiparametric magnetic resonance imaging

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KeyWords:
Multiparametric Prostate MRI, Image Quality, Patient Preparation, Radiographer Practice, Quality Assurance

Abstract

Background: Prostate cancer is one of the most prevalent malignancies among the male population, and multiparametric magnetic resonance imaging (mpMRI) has become a cornerstone of its diagnostic pathway, enabling improved detection and characterization of clinically significant lesions. However, the diagnostic quality of prostate mpMRI is strongly influenced by both technical and patient-related factors, including patient preparation, which may substantially affect the presence of imaging artifacts and overall image interpretability. The aim of this study was to evaluate the impact of patient preparation on the diagnostic quality of prostate mpMRI performed using a 3-Tesla MRI system. Methods: A single-center retrospective observational study was conducted on prostate mpMRI examinations retrieved from the institutional Picture Archiving and Communication System (PACS). Examinations including T2-weighted sequences and diffusion-weighted imaging (DWI) with apparent diffusion coefficient (ADC) maps were eligible for inclusion. The presence of a structured radiological report including PI-RADS assessment served as an inclusion criterion to ensure that the clinical interpretability of each examination had been formally established. Patient preparation was assessed using three parameters: presence of rectal gas, degree of bladder filling, and bowel motion artifacts (scored on a 0–2 scale). An overall preparation score (range, 0–6) was calculated and categorized as good, fair, or poor. Image quality was classified as either diagnostic or limited/non-diagnostic. The association between patient preparation and diagnostic image quality was evaluated using Fisher's exact test. Results: A total of 119 prostate mpMRI examinations were included. Patient preparation was classified as good in 11 patients (9.2%), fair in 75 (63.0%), and poor in 33 (27.7%). Overall, 85 examinations (71.4%) were classified as limited or non-diagnostic. According to PI-RADS version 2.1, lesion distribution was predominantly within the intermediate categories (PI-RADS 1: 0.0%; PI-RADS 2: 74.8%; PI-RADS 3: 2.5%; PI-RADS 4: 11.8%; PI-RADS 5: 10.9%). Fisher's exact test demonstrated a statistically significant association between the quality of patient preparation and diagnostic outcome ($p < 0.05$), indicating that poor preparation was significantly associated with limited diagnostic performance. Analysis of the individual preparation parameters identified the presence of rectal gas as the strongest predictor of diagnostic failure. Conclusions: The findings confirm the statistically significant impact of adequate patient preparation on the technical outcome of prostate mpMRI examinations. This study highlights the pivotal role of the Radiologic Technologist in patient management and artifact prevention, emphasizing the importance of implementing standardized patient preparation protocols to maximize the diagnostic performance of prostate mpMRI

1. Introduction

Prostate cancer is one of the most frequently diagnosed malignancies among men worldwide and remains a major public health challenge [1]. Over the past decade, multiparametric magnetic resonance imaging (mpMRI) has fundamentally transformed the diagnostic pathway and clinical management of prostate cancer. By integrating high-resolution anatomical information obtained from T2-weighted imaging with functional data derived from diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) maps, as well as dynamic contrast-enhanced (DCE) imaging, mpMRI enables accurate localization and characterization of clinically significant prostate lesions. This approach supports targeted biopsy, risk stratification, and treatment planning according to the standardized **Prostate Imaging Reporting and Data System (PI-RADS)** recommendations (Fig. 1) (Fig. 2) [2]

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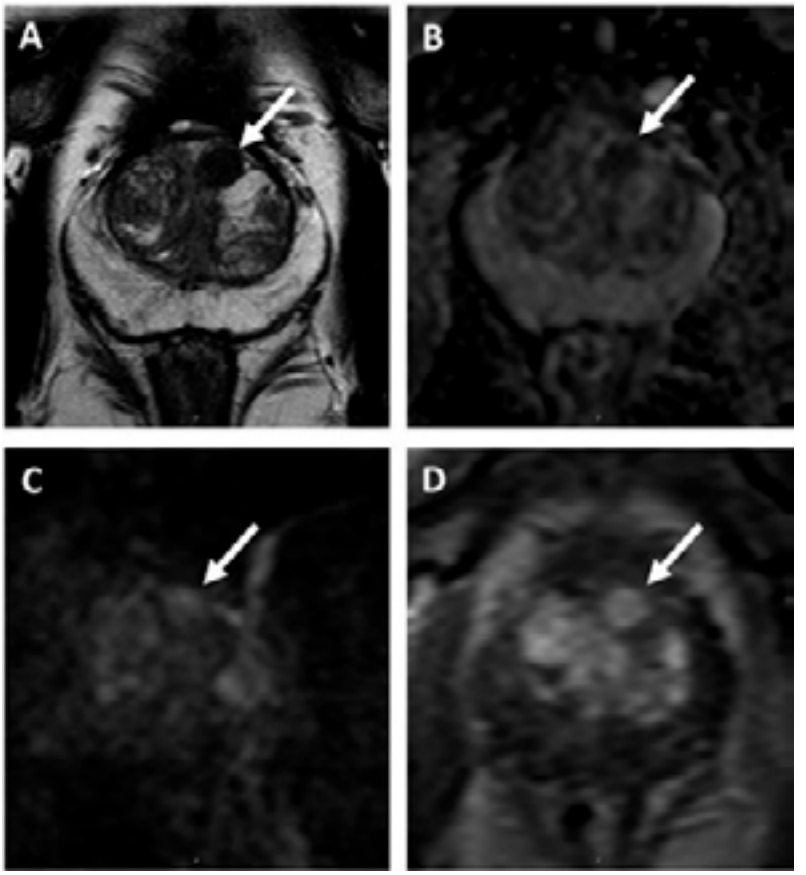

Figure 1. **(A)** *Axial T2-weighted image demonstrating a symmetric, homogeneous hypointense signal (arrows) surrounding the ejaculatory ducts (arrowhead) at the base of the prostate.* **(B)** *Coronal T2-weighted image showing a symmetric, homogeneous hypointense signal (arrows) with a cone-shaped distribution extending from the prostatic base to the level of the verumontanum (arrowhead) within the central portion of the gland.* **(C)** *Axial apparent diffusion coefficient (ADC) map demonstrating a corresponding mildly hypointense symmetric signal (arrow) relative to the findings observed in panel A.* **(D)** *Diffusion-weighted image (b = 1400 s/mm²) showing a corresponding mildly hyperintense symmetric signal (arrow) relative to the findings observed in panels A and B.* **(E)** *Early dynamic contrast-enhanced (DCE) image demonstrating no contrast enhancement within the central zone (arrow)*].

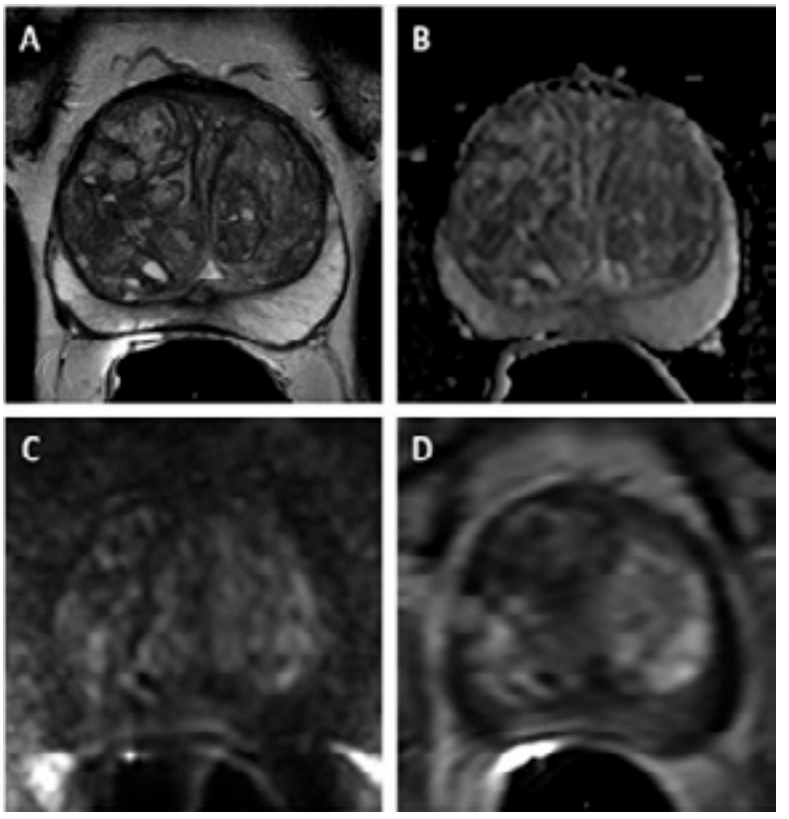

Figure 2. *Prostate gland demonstrating typical imaging features of benign prostatic hyperplasia (BPH). (A) T2-weighted image showing typical, completely encapsulated hyperplastic nodules within the transition zone. (B) Apparent diffusion coefficient (ADC) map demonstrating the absence of focal lesions with low signal intensity. (C) Diffusion-weighted image (DWI, b = 2000 s/mm²) showing no focal areas of marked hyperintensity suggestive of diffusion restriction. (D) Early dynamic contrast-enhanced (DCE) image demonstrating avid enhancement within the typical hyperplastic nodules* [14].

Despite its recognized diagnostic value, the accuracy of prostate mpMRI is highly dependent on image quality. In routine clinical practice, patient-related factors such as motion artifacts, rectal gas, inadequate bladder filling, and bowel peristalsis frequently impair image quality, particularly diffusion-weighted imaging (DWI), which is especially susceptible to local magnetic field inhomogeneities and susceptibility artifacts [3]. Such image degradation may substantially reduce lesion conspicuity, compromise PI-RADS assessment, and ultimately result in false-negative or false-positive findings, as well as limited or non-diagnostic examinations (Fig. 3) [4].

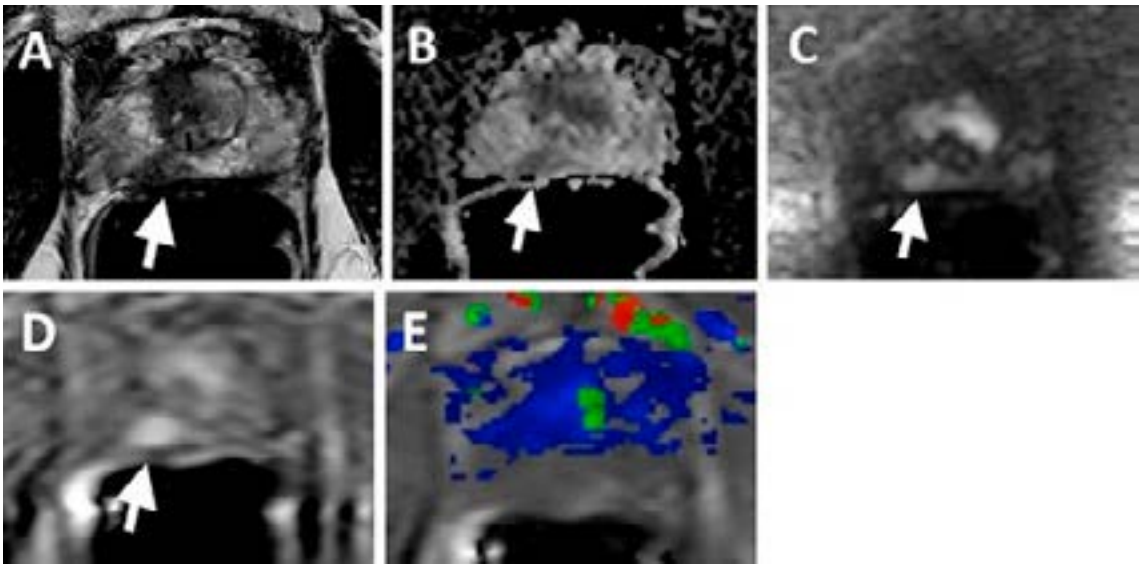

Figure 3. *Multiparametric MRI (mpMRI) examination of the prostate demonstrating a lesion in the* ***right mid-peripheral zone****(arrows).* ***(A)*** *Axial T2-weighted image.* ***(B)*** *Apparent diffusion coefficient (ADC) map.* ***(C)*** *Diffusion-weighted image acquired with* ***b = 2000 s/mm²****.* ***(D)*** *Dynamic contrast-enhanced (DCE) MRI sequence. The* ***Ktrans map*** *derived from the DCE acquisition* ***(E)*** *is degraded by motion artifacts, resulting in poor image quality and failure to accurately localize the lesion on the perfusion map* [26].

Although patient preparation and optimization of acquisition parameters are integral responsibilities of the **Radiologic Technologist (RT)**, standardized patient preparation protocols have not yet been consistently implemented across clinical practice [3,5]. This lack of standardization represents a critical limitation, as variability in patient preparation directly affects image quality, diagnostic confidence, and the overall reliability of prostate mpMRI interpretation.

The present study therefore aimed to evaluate the impact of a standardized patient preparation protocol, implemented and supervised by the Radiologic Technologist, on the diagnostic quality of prostate mpMRI examinations. Specifically, the study investigated whether systematic preventive measures could reduce imaging artifacts, optimize image quality, and improve the consistency and diagnostic accuracy of prostate lesion assessment.

2. Materials and Methods

A single-center, retrospective observational study was conducted to evaluate the impact of patient preparation on the diagnostic quality of prostate multiparametric magnetic resonance imaging (mpMRI).

The study was performed in accordance with the principles of the Declaration of Helsinki. The study protocol was submitted to the Institutional Ethics Committee, which granted a waiver of written informed consent owing to the retrospective design of the study and the use of fully anonymized data extracted from the institutional Picture Archiving and Communication System (PACS). Prior to analysis, all patient data were completely anonymized, and all personal identifiers were removed to ensure confidentiality in compliance with applicable data protection regulations.

A total of 119 consecutive prostate mpMRI examinations performed over a 12-month period (April 2025 to April 2026) were retrieved from the institutional PACS database. As this was a retrospective pilot study based on a convenience sample determined by data availability during the selected study period, no formal *a priori* sample size or statistical power calculation was performed. This methodological choice, reflecting the exploratory nature of the study, is acknowledged as a limitation.

Eligible examinations included complete prostate mpMRI studies comprising high-resolution T2-wei-

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ghted imaging, diffusion-weighted imaging (DWI) with corresponding apparent diffusion coefficient (ADC) maps, and dynamic contrast-enhanced (DCE) sequences following intravenous contrast administration. All included examinations were accompanied by a structured radiological report based on the **Prostate Imaging Reporting and Data System (PI-RADS)** version 2.1 [2]. Examinations were excluded if they were incomplete, prematurely interrupted because of poor patient compliance, or severely degraded by technical failures or physical artifacts unrelated to patient preparation.

Assessment of Patient Preparation

Patient preparation was retrospectively evaluated on the mpMRI images, with particular emphasis on T2-weighted and diffusion-weighted sequences, by assessing three parameters considered to have a potential impact on diagnostic image quality [3,4].

To ensure a standardized and reproducible assessment, each parameter was scored using a three-point ordinal scale (0–2). The scoring system and the composite thresholds defining preparation quality (0–1 = good, 2–3 = fair, and 4–6 = poor) were established by internal consensus among the study authors based on the institution's clinical experience and adapted from qualitative criteria previously developed by expert consensus within the radiology team.

The evaluated parameters were defined as follows:

1. Rectal gas

Rectal gas was visually assessed and classified as:

- **0:** absent or minimal, without appreciable interference with image quality;
- **1:** moderate, with possible but non-significant image degradation;
- **2:** marked, causing evident geometric distortion or magnetic susceptibility artifacts, particularly affecting DWI and ADC images.

2. Bladder filling

Bladder filling was evaluated on sagittal T2-weighted images and classified as:

- **0:** optimal, allowing appropriate anatomical assessment;
- **1:** suboptimal, with the bladder being slightly overfilled or underfilled but still acceptable for diagnostic purposes;
- **2:** inadequate, potentially compromising image quality or patient comfort (e.g., provoking involuntary movement).

3. Bowel motion

Bowel motion was assessed on T2-weighted and DWI sequences according to the presence of motion-related artifacts (ghosting and image blurring) and classified as:

- **0:** absent;
- **1:** mild, without significant impact on diagnostic interpretation;
- **2:** pronounced, with motion or ghosting artifacts potentially limiting assessment of the peripheral or transition zones.

For each examination, an overall patient preparation score was calculated by summing the scores assigned to the three parameters (range: 0–6). The total score was subsequently categorized into three preparation quality groups: **good** (0–1), **fair** (2–3), and **poor** (4–6).

Patient preparation was independently assessed by two board-certified radiologists with 5 and 10 years of experience in genitourinary imaging, respectively. Both readers were blinded to the patients' clinical information and to the original radiological reports. In cases of disagreement regarding the scoring of individual parameters, the final assessment was established by consensus following a joint review of the images. Interobserver agreement prior to consensus was evaluated statistically.

Assessment of Diagnostic Image Quality

Overall diagnostic image quality was classified into two categories:

- **Diagnostic examination**
- **Limited diagnostic examination or non-diagnostic examination**

This classification was extracted directly from the original radiological report issued by the reporting radiologist at the time of image interpretation. To minimize reporting bias, it should be noted that the reporting radiologist was fully blinded to the formal patient preparation score (0–6), which was assigned retrospectively as part of the present study.

Statistical Analysis

Collected data were entered into an anonymized electronic database. Categorical variables were summarized as absolute frequencies and percentages.

The demographic characteristics of the study population and the distribution of the individual patient preparation scores are summarized in **Table 1** and **Table 2**, respectively.

ID studio	Exam date	Age	Rectal air (0=absent,1=-moder-ate,2=marked)	Bladder distension (0=opti-mal,1=subopti-mal,2=nonopti-mal)	Intestinal motility (0=ab-sent,1=mild,2=ev-ident)	Preparation index (sum 0-6)
SY840774	19/03/25	61	1	0	0	1
SY513545	19/03/25	69	1	1	1	3
SY505378	10/07/25	70	0	0	1	1
SY2394125	19/06/25	81	0	2	2	4
SY2507180	11/12/25	69	1	0	1	2
SY2473961	30/10/25	73	1	0	1	2
SY2592433	08/05/25	60	1	2	1	4
SY287006	30/10/25	80	1	1	0	2
SY3165	11/09/25	60	1	0	2	3
SY85443	13/11/25	61	1	1	0	2
SY287898	27/11/25	54	1	1	1	3
SY312814	31/07/25	74	1	1	0	2
SY514087	13/11/25	75	1	1	1	3
SY510015	22/05/25	59	1	0	1	2
SY520449	25/09/25	53	1	0	1	2
SY562334	18/09/25	59	2	0	1	3
SY628456	22/01/26	70	1	1	1	3
SY695160	03/04/25	75	1	0	1	2
SY819769	10/03/26	60	1	1	1	3
SY1165416	13/11/25	69	2	1	2	5
SY77113	12/02/26	65	2	2	2	6
SY713907	29/05/25	55	1	1	1	3
SY651321	05/02/26	52	2	2	2	6
SY2654002	19/03/26	68	2	1	1	4
SY2599137	03/07/25	65	1	1	2	4
SY740562	10/07/25	62	2	1	1	4
SY300697	22/01/26	39	2	1	1	4
SY72465	01/04/15	71	1	0	1	2
SY2798130	04/12/25	70	2	0	1	3
SY1028262	04/09/25	63	2	2	1	5
SY2932354	19/03/26	62	1	2	1	4
SY511087	30/10/25	56	1	1	1	3
SY2629720	18/12/25	55	1	0	0	1
SY287941	23/10/25	77	1	0	1	2
SY1187471	22/05/25	75	1	0	1	2
SY2254067	30/10/25	57	1	0	0	1
SY778540	03/04/25	60	1	1	1	3
SY2962648	05/03/25	73	1	0	0	1
SY2808010	27/11/25	82	1	0	2	3
SY2505902	13/11/2015	65	1	0	1	2
SY2398162	18/12/2025	43	1	2	1	4
SY2668442	07/08/2025	79	2	1	1	4
SY2793849	13/11/2025	66	2	1	1	4
SY2161004	05/06/2025	66	1	1	1	3
SY2728792	16/10/2025	74	1	0	1	2
SY1148186	11/12/2025	64	1	1	1	3
SY1198826	08/01/2026	77	1	1	1	3
SY2779169	27/11/2025	61	1	1	1	3
SY2816269	11/12/2025	71	1	1	2	4
SY991906	12/02/2026	76	2	0	1	3
SY2731610	25/09/2025	58	1	1	1	3
SY2768870	30/10/2025	79	2	1	1	4
SY2663700	31/07/2025	59	2	0	1	3
SY2804193	27/11/2025	69	1	2	1	4
SY2442948	10/04/2025	47	1	1	1	3

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SY1060598	05/03/2025	81	1	1	1	3
SY565678	29/05/2025	72	1	0	1	2
SY503480	09/10/2025	70	1	0	1	2
SY770385	13/11/2025	50	2	2	1	5
SY2397380	22/05/2025	58	1	0	1	2
SY2962474	05/03/2025	66	1	1	1	3
SY37211	31/07/2025	66	1	1	1	3
SY710899	29/05/2025	52	1	0	1	2
SY2783089	05/02/2025	66	1	1	1	3
SY1927743	25/09/2025	69	2	1	1	4
SY2162522	05/03/2026	77	1	1	1	3
SY2432783	24/07/2025	59	2	1	1	4
SY1218593	17/04/2025	71	2	0	1	3
SY505378	10/07/2025	70	1	0	1	2
SY1920925	09/10/2025	65	0	1	1	2
SY66437	24/04/2025	69	2	0	1	3
SY2961209	19/03/2026	73	1	2	1	4
SY499776	16/10/2025	71	1	1	1	3
SY2570876	24/04/2025	66	1	1	2	4
SY513545	19/03/2025	69	1	1	1	3
SY1409918	30/10/2025	64	1	1	1	3
SY2864029	22/01/2025	50	1	2	1	4
SY3165	11/09/2025	60	1	0	1	2
SY2721509	16/10/2025	77	2	1	2	5
SY1789190	10/04/2025	74	2	0	1	3
SY340772	03/07/2025	66	1	0	1	2
SY2786909	27/11/2025	48	1	2	1	4
SY1903825	03/04/2025	68	1	1	1	3
SY2632520	31/07/2025	63	1	1	1	3
SY2655520	26/06/2025	78	2	0	1	3
SY1180292	22/01/2026	62	1	1	1	3
SY2981448	19/03/2026	67	1	0	2	3
SY333319	22/05/2025	60	1	1	1	3
SY2805329	27/11/2025	69	0	0	1	1
SY362432	07/08/2025	73	1	1	1	3
SY2573478	08/05/2025	73	1	1	1	3
SY269835	19/03/2026	61	1	0	0	1
SY623303	13/11/2025	69	1	1	1	3
SY624550	04/09/2025	65	1	0	1	2
SY1887862	24/07/2025	71	1	0	1	2
SY1003785	27/11/2025	51	1	1	1	3
SY517886	19/03/2026	72	2	1	1	4
SY2778951	30/10/2025	64	1	0	0	1
SY974696	18/12/2025	66	1	1	2	4
SY2678065	24/07/2025	60	2	0	1	3
SY313797	22/01/2026	69	0	0	0	0
SY2323562	22/05/2025	61	1	1	1	3
SY604957	22/01/2026	61	1	0	1	2
SY517090	05/03/2025	58	1	0	1	2
SY510015	22/05/2025	59	1	0	1	2
SY345669	02/10/2025	61	1	1	1	3
SY520972	05/02/2026	64	2	0	1	3
SY345383	12/06/2025	68	1	1	1	3
SY557720	12/02/2026	64	2	1	2	5
SY280195	06/11/2025	62	1	2	1	4
SY2721050	11/09/2025	72	0	1	1	2
SY2500047	27/11/2025	73	1	1	2	4
SY277149	12/06/2025	63	0	0	1	1
SY659298	31/07/2025	68	1	2	1	4
SY14543	19/06/2025	63	1	0	2	3
SY2501682	04/12/2025	43	1	1	1	3
SY738669	02/10/2025	62	0	1	0	1
SY86224	08/01/2026	51	2	2	1	5
SY2883730	22/01/2026	69	2	2	1	5

Tab. 1: *Demographic characteristics and physiological assessment of exam preparation. The table shows the study ID, the date of execution and the age of the patient. Physiological parameters that can influence imaging quality are also quantified, rated on a scale of* 0 *to* 2: *amount of rectal air* (0 = *absent*, 1 = *moderate*, 2 = *marked*), *degree of bladder distension* (0 = *optimal*, 1 = *suboptimal*, 2 = *suboptimal*) *and level of bowel motility* (0 = *absent*, 1 = *mild*, 2 = *evident*). *The overall readiness index represents the sum of the scores of these three factors, ranging from* 0 *to* 6.

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ID studio	Preparation class (Good/Fair/Poor)	Quality (Diagnostic / Limited-Non-Diagnostic)	Mostly impaired sequence (None/T2/DWI/DCE)	PI-RADS (1-5)
SY840774	Good	Diagnostic	None	2
SY513545	Fair	Diagnostic	None	2
SY505378	Good	Diagnostic	None	3
SY2394125	Poor	Diagnostic	None	4
SY2507180	Fair	Diagnostic	None	2
SY2473961	Fair	Diagnostic	None	2
SY2592433	Poor	Diagnostic	None	2
SY287006	Fair	Limited-Non-Diagnostic	DWI	5
SY3165	Fair	Limited-Non-Diagnostic	None	2
SY85443	Fair	Limited-Non-Diagnostic	DWI	2
SY287898	Fair	Limited-Non-Diagnostic	DWI	2
SY312814	Fair	Diagnostic	None	4
SY514087	Fair	Limited-Non-Diagnostic	DWI	2
SY510015	Fair	Diagnostic	None	2
SY520449	Fair	Diagnostic	None	2
SY562334	Fair	Limited-Non-Diagnostic	DWI	2
SY628456	Fair	Limited-Non-Diagnostic	DWI	2
SY695160	Fair	Diagnostic	None	2
SY819769	Fair	Limited-Non-Diagnostic	DCE	2
SY1165416	Poor	Limited-Non-Diagnostic	DWI	2
SY77113	Poor	Limited-Non-Diagnostic	DWI	2
SY713907	Fair	Limited-Non-Diagnostic	DWI	2
SY651321	Poor	Limited-Non-Diagnostic	DWI	2
SY2654002	Poor	Limited-Non-Diagnostic	DWI	4
SY2599137	Poor	Limited-Non-Diagnostic	DWI	4
SY740562	Poor	Limited-Non-Diagnostic	DWI	2
SY300697	Poor	Limited-Non-Diagnostic	DWI	2
SY72465	Fair	Limited-Non-Diagnostic	None	2
SY2798130	Fair	Limited-Non-Diagnostic	DWI	5
SY1028262	Poor	Limited-Non-Diagnostic	DCE	5
SY2932354	Poor	Limited-Non-Diagnostic	DWI	2
SY511087	Fair	Limited-Non-Diagnostic	DWI	2
SY2629720	Good	Limited-Non-Diagnostic	DWI	2
SY287941	Fair	Limited-Non-Diagnostic	DWI	4
SY1187471	Fair	Diagnostic	None	2
SY2254067	Good	Diagnostic	None	2
SY778540	Fair	Limited-Non-Diagnostic	DWI	2
SY2962648	Good	Diagnostic	None	4
SY2808010	Fair	Limited-Non-Diagnostic	DWI	5
SY2505902	Fair	Limited-Non-Diagnostic	DWI	2
SY2398162	Poor	Limited-Non-Diagnostic	DWI	2
SY2668442	Poor	Limited-Non-Diagnostic	DWI	3
SY2793849	Poor	Limited-Non-Diagnostic	DWI	2
SY2161004	Fair	Diagnostic	None	2
SY2728792	Fair	Limited-Non-Diagnostic	DWI	2
SY1148186	Fair	Diagnostic	None	2
SY1198826	Fair	Diagnostic	None	4
SY2779169	Fair	Limited-Non-Diagnostic	DWI	2
SY2816269	Poor	Limited-Non-Diagnostic	DWI	5
SY991906	Fair	Limited-Non-Diagnostic	DWI	2
SY2731610	Fair	Diagnostic	None	2
SY2768870	Poor	Limited-Non-Diagnostic	DWI	2
SY2663700	Fair	Limited-Non-Diagnostic	DCE	4
SY2804193	Poor	Limited-Non-Diagnostic	DWI	2
SY2442948	Fair	Limited-Non-Diagnostic	DWI	2
SY1060598	Fair	Limited-Non-Diagnostic	DWI	2
SY565678	Fair	Limited-Non-Diagnostic	DWI	2
SY503480	Fair	Diagnostic	None	2
SY770385	Poor	Limited-Non-Diagnostic	DWI	2
SY2397380	Fair	Limited-Non-Diagnostic	DWI	5
SY2962474	Fair	Diagnostic	None	5
SY37211	Fair	Limited-Non-Diagnostic	DWI	2
SY710899	Fair	Diagnostic	None	2
SY2783089	Fair	Limited-Non-Diagnostic	DWI	2

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SY1927743	Poor	Limited-Non-Diagnostic	DWI	2
SY2162522	Fair	Limited-Non-Diagnostic	DWI	4
SY2432783	Poor	Limited-Non-Diagnostic	DWI	2
SY1218593	Fair	Limited-Non-Diagnostic	DCE	4
SY505378	Fair	Diagnostic	DWI	3
SY1920925	Fair	Diagnostic	None	2
SY66437	Fair	Limited-Non-Diagnostic	DWI	2
SY2961209	Poor	Limited-Non-Diagnostic	DWI	2
SY499776	Fair	Limited-Non-Diagnostic	DWI	2
SY2570876	Poor	Limited-Non-Diagnostic	DCE	2
SY513545	Fair	Limited-Non-Diagnostic	DWI	2
SY1409918	Fair	Limited-Non-Diagnostic	DWI	2
SY2864029	Poor	Limited-Non-Diagnostic	T2	2
SY3165	Fair	Diagnostic	None	2
SY2721509	Poor	Limited-Non-Diagnostic	DWI	2
SY1789190	Fair	Limited-Non-Diagnostic	DWI	2
SY340772	Fair	Diagnostic	None	2
SY2786909	Poor	Limited-Non-Diagnostic	DWI	5
SY1903825	Fair	Limited-Non-Diagnostic	DWI	2
SY2632520	Fair	Diagnostic	None	2
SY2655520	Fair	Limited-Non-Diagnostic	DWI	5
SY1180292	Fair	Limited-Non-Diagnostic	DWI	2
SY2981448	Fair	Limited-Non-Diagnostic	DWI	2
SY333319	Fair	Limited-Non-Diagnostic	DWI	2
SY2805329	Good	Diagnostic	None	5
SY362432	Fair	Limited-Non-Diagnostic	DWI	2
SY2573478	Fair	Limited-Non-Diagnostic	DWI	5
SY269835	Good	Diagnostic	None	4
SY623303	Fair	Limited-Non-Diagnostic	DWI	2
SY624550	Fair	Limited-Non-Diagnostic	DWI	2
SY1887862	Fair	Limited-Non-Diagnostic	DWI	4
SY1003785	Fair	Limited-Non-Diagnostic	DCE	2
SY517886	Poor	Limited-Non-Diagnostic	DWI	2
SY2778951	Good	Diagnostic	None	2
SY974696	Poor	Limited-Non-Diagnostic	T2	5
SY2678065	Fair	Limited-Non-Diagnostic	DWI	2
SY313797	Good	Diagnostic	None	2
SY2323562	Fair	Limited-Non-Diagnostic	DWI	2
SY604957	Fair	Limited-Non-Diagnostic	DWI	2
SY517090	Fair	Limited-Non-Diagnostic	DWI	2
SY510015	Fair	Limited-Non-Diagnostic	DCE	2
SY345669	Fair	Limited-Non-Diagnostic	DCE	2
SY520972	Fair	Limited-Non-Diagnostic	DWI	2
SY345383	Fair	Limited-Non-Diagnostic	DWI	2
SY557720	Poor	Limited-Non-Diagnostic	DWI	4
SY280195	Poor	Limited-Non-Diagnostic	DWI	2
SY2721050	Fair	Diagnostic	None	2
SY2500047	Poor	Limited-Non-Diagnostic	T2	5
SY277149	Good	Diagnostic	None	2
SY659298	Poor	Limited-Non-Diagnostic	DCE	2
SY14543	Fair	Limited-Non-Diagnostic	T2	2
SY2501682	Fair	Limited-Non-Diagnostic	DCE	2
SY738669	Good	Diagnostic	None	4
SY86224	Poor	Limited-Non-Diagnostic	DWI	2
SY2883730	Poor	Limited-Non-Diagnostic	DWI	2

Tab. 2: *Qualitative imaging outcome and diagnostic results (PI-RADS). The table illustrates the classification of patient preparation into three categories (Good, Fair, Poor) and the impact on the overall quality of the examination (judged as Diagnostic or Limited/Non-Diagnostic). For exams compromised by artifacts, the most affected MRI sequence (None, T2, DWI, or DCE) is specified. Finally, the PI-RADS score assigned is reported for each study, rated on a scale of 1 to 5.*

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Interobserver agreement between the two independent readers for the patient preparation scores was assessed using the **weighted Cohen's kappa coefficient** for the individual preparation parameters and the **intraclass correlation coefficient (ICC)** for the overall preparation score (range: 0–6).

To evaluate the association between patient preparation quality (**good**, **fair**, and **poor**) and the diagnostic quality of the examination (**diagnostic** vs. **limited/non-diagnostic**), a contingency table was constructed (Table 3). Differences between observed and expected frequencies were analyzed using **Pearson's chi-square test**. Statistical significance was defined as a two-sided p value < 0.05 ($p < 0.05$ indicating a statistically significant association, whereas $p \geq 0.05$ was considered not statistically significant).

Patient preparation quality was categorized into three groups, with the following distribution:

- **Good preparation:** 11 patients (9.2%)
- **Fair preparation:** 75 patients (63.0%)
- **Poor preparation:** 33 patients (27.7%)

Overall, 85 examinations (71.4%) were classified as **limited** or **non-diagnostic**. This proportion is consistent with the institution's historical experience for outpatient examinations performed without a standardized bowel preparation protocol.

Lesions were classified according to **PI-RADS version 2.1** [2]. The distribution of PI-RADS scores was as follows: PI-RADS 1, 0 patients (0.0%); PI-RADS 2, 89 patients (74.8%); PI-RADS 3, 3 patients (2.5%); PI-RADS 4, 14 patients (11.8%); and PI-RADS 5, 13 patients (10.9%). The majority of examinations were therefore concentrated within the lower-to-intermediate PI-RADS categories.

Observed contingency table			
Preparation class	Diagnostic	Limited/Non-diagnostic	Total
Good	10	1	11
Discreet	22	53	75
Poor	2	31	33
Total	34	85	119
Expected frequencies			
Preparation class	Diagnostic	Limited/Non-diagnostic	
Good	3.142857143	7.857142857	
Discreet	21.42857143	53.57142857	
Poor	9.428571429	23.57142857	
Chi-square p-value	0.0000004654023036		

Table 3. *Contingency table between preparation class and exam quality; Pearson chi-square test with statistical significance level* (p).

3. Results

A total of 119 prostate multiparametric magnetic resonance imaging (mpMRI) examinations were included in the present study to investigate the association between patient preparation quality and diagnostic image quality. All examinations were performed according to the institutional standardized prostate mpMRI protocol. For each examination, data regarding patient preparation and lesion assessment according to the **Prostate Imaging Reporting and Data System (PI-RADS)** were collected.

The association between patient preparation quality and diagnostic outcome was assessed using **Fisher's exact test**, which was selected instead of Pearson's chi-square test because the expected frequency for the **Good preparation/Diagnostic examination** cell was below the recommended threshold of

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five (expected count = 3.14). The analysis demonstrated a statistically significant association between preparation quality and diagnostic image quality ($p < 0.001$). As expected for Fisher's exact test, only the exact p-value was reported, without calculation of a test statistic or degrees of freedom.

Specifically, higher-quality patient preparation was associated with a greater likelihood of obtaining diagnostic examinations, whereas poor preparation was significantly associated with limited or non-diagnostic studies.

A separate analysis of the individual preparation parameters (rectal gas, bladder filling, and bowel motion) was subsequently performed to identify the factors most strongly associated with reduced image quality. Among these variables, **marked rectal gas (score = 2)** emerged as the strongest predictor of diagnostic failure, confirming its major impact on image degradation, particularly in diffusion-weighted imaging [3].

4. Discussion

The present study demonstrated a statistically significant association between patient preparation quality and the diagnostic performance of prostate multiparametric magnetic resonance imaging. These findings support the hypothesis that inadequate patient preparation adversely affects image quality and consequently the accurate interpretation of prostate mpMRI examinations.

Although prostate mpMRI is recognized as one of the most accurate imaging modalities for the detection of clinically significant prostate cancer, its diagnostic performance remains highly dependent on technical image quality. Patient-related factors, including rectal gas, residual fecal material, inadequate bladder filling, and bowel peristalsis, are well-established sources of artifacts, particularly on diffusion-weighted imaging (DWI), where magnetic susceptibility effects may substantially impair lesion conspicuity [3]. Such artifacts may reduce diagnostic confidence and compromise the accurate detection and characterization of clinically significant lesions.

The statistically significant association observed in the present study ($p < 0.001$) indicates that better patient preparation is associated with improved diagnostic reliability, further emphasizing the importance of standardized pre-examination preparation as an integral component of the prostate mpMRI workflow.

The influence of patient preparation on prostate mpMRI quality has been extensively documented in earlier literature, particularly between 2012 and 2018, including the recommendations issued by the **European Society of Urogenital Radiology (ESUR)**, which emphasized the importance of minimizing rectal gas and optimizing bladder filling before image acquisition. More recently, attention has shifted toward standardized assessment of image quality itself through the introduction of the **PI-QUAL** scoring system, first described by Giganti et al. in 2020 [4]. PI-QUAL is a validated five-point scoring system specifically developed to evaluate the diagnostic adequacy of each mpMRI sequence.

Unlike PI-QUAL, the present study introduced an internally developed composite preparation score specifically designed to assess **pre-analytical patient-related factors** rather than the quality of the acquired images themselves. Although this score has not yet undergone external validation, it addresses a different aspect of the imaging process by providing an objective assessment of anatomical conditions that can be directly evaluated and, to some extent, managed by the **Radiologic Technologist (RT)** before or during image acquisition. Therefore, rather than replacing image-quality assessment systems such as PI-QUAL, the proposed preparation score may complement them by focusing on modifiable factors upstream of image acquisition.

From a clinical perspective, the observed association suggests that appropriate patient preparation improves image quality and enhances the reliability of PI-RADS assessment, thereby reducing the risk of both overestimation and underestimation of clinically significant lesions. In this context, several evidence-based recommendations may help reduce the number of suboptimal examinations: (i) providing patients with clear written and verbal preparation instructions before the examination; (ii) implementing standardized measures to reduce rectal gas, such as the administration of a rectal micro-enema approximately 2–3 hours before imaging, when not contraindicated; and (iii) adopting standardized bladder preparation protocols based on controlled fluid intake following bladder emptying immediately before the examination [3]. These relatively simple interventions may substantially improve examination quality and overall diagnostic performance.

Several limitations should be acknowledged. First, the study included a relatively small sample from a single institution, limiting the generalizability of the findings. Second, assessment of patient preparation was based on an internally developed scoring system

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that has not yet undergone external validation, unlike the validated PI-QUAL system for image quality assessment [4]. Although interobserver agreement was evaluated, some degree of subjective interpretation remains unavoidable. Furthermore, potentially relevant variables, including scanner-specific acquisition parameters and operator experience, were not investigated. Finally, complete histopathological confirmation was not available for all patients, precluding direct correlation between preparation quality and diagnostic accuracy.

Future multicenter studies including larger patient cohorts will be required to validate the proposed preparation score and confirm its clinical applicability. Moreover, integrating this pre-acquisition preparation score with validated image-quality assessment tools such as PI-QUAL may provide a more comprehensive evaluation of the entire diagnostic pathway and clarify its impact on histopathological outcomes, diagnostic accuracy, and patient management.

5. Conclusions

The present study investigated the impact of patient bowel preparation on the diagnostic quality of prostate multiparametric magnetic resonance imaging (mpMRI), highlighting its influence on examination performance. The findings indicate that patient preparation represents a relevant factor in prostate imaging. In particular, although most patients demonstrated **fair** preparation, a substantial proportion presented with **poor** preparation, which may adversely affect image quality and diagnostic interpretation. The most important finding of this study was the demonstration of a statistically significant association ($p < 0.05$) between the quality of patient preparation and diagnostic image quality. These results suggest that bowel preparation should not be regarded as a secondary aspect of the imaging workflow but rather as a determinant of the overall diagnostic performance of prostate mpMRI. Inadequate preparation may compromise image interpretation and consequently influence the assignment of the **PI-RADS** score [2]. From a clinical perspective, these findings are particularly relevant because prostate mpMRI currently represents a key imaging modality for the detection, risk stratification, and therapeutic management of prostate cancer. Suboptimal image quality may reduce diagnostic accuracy and potentially affect subsequent clinical decision-making, including biopsy indication, patient surveillance, and treatment planning. Based on these observations, the implementation of standardized patient preparation protocols should be strongly encouraged to minimize image artifacts and optimize examination quality [3]. Relatively simple interventions—including comprehensive patient education and standardized bowel and bladder preparation procedures—may substantially improve the diagnostic performance of prostate mpMRI. Nevertheless, the findings should be interpreted in light of several limitations, including the relatively small sample size, the single-center retrospective design, and the potential subjectivity associated with assessment of patient preparation. In addition, the preparation score used in this study has not yet undergone external validation. Therefore, larger prospective multicenter studies using standardized and validated assessment tools are warranted to confirm these preliminary findings. In conclusion, this study emphasizes that patient preparation is a critical determinant of the quality and diagnostic reliability of prostate mpMRI. Greater attention to standardized preparation protocols, together with the active involvement of the **Radiologic Technologist** in patient education and pre-examination management, may significantly enhance diagnostic performance and ultimately contribute to improved clinical management of patients with suspected or confirmed prostate cancer.

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