Advanced International Journal of Multidisciplinary Research
E-ISSN: 2584-0487
editor@aijmr.com
Volume 4, Issue 2, March-April 2026
CrossRef DOI: 10.62127/aijmr.2026.v04i02.1247

Correlation of Pelvic Magnetic Resonance Imaging Findings with Histopathology Findings for Adnexal Pathologies Among Women Attending Kilimanjaro Christian Medical Centre

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Abstract:
Aim: This study evaluated correlation of pelvic MRI findings with histopathological findings of adnexal pathologies among women attending Kilimanjaro Christian Medical Centre (KCMC), Tanzania, from 2022 to 2024.
Methodology: A hospital-based cross-sectional study was conducted among women who underwent pelvic MRI and subsequent histopathology for suspected adnexal pathology at Kilimanjaro Christian Medical Centre (KCMC) during 2022–2024. Data were collected and analyzed using SPSS version 26. Descriptive statistics summarized patient demographic characteristics, clinical characteristics, Pelvic MRI findings, and histopathological findings while Chi-square test was used to compare the diagnostic accuracy between pelvic MRI and histopathology, 95% confidence intervals, and p-values of 0.05 as a cut-off level of statistical significance for associations between pelvic MRI findings and histopathology findings.
Results: Among 130 participants, pelvic MRI demonstrated predominantly cystic lesions (86.2%), followed by solid (50.0%) and mixed/complex lesions (46.9%); hemorrhage and calcification were less frequent (13.8% and 6.9%) respectively. Pelvic MRI classified 87.7% as benign and 12.3% as malignant, while histopathology confirmed 86.9% benign and 13.1% malignant. Agreement between Pelvic MRI and histopathology was almost perfect (Cohen's kappa = 0.89; $p<0.001$).
Conclusion: Pelvic MRI at Kilimanjaro Christian Medical Centre shows the majority of adnexal pathologies evaluated were benign, with pelvic MRI correctly identifying lesion types in most cases which showed strong concordance with histopathology for characterization of adnexal pathologies that can support preoperative risk stratification and clinical decision-making, particularly for distinguishing benign from malignant pathologies.

Keywords: Pelvic MRI; Adnexal pathology; Histopathology; Diagnostic accuracy; KCMC, Tanzania.

INTRODUCTION

The adnexa: Refers to the appendages that associated with the uterus such as ovaries, fallopian tubes, and various ligaments that support the uterus in the female reproductive system. Adnexal pathologies are one of the common gynecologic problems in females across various age groups, with highly threatening conditions which contribute to significant morbidity and mortality globally, with an estimated prevalence of 0.17% to 5.9% in asymptomatic and 7.1% to 12% in symptomatic patients (11). The etiology of these

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conditions includes a broad spectrum of benign conditions, such as pedunculated uterine myoma, normal luteal cysts, tubo-ovarian abscess, polycystic ovaries or malignant entities, including ovarian carcinoma, endometrial carcinoma, metastasis, cystadenocarcinoma and sarcoma. It is estimated that the lifetime risk of surgical evaluation of adnexal lesions for a woman is 5%–10% (7). Notably, among adnexal pathologies, ovarian cancer remains one of the most lethal gynecological malignancies globally, ranking as the eighth leading cause of cancer-related deaths among women (18). Early and accurate diagnosis of adnexal pathologies is critical for initiating appropriate clinical management, improving prognosis, and enhancing quality of life. The most important approach in the evaluation of adnexal pathologies is excluding malignancy. Though the prevalence of ovarian malignancy is not high and it consists 3% of all cancers in women, it is associated with a higher rate of mortality (5). In Tanzania among adnexal pathologies the ovarian cancer is the leading cause of cancer-related deaths among women, accounting for about 0.11% of total deaths. (19). Ultrasound, being the first-line imaging tool, is widely used due to its accessibility, cost-effectiveness, and real-time capabilities. However, it has limitations in accurately characterizing complex adnexal lesions, particularly in differentiating benign from malignant masses (15). When ultrasound findings are intermediate, pelvic MRI plays a crucial role in further lesion characterization by providing detailed information on tissue composition, vascularity, and the presence of haemorrhage, necrosis, or solid components, aiding in better classification before histopathological confirmation (16). Magnetic Resonance Imaging (MRI) has emerged as an essential tool in evaluating adnexal pathologies due to its superior soft-tissue contrast, high spatial resolution, and multiplanar imaging capabilities. It serves as an intermediate imaging modality between ultrasound and histopathology in diagnosing adnexal pathologies (8). Additionally, Computed Tomography (CT) plays a critical role in staging malignant adnexal pathologies and assessing therapeutic response. CT provides excellent visualization of metastatic spread, lymph node involvement, and peritoneal dissemination, making it the imaging modality of choice for surgical planning and monitoring disease progression during treatment (14). Histopathological analysis, however, remains the gold standard for definitive diagnosis. It provides critical information on tumor histology, grade, and stage, there by confirming imaging-based diagnoses (15). While pelvic MRI offers excellent sensitivity and specificity in identifying certain adnexal pathologies, overlapping imaging characteristics between benign and malignant lesions can lead to diagnostic uncertainty (17). For example, hemorrhagic cysts and endometriomas may mimic malignant lesions on pelvic MRI due to shared features such as irregular borders or heterogeneous signal intensities. Consequently, the integration of pelvic MRI findings with histopathological results is essential for achieving accurate and reliable diagnoses (1)

Materials and Methods

Methodology

Study Design and Population

This was a hospital-based cross-sectional study conducted at Kilimanjaro Christian Medical Centre (KCMC) women with suspected adnexal pathologies who underwent pelvic MRI and had a corresponding histopathology report between January 2022 to December 2024 were reviewed. Patients were included if complete pelvic MRI images and histopathology results were available.

Eligibility criteria

Women aged greater than 15 years who underwent both pelvic MRI and histopathology examination for suspected adnexal pathologies at KCMC from 2022 to 2024 and had complete and adequate medical

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records available. Women with a history of prior pelvic surgery including Total Abdominal Hysterectomy with Bilateral Salpingo-Oophorectomy (TAHBSO) were excluded.

Ethical approval

Ethical clearance was obtained from the KCMC University Research Ethics committee (Approval No. PG.130/2024). Institutional permission to access patient records was granted by the relevant departments at KCMC. All data were handled confidentially, with no patient identifiers used in the analysis.

Statistical analysis

Data were entered and analyzed in SPSS version 26. Descriptive statistics were used to summarize the study variables. Categorical variables were presented as frequencies and proportions, while continuous variables were summarized using means and standard deviations or medians and interquartile ranges, as appropriate. Concordance between Pelvic MRI findings and histopathology findings was assessed using cross-tabulation and Cohen's kappa. Diagnostic performance metrics (sensitivity, specificity, PPV, NPV) were calculated using histopathology as the gold standard, with 95% confidence intervals. Statistical significance was set at $p < 0.05$.

Study Setting

The study was conducted at Kilimanjaro Christian Medical Centre, a university teaching hospital affiliated with KCMC University and KCRI, where the Radiology and Pathology departments manage approximately 213 and 160 adnexal pathologies cases annually, respectively. KCMC is located in Moshi town in Northern Tanzania

Sampling Method and Sample Size

All eligible patients meeting the inclusion criteria during the study period were consecutively enrolled. The minimum sample size was calculated using the formula $n = Z^2 \times p(1–p) / d^2$, where $Z = 1.96$ (95% confidence level), $p = 9.3\%$ (prevalence of adnexal pathologies (11) and $d = 0.05$ (margin of error). This yielded a required sample size of 130 patients.

RESULTS

Demographic and Clinical Characteristics

A total of 130 women with suspected adnexal pathology who had both pelvic MRI and histopathology results were included in the analysis.

Table 1. Demographic and clinical characteristics of study participants (N = 130).

Variable	Frequency (n)	Percentage (%)
Age in years		
18-34	51	39.2
35-64	60	46.2
≥65	19	14.6
Median (IQR)	37 (32, 52)	
Marital status		
Single	40	30.8
Cohabiting	2	1.5
Married	88	67.7

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Education Level		
Primary	20	15.3
Secondary	50	38.5
Higher level	60	46.2
Employment status		
Unemployed	35	27.9
Self Employed	42	35.4
Formal employment	53	36.7
Symptoms		
Lower Abdominal pain	109	83.8
Abdominal distension	2	2.5
Per vaginal bleeding	21	16.2
Irregular menses	26	31.7
Infertility	9	7.6
Duration of symptoms in days (median; IQR)	150 (30, 360)	

Description of pelvic MRI findings among women with adnexal pathologies attended at KCMC hospital.

Regarding the Pelvic MRI findings of women with adnexal pathologies, the majority, (86.2%) were reported to have cystic lesions, followed by solid lesions (50.0%), mixed lesion (46.9%) Lower proportion of patients were reported to have hemorrhagic and calcifications (13.8% and 6.9% respectively) (Figure 1).

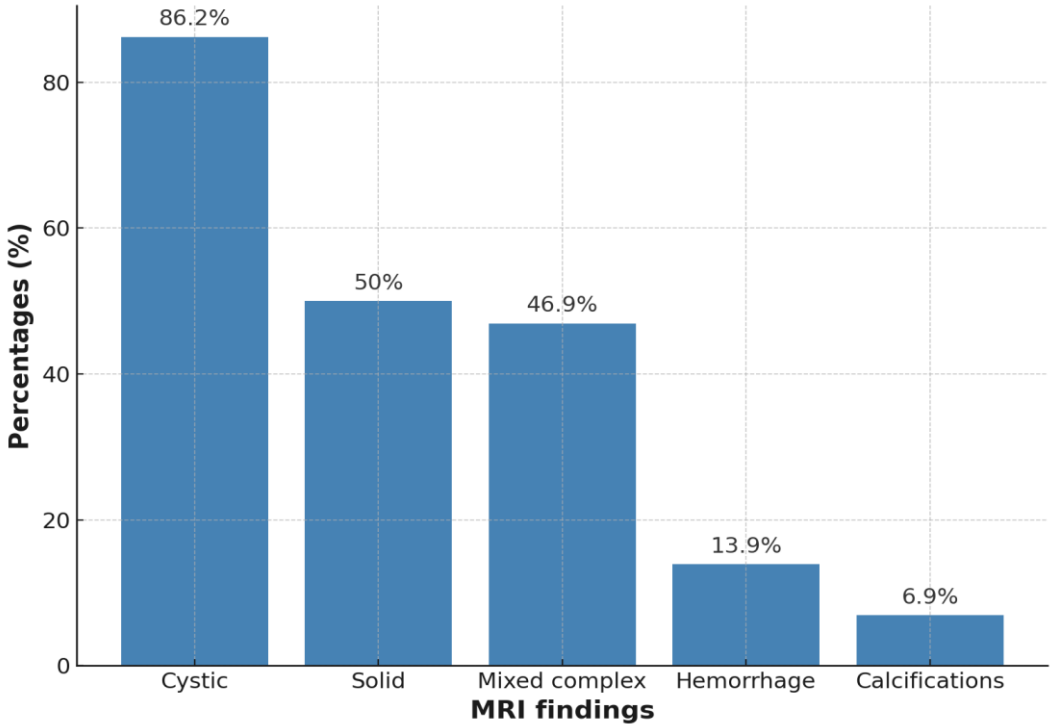

Figure 1: Pelvic MRI Findings of study participants (N=130)

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Table 2. Pelvic MRI classification of adnexal lesions (N = 130).

MRI finding	Frequency	Percentage
Benign	114	87.7
Malignant	16	12.3
Total	130	100

Table 3. Histopathology classification of adnexal lesions (N = 130).

Histopathology results	Frequency	Percent
Benign	113	86.9
Malignant	17	13.1
Total	130	100.0

Table 4. Cross-tabulation of pelvic MRI versus histopathology (benign vs malignant).

Pelvic MRI findings	Histopathology findings		Total
	Malignant	Benign	
Malignant	15	1	16
Benign	2	112	114
Total	17	113	130

Table 5. Diagnostic accuracy of pelvic MRI for malignant adnexal lesions using histopathology as reference.

Diagnostic accuracy	Value
Sensitivity	88.2% (0.66, 0.97)
Specificity	98.4% (0.91, 0.99)
Positive predictive value	93.8% (0.72, 0.99)
Negative predictive value	96.8% (0.89, 0.99)
Cohens Kappa	0.89 (0.76, 1.01), p value <0.001

The median age of participants was 37 years (IQR: 32–52). Nearly half (46.2%) were aged 35–64 years and 67.7% were married. Lower abdominal pain was the most common presenting symptom (83.8%).
On pelvic MRI, cystic morphology was the most frequent feature (86.2%), followed by solid components (50.0%) and mixed/complex morphology (46.9%); hemorrhage and calcification were less common (13.8% and 6.9%). Pelvic MRI classified 114 (87.7%) lesions as benign and 16 (12.3%) as malignant, while histopathology classified 113 (86.9%) as benign and 17 (13.1%) as malignant.
Agreement between pelvic MRI and histopathology for benign versus malignant classification was almost perfect (Cohen's kappa = 0.89; $p < 0.001$).

DISCUSSION

This study demonstrated that Pelvic MRI findings of women with adnexal pathologies, the majority, (86.2%) were reported to have cystic lesions, followed by solid lesions (50.0%), mixed lesion (46.9%) Lower proportion of patients were reported to have hemorrhagic and calcifications (13.8% and 6.9% respectively)

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The diagnostic criteria employed, including lesion morphology, internal architecture, and contrast enhancement, facilitated a comprehensive assessment. These Findings are consistent with the study done in Europe and Italy reported Pelvic MRI effectively differentiated complex lesions such as dermoid cysts and endometriomas based on mixed signal intensity and enhancement patterns emphasized the critical role of pelvic MRI in distinguishing solid and cystic components of adnexal lesions(4, 9) similar trends findings were reported in China and Brazil observed that pelvic MRI effectively differentiated complex lesions such as dermoid cysts and endometriomas based on mixed signal intensity and enhancement patterns(20, 10).

In South Africa, the study found a sensitivity of 85% for pelvic MRI in identifying adnexal malignancies, reinforcing the modality's value despite regional limitations in access (12). These findings reinforce the role of pelvic MRI as an essential imaging modality for preoperative evaluation. It facilitates early and accurate characterization of adnexal pathologies, particularly when ultrasound is inconclusive, thus reducing unnecessary surgeries and guiding appropriate treatment pathways (17)

In this current study, histopathology findings of adnexal lesions show that 86.9% of the lesions as benign and 13.1% as malignant. The predominant benign lesions were simple cysts, fibroids, mucinous cystadenomas, endometriomas, and dermoid cysts. Among malignancies, serous cystadenocarcinoma and mucinous carcinoma were frequently encountered. These findings align with those reported in the United States, where epithelial ovarian cancers dominated the malignant spectrum, and functional cysts were the most common benign lesions (15).

In Nigeria benign lesions also comprise the majority, with malignancy rates around 15% 84.7% benign and 15.3% malignant lesions (3).
(6) at MNH and (13) at KCMC corroborated the predominance of benign lesions in Tanzanian populations, though both noted that limited diagnostic infrastructure can delay histopathological confirmation and management. Histopathological confirmation remains crucial, especially when imaging findings are equivocal, ensuring accurate diagnosis, tumour grading, and treatment planning.

The diagnostic performance of pelvic MRI in this study was notable, with a sensitivity of 88.2%, specificity of 98.4%, PPV of 93.8%, and NPV of 96.8%. The Cohen's Kappa value of 0.89 ($p < 0.001$) indicated almost perfect agreement with histopathological findings. These results are consistent with the findings of (15) and (2), who reported MRI diagnostic accuracy above 90%. (16) reported sensitivity and specificity values of 92.7% and 89.3%, respectively, in a prospective analysis, further affirming pelvic MRI's role in adnexal lesions characterization.

False positives in this study were minimal and largely due to hemorrhagic or inflammatory lesions that mimicked malignancy. Conversely, false negatives often involve small malignant nodules with benign-appearing MRI features, emphasizing the importance of radiologic expertise and multidisciplinary review. In resource-constrained settings, such as Tanzania, the integration of pelvic MRI into diagnostic protocols offers substantial benefit in reducing diagnostic uncertainty, improving patient stratification, and enhancing surgical planning.

In this hospital-based series of women with suspected adnexal pathology at KCMC, pelvic MRI demonstrated high concordance with histopathology for classifying lesions as benign versus malignant.

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Most lesions were benign, consistent with reports that the majority of adnexal pathologies are non-malignant in clinical practice. Pelvic MRI frequently demonstrated cystic morphology, and a smaller proportion showed haemorrhage or calcification.

The observed high agreement supports the value of pelvic MRI as a problem-solving modality when ultrasound is indeterminate, particularly in settings where timely surgical triage is critical. These findings reinforce the role of pelvic MRI for preoperative characterization and for reducing potentially avoidable surgery in clearly benign lesions, while prioritizing malignancy work-up for suspicious masses.

STRENGTHS AND LIMITATIONS

The strengths of this study lie in that it evaluated the diagnostic accuracy of pelvic MRI in characterizing adnexal pathologies using histopathology as the gold standard. The use of standardized imaging protocols and the involvement of experienced radiologists and pathologists enhanced the reliability of the findings. Additionally, the study demonstrated high sensitivity (88.2%), specificity (98.4%), and almost perfect agreement (Cohen's kappa = 0.89) between pelvic MRI and histopathology, reinforcing the validity of the results.

The limitations of this study include its single-centre design, which may limit the generalizability of the results. The study also faced challenges related to the accessibility of pelvic MRI in low-resource settings, potentially limiting its routine use which could restrict the broader applicability of the findings. Long-term outcomes, such as the impact of pelvic MRI findings on surgical planning and patient prognosis, were not evaluated, leaving room for future research to explore these aspects.

CONCLUSION

Pelvic MRI showed strong concordance with histopathology for benign versus malignant characterization of adnexal lesions among women evaluated at KCMC from 2022 to 2024. The findings support pelvic MRI as an effective preoperative diagnostic tool to guide clinical management and referral decisions.

RECOMMENDATIONS

Strengthen local diagnostic pathways that use ultrasound as first-line imaging and pelvic MRI for indeterminate adnexal pathologies.Promote multidisciplinary radiology–pathology review for discordant or complex cases to improve diagnostic confidence and feedback. Consider ongoing training and protocol optimization for pelvic MRI characterization of adnexal pathologies, including standardized reporting to improve consistency.Encourage future multicenter studies to validate diagnostic performance and evaluate patient outcomes and cost-effectiveness in the Tanzanian context.

Acknowledgments

The authors acknowledge the logistical and technical support provided by KCMC University. We are also grateful to all healthcare workers who participated in this study for their time and cooperation.

Ethics Approval and Consent to Participate

Ethical approval for this study was obtained from the KCMC University. Written informed consent was obtained from all participants prior to data collection, in accordance with the Declaration of Helsinki.

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Competing Interests
The authors do not have any conflicts of interest to declare.

Funding
This work was supported by the Tanzania Ministry of Health—postgraduate grant.

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