# European Journal of Clinical Pharmacy

**Print ISSN:** 2385-409X **Online ISSN**: 3105-0409

Website: https://farmclin.com/


*Original Research*

# Diagnostic Accuracy of Magnetic Resonance Imaging (MRI) in Detection of Cervical Carcinoma by Taking Histopathology as Gold Standard


***Article History:***



**Name of Author:**

Murk Razzaque[1], Ghazala Shahzad[2], Ulfat Memon[3], Rabail Ayaz[4], Iqra Mustafa[5], Saddam Hussain[6]

***Affiliation:***

[1-6]*Liaquat University of Medical and Health Sciences, Jamshoro, Hyderabad, Pakistan.*

***Corresponding Author:***

Murk Razzaque

Email: akhlaquddin.tmg@gmail.com



***Received:*** 17-11-2025

***Revised:*** 19-12-2025

***Accepted:*** 24-12-2025

***Published:*** 30-12-2025





***Abstract***: **Objective:** To determine the diagnostic accuracy of magnetic resonance imaging in detection of cervical carcinoma by taking histopathology as gold standard. **Study Design:** Cross sectional validation study. **Place and Duration of Study:** Conducted from 16 July 2025 to 16 November 2025 at the Department of Diagnostic Radiology, Liaquat University of Medical and Health Sciences, Jamshoro, Hyderabad. **Methodology:** A total of 100 clinically suspected female patients aged 30 to 50 years were included. Magnetic resonance imaging of pelvis was performed followed by cervical biopsy for histopathological confirmation. SPSS 26 was used for data analysis. A 2 × 2 contingency table was constructed to calculate sensitivity, specificity, positive predictive value, negative predictive value and overall diagnostic accuracy. **Results:** Mean age was 39.66 ± 6.34 years. Magnetic resonance imaging showed positive findings in 29 (29.0%) patients, while histopathology confirmed cervical carcinoma in 12 (12.0%) patients. Sensitivity was 83.30%, specificity was 78.40%, and overall diagnostic accuracy was 79.00%. Positive predictive value was 34.50%, and negative predictive value was 97.20%. Higher sensitivity was observed in patients aged >40 years and in those with body mass index >25 kg/m$^2$. **Conclusion:** Magnetic resonance imaging showed good sensitivity and very high negative predictive value but moderate specificity in detection of cervical carcinoma. It is helpful for ruling out disease but histopathology remain definitive diagnostic method.



*Keywords*: Diagnostic Imaging; Magnetic Resonance Imaging; Sensitivity and Specificity; Uterine Cervical Neoplasms


## INTRODUCTION

Cervical carcinoma is one of the major cancers of the female reproductive system. It is a major health concern, particularly in developing countries.1 This cancer results from uncontrolled cellular growth, which occurs in the cervical epithelium. This uncontrolled cellular growth is most common at the transformation zone. The major causative agent of cervical cancer is considered to be human papillomavirus, although other causative factors include early age at marriage, multiple sexual partners, multiple pregnancies, low socioeconomic status and the use of tobacco.2 In the early stages, patients with cervical cancer are asymptomatic. They may be unaware of their condition for a long time. When symptoms occur, they may include irregular vaginal bleeding, vaginal bleeding after coitus, intermenstrual bleeding, foul-smelling watery discharge, and pelvic pain.3 Advanced cases of cervical cancer can also result in urinary symptoms, bowel symptoms, and lower limb edema.3

Diagnosis of cervical carcinoma involves an integrative approach that includes the clinical evaluation of the patient, cytological screening, and imaging studies followed by histopathological examination of the tumor.4 Various screening methods, including the Papanicolau smear and HPV testing, help to detect precancerous changes before the occurrence of invasive cancer.5 During the clinical examination of the patient, the presence of a tumor can be detected by speculum examination of the cervix, which may be ulcerative, exophytic and infiltrative in nature.6 Colposcopy is used to examine abnormal areas of the cervix and to obtain a

biopsy specimen. Histopathological examination of the tumor tissue is used to establish the definitive diagnosis of the tumor by the presence of dysplastic or malignant cells invading the stroma of the cervix.7

Magnetic Resonance Imaging (MRI), being a key non-invasive imaging technique for the assessment of cervical carcinoma, is useful due to the high contrast resolution provided by the modality and the lack of the use of ionizing radiation.8 MRI is particularly useful for assessing the extent of the tumor, the depth of invasion into the stroma, the involvement of the parametrium, and the involvement of adjacent structures such as the bladder and the rectum.9 In T2-weighted images, cervical carcinoma is hyperintense compared to the surrounding cervical tissue. In T1-weighted images, it is isointense. 10

There is a scarcity of local literature regarding the diagnostic accuracy of magnetic resonance imaging in cervical carcinoma in the Hyderabad region. Most literature is from abroad or from metropolitan cities, and it is suspected that the results may not truly reflect the population and the pattern of the disease in our region. In Hyderabad, it is observed that patients with cervical cancer usually present late with the disease, and this is due to the lack of screening facilities and awareness among the population. Hence, it is crucial to make an accurate diagnosis in such patients, and the assessment of the accuracy of MRI in our institution would provide valuable information regarding the reliability of the procedure.

## METHODOLOGY

This cross-sectional validation study was carried out in the Department of Diagnostic Radiology Liaquat University of Medical and Health Sciences, Jamshoro, Hyderabad from 16 July 2025 to 16 November 2025. Approval of synopsis was obtained from CPSP and ethical approval was taken from the institutional ethical review committee (certificate No. LUMHS/REC/-880 dated 09/07/2025) before starting the study. Sample size was calculated by using WHO Sample Size Calculator based on sensitivity and specificity. Sensitivity was taken as 80%,11 specificity 76.9%,11 prevalence 9%,12 margin of error 15% and confidence interval 95%, and the calculated sample size was 312. Due to less patient turnover during study period 100 patients were finally included. All female patients aged 30 to 50 years who were clinically suspected to have cervical carcinoma and referred to Radiology department for MRI were included. Clinical suspicion was considered when patient had symptoms for more than 2 months such as irregular vaginal bleeding including postcoital, intermenstrual or postmenopausal bleeding, pain during sexual intercourse, watery or bloody vaginal discharge with strong odor and pelvic pain. Females already diagnosed as Ca cervix, those receiving chemotherapy or radiotherapy, those having previous cervical surgery or carcinoma of uterus were excluded. Written informed consent was taken from each patient before enrollment after explaining study purpose and procedure.

A comprehensive clinical history was taken, with the duration of symptoms being recorded. The clinical findings were also recorded. Magnetic resonance imaging of the pelvis was done with a Philips Achieva Nova machine, which is a dual 1.5-tesla machine. The imaging sequences included sagittal T2-weighted imaging, axial T1-weighted and T2-weighted imaging, and coronal T1-weighted and T2 fat-saturated imaging of the cervix. Subsequently, a biopsy of the cervix was taken. The findings of histopathology were used as the gold standard to confirm the disease. The results were then classified after all the imaging and biopsy procedures were done. The imaging findings of cervical carcinoma included the presence of an irregular area in the endocervical canal, which was isointense on T1-weighted imaging, hyperintense on T2-weighted imaging, and enhanced on fat-saturated T2-weighted imaging. The histopathology findings of cervical carcinoma included the presence of atypical cells with squamous cell carcinoma in the biopsy of the cervix.

Data were entered and analyzed using SPSS version 26. For quantitative variables including age, height, weight, BMI and duration of symptoms mean ± standard deviation was calculated. Frequencies and percentages were calculated for residential status and cervical carcinoma on MRI and histopathology. A 2 × 2 contingency table was constructed to compute sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of MRI by taking histopathology as gold standard. Effect modifiers including age, BMI and duration of symptoms were controlled through stratification. Post-stratification diagnostic accuracy were also determined accordingly.

## RESULTS

The mean age of participants was 39.66±6.34 years with average weight were 66.25±7.26 kg and height was 1.59±0.05 m. The body mass index was calculated as 26.05±2.08 kg/m² and duration of symptoms were 75.68±8.82 days. In terms of residential distribution, majority of patients was from urban areas with 60 (60.0%) while rural residents comprised 40 (40.0%) of sample. Clinical presentations were variable, where irregular vaginal bleeding were most common symptom observed in 42 (42.0%) patients, followed by vaginal discharge in 29 (29.0%), pelvic pain in 17 (17.0%), and pain during sexual intercourse in 12 (12.0%) of cases (Table-I).

**Table 1. Patient Demographics**

| Demographics | Mean ± SD |
|---|---|
| **Age (years)** | 39.66±6.34 |
| **Weight (kg)** | 66.25±7.26 |
| **Height (m)** | 1.59±0.05 |
| **BMI (kg/m²)** | 26.05±2.08 |
| **Duration (days)** | 75.68±8.82 |
| **Residential Status** | |
| **Urban n (%)** | 60 (60.0%) |
| **Rural n (%)** | 40 (40.0%) |
| **Clinical Signs/Symptoms** | |
| **Irregular vaginal bleeding n (%)** | 42 (42.0%) |
| **Pain during sex n (%)** | 12 (12.0%) |
| **Vaginal discharge n (%)** | 29 (29.0%) |
| **Pelvic pain n (%)** | 17 (17.0%) |
| **Height (m)** | 1.59±0.05 |

The overall diagnostic findings showed that MRI identified cervical carcinoma in 29 (29.0%) cases while histopathology confirmed disease in only 12 (12.0%) cases. MRI reported negative results in 71 (71.0%) patients whereas histopathology showed negative findings in 88 (88.0%) of total 100 cases examined (Table-II).

**Table 2. Overall results of MRI and Histopathology in diagnosis of cervical carcinoma**

| Cervical Carcinoma | MRI | Histopathology |
|---|---|---|
| **Positive** | 29 (29.0%) | 12 (12.0%) |
| **Negative** | 71 (71.0%) | 88 (88.0%) |
| **Total** | 100 (100%) | 100 (100%) |

MRI correctly identified 10 (10.0%) true-positive cases but also generated 19 (19.0%) false-positive results. Among the MRI-negative cases, 2 (2.0%) were false negatives and 69 (69.0%) were true negatives. Histopathology confirmed 12 (12.0%) positive and 88 (88.0%) negative cases among 100 (100.0%) patients (Table-III).

**Table 3. Comparison of MRI versus Histopathology in diagnosis of cervical carcinoma**

| MRI | Histopathology Positive n (%) | Histopathology Negative n (%) | Total n (%) |
|---|---|---|---|
| **Positive** | 10 (10.0%) TP | 19 (19.0%) FP | 29 (29.0%) |
| **Negative** | 2 (2.0%) FN | 69 (69.0%) TN | 71 (71.0%) |
| **Total** | 12 (12.0%) | 88 (88.0%) | 100 (100.0%) |

*Key: TP = True positive, FP = False positive, FN = False negative, TN = True negative*

The diagnostic performance parameters of MRI in detecting cervical carcinoma showed sensitivity was 83.30%, specificity was 78.40%, and overall diagnostic accuracy were 79.00%. The positive predictive value was relatively low at 34.50% while negative predictive value was high at 97.20% (Table-IV).

Sensitivity, Specificity, Diagnostic Accuracy, PPV and NPV of MRI in diagnosis of cervical carcinoma

**Table 4. Sensitivity, Specificity, Diagnostic Accuracy, PPV and NPV of MRI in diagnosis of cervical carcinoma**

| Diagnostic Parameter | Result |
|---|---|
| **Sensitivity** | 83.30% |
| **Specificity** | 78.40% |
| **Diagnostic Accuracy** | 79.00% |
| **PPV** | 34.50% |
| **NPV** | 97.20% |

Stratified analysis according to age groups revealed that for patients aged ≤40 years, sensitivity was 75.00%, specificity was 78.30%, diagnostic accuracy was 77.80%, positive predictive value was 37.50%, and negative predictive value were 94.70%. In contrast, for patients aged >40 years, sensitivity increased to 100.00%, specificity was 78.60%, diagnostic accuracy was 80.40%, positive predictive value was 30.80%, and negative predictive value was 100.00%. When stratified by BMI, patients with BMI ≤25 kg/m² showed sensitivity of 66.70%, specificity of 74.30%, diagnostic accuracy of 73.20%, positive predictive value of 30.80%, and negative predictive value of 92.90%. For patients with BMI >25 kg/m², sensitivity was 100.00%, specificity was 81.10%, diagnostic accuracy was 83.10%, positive predictive value was 37.50%, and negative predictive value were 100.00%. Analysis based on duration of symptoms demonstrated that for symptoms lasting ≤75 days, sensitivity was 100.00%, specificity was 81.40%, diagnostic accuracy was 83.00%, positive predictive value was 33.30%, and negative predictive value were 100.00%. For symptoms duration >75 days, sensitivity was 75.00%, specificity was 75.60%, diagnostic accuracy was 75.50%, positive predictive value was 35.30%, and negative predictive value were 94.40% (Table-V).

**Table-V: Stratified analysis of Sensitivity, Specificity, Diagnostic Accuracy, PPV and NPV of MRI in diagnosis of cervical carcinoma with age, BMI and duration of symptoms**

| Variables | Groups | Diagnostic Parameter | Result |
|---|---|---|---|
| **Age (years)** | ≤40 | Sen | 75.00% |
| | | Spec | 78.30% |
| | | DA | 77.80% |
| | | PPV | 37.50% |
| | | NPV | 94.70% |
| | >40 | Sen | 100.00% |
| | | Spec | 78.60% |
| | | DA | 80.40% |
| | | PPV | 30.80% |
| | | NPV | 100.00% |
| **BMI (Kg/m$^2$)** | ≤25 | Sen | 66.70% |
| | | Spec | 74.30% |
| | | DA | 73.20% |
| | | PPV | 30.80% |
| | | NPV | 92.90% |
| | >25 | Sen | 100.00% |
| | | Spec | 81.10% |
| | | DA | 83.10% |
| | | PPV | 37.50% |
| | | NPV | 100.00% |
| **Duration of symptoms (days)** | ≤75 | Sen | 100.00% |
| | | Spec | 81.40% |
| | | DA | 83.00% |
| | | PPV | 33.30% |
| | | NPV | 100.00% |
| | >75 | Sen | 75.00% |
| | | Spec | 75.60% |
| | | DA | 75.50% |
| | | PPV | 35.30% |
| | | NPV | 94.40% |

## DISCUSSION

The findings revealed that the magnetic resonance imaging (MRI) test resulted in a sensitivity of 83.30%, a specificity of 78.40%, and a diagnostic accuracy of 79.00%. Although the performance metrics of the MRI test were found to be sufficiently robust, they were not found to be excellent. This could be due to the limitations of the MRI test in differentiating between inflammatory changes and malignant changes. The negative predictive value was found to be high at 97.20%, whereas the positive predictive value was found to be 34.50%. This is because a high NPV suggests that the MRI test is highly reliable in ruling out the disease when the test is found to be negative. However, the low PPV suggests that the MRI test is positive for malignancy in only one-third of the patients. This is due to the fact that the MRI test is susceptible to various pathological changes, including benign conditions such as cervicitis, endometriosis, or fibroids.

Present study findings was comparable to Khan L et al. 13 who reported sensitivity 94.62%, specificity 92.59%, and diagnostic accuracy 94.17%, though their results was slightly superior which may be due to different patient population and MRI protocols utilized. Similarly, Ahmad N et al. 14 found sensitivity 91.26%, specificity 89.70%, and diagnostic accuracy 90.50% which also exceed current study values. The higher accuracy in these studies could be attributed to more advanced MRI sequences or experienced radiologists performing interpretations. In contrast, Orakzai ZJ et al. 15 reported much lower diagnostic accuracy of 50% with sensitivity 47% and specificity 52%, which was substantially inferior to present findings. Mohamed HH et al. 16 demonstrated exceptional diagnostic performance with sensitivity 96.6%, specificity 96.9%, and diagnostic accuracy 99.5% using optimal ADC cutoff value of $1.10\times10^{-3}$ mm$^2$/s, which was remarkably higher than current study results. Their superior accuracy was likely due to incorporation of diffusion-weighted imaging and ADC mapping which provide additional functional information beyond conventional MRI sequences. Zhang J et al. 17 reported MRI sensitivity 95.65% and

diagnostic accuracy 92.59%, which was also higher than present study findings of 83.30% sensitivity and 79.00% accuracy. The positive predictive value in current study was 34.50% which indicate high rate of false positive results, with 19 false positives out of 29 MRI-positive cases. This was considerably lower than Khan L et al. 13 who achieved PPV of 97.78%, and Ahmad N et al. 14 who reported PPV of 90.38%. The low PPV in present study suggest that MRI frequently misinterpreted benign conditions as malignant, possibly due to overlap of imaging characteristics between inflammatory lesions and early cancer. Mohamed HH et al. 16 identified one false positive case of chronic cervicitis which highlight similar challenge. However, current study negative predictive value of 97.20% was excellent and comparable to Ahmad N et al. 14 who found NPV 90.63%, and Khan L et al. 13 with NPV 87.33%. High NPV indicate reliability of MRI in excluding disease when test was negative.

Ali J et al. 18 evaluated parametrial invasion specifically and found overall MRI sensitivity 81.7%, specificity 82.2%, and accuracy 81.9%, which was similar to current study overall diagnostic parameters. Their stratified analysis by age showed sensitivity 82.9% for patients ≤50 years and 80.0% for >50 years, while present study found sensitivity of 75.00% for ≤40 years and 100.00% for >40 years. The higher sensitivity in older age group in current study align with concept that advanced disease in older women was easier to detect on imaging. Sultana J et al. 19 reported variable accuracy for different parameters with tumor size <4 cm showing 98% accuracy and deep stromal invasion showing only 72% accuracy, which demonstrate that MRI performance depend on specific feature being evaluated. Masroor I et al. 20 evaluated cervical involvement in endometrial cancer and achieved sensitivity 92.85%, specificity 88.09%, and diagnostic accuracy 89.28%, which was higher than current study values. Their study focus on different clinical scenario of endometrial cancer extending to cervix rather than primary cervical carcinoma, which may explain differences in diagnostic performance. Nauman M et al. 21 examined metastatic cervical nodes in oral cancer patients and reported overall MRI sensitivity 94.12%, specificity 61.11%, and accuracy 80.46%, demonstrating that MRI utility extend beyond gynecological malignancies with variable performance depending on anatomical site and disease type being evaluated.

The current study also had several limitations, which are important to note. First, the study had the limitation of being conducted in a single center and, therefore, may not be generalized to the whole population. The study also had the limitation of only including 100 patients, which may affect the results regarding the diagnostic accuracy. The study did not assess the results after follow-up and the correlation with treatment outcomes, which would give a better picture regarding the utility of MRI. Another limitation is that the study did not assess the inter-observer variation among radiologists, which may affect the diagnostic accuracy.

## CONCLUSION

The conclusion of this research states that magnetic resonance imaging shows a high sensitivity with a significant negative predictive value in cervical carcinoma diagnosis when compared with histopathology as the gold standard. The specificity and positive predictive value are moderate, showing a bias towards false positive. The accuracy of the test is reasonably acceptable, thus supporting the idea that MRI should not replace histopathology.

**Disclaimer:**

No disclaimer is provided.

**Acknowledgment:**

The author wants to thank the medical staff of the department. Their hard work, proper keeping of record and handling patient's data helped a lot in completing this study.

**Ethical Approval:**

This study was approved by the Ethical Committee. All works was carried out by following committee rules and also according to Helsinki Declaration.

**Patients' Consent:**

Before joining the study all patient signed written consent. They were informed that their data will be kept confidential and they are free to withdraw from the study at any time.

**Conflict of Interest:**

The author declares that there is no any conflict of interest related to this research.

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