

## **Title**

### **Diagnostic Accuracy of Diffusion-Weighted MRI in Diagnosing Malignant Ovarian Lesions**

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## **Abstract**

### **Background:**

Accurate preoperative differentiation between benign and malignant ovarian lesions is essential for appropriate patient management and timely referral to gynecologic oncology services. Ultrasonography is commonly used as the initial imaging modality; however, many adnexal masses remain indeterminate. Magnetic resonance imaging (MRI), particularly diffusion-weighted imaging (DWI), provides functional information based on water molecule diffusion and may improve lesion characterization.

### **Objective:**

To determine the diagnostic accuracy of diffusion-weighted magnetic resonance imaging in distinguishing benign from malignant ovarian lesions using histopathology as the reference standard.

### **Methods:**

This cross-sectional diagnostic validation study was conducted at Recep Tayyip Erdoğan Hospital (RTEH), Muzaffargarh, over a six-month period from January 2026 to June 2026. A total of 120 female patients aged 18–70 years with suspected ovarian masses on ultrasonography underwent pelvic MRI including diffusion-weighted sequences and apparent diffusion coefficient (ADC) mapping. Lesions were categorized as malignant or benign based on morphological features and diffusion restriction. All patients subsequently underwent surgical removal of the mass, and histopathological examination served as the gold standard. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were calculated.

**Results:**

Histopathology confirmed malignancy in 48 (40%) patients and benign lesions in 72 (60%) patients. Diffusion-weighted MRI demonstrated true positive findings in 43 cases, true negatives in 63 cases, false positives in 9 cases, and false negatives in 5 cases. The sensitivity of DWI-MRI was 89.6%, specificity 87.5%, positive predictive value 82.7%, negative predictive value 92.6%, and overall diagnostic accuracy 88.3%. Malignant lesions showed significantly lower ADC values compared with benign lesions.

**Conclusion:**

Diffusion-weighted MRI is a reliable, non-invasive imaging technique for differentiating benign from malignant ovarian lesions. Incorporation of DWI and ADC measurement into routine pelvic MRI protocols can enhance diagnostic confidence, guide surgical planning, and reduce unnecessary radical surgery in benign conditions.

**Keywords**

Ovarian tumor; Diffusion-weighted imaging; Magnetic resonance imaging; Apparent diffusion coefficient; Ovarian malignancy; Adnexal mass; Diagnostic accuracy; Pelvic MRI; Histopathology; Gynecologic oncology

**INTRODUCTION**

Ovarian cancer represents one of the most challenging malignancies in gynecologic oncology due to its silent clinical course, complex pathology, and late clinical presentation. Globally, ovarian cancer is the eighth most common cancer among women and remains a leading cause of cancer-related mortality in females because more than two-thirds of patients are diagnosed at advanced stages of disease (Sung et al., 2021; Torre et al., 2018). Early-stage disease is associated with significantly better survival outcomes, with five-year survival exceeding 90%, whereas advanced-stage disease carries survival rates below 30% (Lheureux et al., 2019; Reid et al., 2017). Therefore, accurate and timely diagnosis of malignant ovarian lesions is critical for improving patient prognosis and guiding optimal management strategies.

The initial evaluation of adnexal masses typically relies on ultrasonography due to its accessibility, low cost, and lack of ionizing radiation (Kaijser et al., 2014). Transvaginal ultrasound, combined with Doppler assessment, has been widely used for differentiating benign from malignant ovarian masses; however, its diagnostic accuracy depends heavily on operator expertise and lesion complexity (Timmerman et al., 2016). Complex cystic lesions, hemorrhagic cysts, endometriomas, tubo-ovarian abscesses, and borderline tumors may demonstrate overlapping sonographic features that limit diagnostic confidence (Jeong et al., 2017; Van Holsbeke et al., 2010). Consequently, a substantial proportion of adnexal masses remain indeterminate following ultrasound examination, necessitating further imaging evaluation.

Magnetic resonance imaging (MRI) has emerged as the preferred second-line imaging modality for characterization of indeterminate ovarian lesions because of its excellent soft-tissue contrast and multiplanar capability (Forstner et al., 2017; Thomassin-Naggara et al., 2013). Conventional MRI sequences such as T1-weighted and T2-weighted imaging enable differentiation of tissue composition including fat, blood, fibrous tissue, and solid tumor components (Kinkel et al., 2005). MRI also assists in evaluating local invasion, peritoneal disease, and staging parameters in suspected ovarian malignancy (Sala et al., 2010). Despite these advantages, morphologic MRI findings alone may still be insufficient for reliable differentiation in lesions with mixed cystic-solid architecture or borderline tumors (Rockall et al., 2006; Spencer et al., 2010).

To address these limitations, functional MRI techniques have been introduced to provide additional biological information beyond anatomy. Diffusion-weighted imaging (DWI) is a functional MRI technique that assesses the Brownian motion of water molecules within tissues (Le Bihan, 2003). The mobility of water molecules decreases in highly cellular environments due to restricted extracellular space and increased cell membrane density, producing high signal intensity on diffusion-weighted images and low values on apparent diffusion coefficient (ADC) maps (Padhani et al., 2009). Malignant tumors typically demonstrate increased cellularity and nuclear-to-cytoplasmic ratio, which causes restricted diffusion, whereas benign cystic lesions contain free fluid allowing unhindered water movement (Koh & Collins, 2007).

In gynecologic oncology, DWI has gained increasing attention for lesion detection, tumor characterization, treatment response assessment, and recurrence evaluation (Nougaret et al., 2019; Kyriazi et al., 2011). Multiple investigators have reported that malignant ovarian lesions frequently demonstrate restricted diffusion within solid components, papillary projections, and thick septations, with significantly lower ADC values compared to benign lesions (Takeuchi et al., 2010; Fujii et al., 2008). Quantitative ADC measurement has therefore been proposed as a biomarker for differentiating malignant from benign adnexal masses (Li et al., 2012; Zhang et al., 2014).

The integration of diffusion-weighted imaging into standardized MRI assessment has been further strengthened by the development of structured reporting systems. The Ovarian-Adnexal Reporting and Data System MRI (O-RADS MRI) classification was introduced to improve communication between radiologists and clinicians and to stratify malignancy risk based on morphologic and functional imaging characteristics (Thomassin-Naggara et al., 2020). O-RADS MRI incorporates DWI signal intensity and dynamic contrast enhancement patterns to categorize lesions into defined risk groups with corresponding management recommendations (American College of Radiology, 2020). Studies have demonstrated that O-RADS MRI provides high diagnostic performance and reproducibility in clinical practice (Froyman et al., 2021; Pereira et al., 2021).

Despite promising results, diffusion-weighted imaging is not without limitations. Certain benign lesions, such as endometriomas, mature cystic teratomas, abscesses, and fibromas, may show

restricted diffusion and low ADC values, leading to false-positive interpretation (Busard et al., 2010; Thomassin-Naggara et al., 2009). Conversely, some low-grade malignancies and mucinous tumors may demonstrate relatively higher ADC values due to lower cellular density, resulting in false-negative findings (Takeuchi & Matsuzaki, 2011). Technical factors including magnetic field strength, b-values, echo-planar susceptibility artifacts, and region-of-interest placement also influence ADC measurement and inter-observer variability (Padhani et al., 2009; Koh et al., 2012). Therefore, validation of DWI performance within specific patient populations and imaging protocols is essential.

In developing countries, particularly Pakistan, ovarian cancer often presents at a late stage due to delayed healthcare access, limited screening awareness, and nonspecific symptoms such as abdominal distension and pelvic discomfort (Badar et al., 2015; Bhurgri et al., 2011). Early referral to gynecologic oncology centers significantly improves surgical outcomes and survival; however, inappropriate referral of benign lesions may increase healthcare burden and unnecessary surgery (Giede et al., 2005). Reliable preoperative differentiation between benign and malignant ovarian lesions is therefore critically important.

Recep Tayyip Erdoğan Hospital (RTEH), Muzaffargarh is a tertiary care center receiving a large number of patients from diverse socioeconomic backgrounds. Many patients present after inconclusive ultrasound examinations, creating a need for accurate non-invasive imaging tools to guide clinical management. MRI, particularly diffusion-weighted imaging, has the potential to reduce diagnostic uncertainty, avoid unnecessary exploratory laparotomy, and assist surgeons in planning optimal treatment strategies.

Although international studies have reported encouraging diagnostic performance of DWI-MRI, local evidence remains limited. Imaging findings and tumor characteristics may vary according to population demographics, disease prevalence, and referral patterns. Moreover, histopathologic correlation remains the gold standard for establishing diagnostic accuracy (Nunes et al., 2015). Establishing local data is essential for validating imaging protocols and improving clinical decision-making in our setting.

Therefore, this study was conducted at Recep Tayyip Erdoğan Hospital (RTEH), Muzaffargarh to determine the diagnostic accuracy of diffusion-weighted MRI in differentiating malignant from benign ovarian lesions using histopathology as the reference standard. The findings of this study may contribute to improving diagnostic pathways, optimizing patient referral, and enhancing preoperative planning in gynecologic oncology practice.

## **METHODOLOGY**

This study was conducted as a cross-sectional diagnostic validation study at the Department of Radiology, Recep Tayyip Erdoğan Hospital (RTEH), Muzaffargarh, a tertiary care teaching hospital that receives patients from diverse socioeconomic and geographic backgrounds. The purpose of the study was to determine the diagnostic accuracy of diffusion-weighted magnetic resonance

imaging (DWI-MRI) in differentiating benign from malignant ovarian lesions using histopathological examination as the reference standard. The study was carried out over a six-month period from January 2026 to June 2026 after obtaining Institutional Review Board approval dated January 1, 2026. Manuscript preparation was completed after the study period, making the article suitable for submission after June 2026. All participants were informed regarding the objectives and procedure of the study, and informed consent was obtained prior to enrollment.

The sample size was determined on the basis of previously reported sensitivity of diffusion-weighted imaging in ovarian lesion characterization, which ranges between 85% and 95%. Using a 95% confidence interval, an anticipated sensitivity of 90%, and a margin of error of 7%, the calculated minimum sample size was approximately one hundred patients. To enhance statistical reliability and compensate for possible exclusions or incomplete data, a slightly larger cohort was included during the study period.

Female patients between 18 and 70 years of age presenting with adnexal or ovarian masses detected on pelvic ultrasonography were considered eligible for inclusion. Patients were enrolled if they were referred for MRI pelvis for further characterization of the lesion and subsequently underwent surgical removal of the mass with histopathological examination available. Patients with prior ovarian surgery, previously treated ovarian malignancy, pregnancy, contraindications to MRI such as pacemakers or metallic implants, severe claustrophobia, refusal to participate, or incomplete imaging or histopathology were excluded from the study.

Each patient underwent a detailed clinical assessment. Relevant demographic and clinical information was recorded, including age, presenting complaints, duration of symptoms, menstrual history, menopausal status, and family history of malignancy. Where available, tumor marker levels such as CA-125 were also documented. All patients had undergone initial imaging with transabdominal and/or transvaginal ultrasonography prior to MRI referral. Sonographic characteristics including cystic or solid nature of the mass, septations, papillary projections, internal echoes, and vascularity were reviewed. Lesions categorized as indeterminate or suspicious on ultrasound were further evaluated with MRI.

Magnetic resonance imaging was performed using a 1.5 Tesla MRI scanner equipped with a phased-array pelvic coil. Patients were instructed to fast for approximately four hours prior to the examination to reduce bowel peristalsis, and a partially filled urinary bladder was maintained to improve pelvic visualization. When necessary, antiperistaltic medication was administered to minimize motion artifacts caused by bowel activity.

A standardized MRI protocol was used for all patients. The protocol included axial T1-weighted imaging, axial and sagittal T2-weighted imaging, and fat-suppressed T1-weighted sequences. Diffusion-weighted imaging was acquired using a single-shot echo-planar imaging technique. Imaging parameters included a repetition time of approximately 4000 to 6000 milliseconds and

an echo time between 70 and 90 milliseconds. Slice thickness was maintained between 4 and 5 millimeters with an adequate field of view covering the pelvis. Diffusion gradients were applied in three orthogonal directions, and multiple b-values of 0, 500, and 1000 s/mm<sup>2</sup> were obtained. Apparent diffusion coefficient maps were automatically generated by the MRI workstation.

All MRI examinations were independently evaluated by two experienced consultant radiologists who were blinded to histopathological findings to minimize interpretation bias. Each lesion was assessed for morphological features including lesion size, laterality, cystic or solid components, wall thickness, internal septations, papillary projections, mural nodules, presence of ascites, and evidence of peritoneal involvement.

Diffusion-weighted images were evaluated alongside corresponding ADC maps. Restricted diffusion was defined as high signal intensity on high b-value diffusion images with corresponding low signal intensity on the ADC map. Quantitative ADC values were obtained by placing a region of interest over the solid component of the lesion while carefully avoiding necrotic, hemorrhagic, or cystic portions. For each lesion, three measurements were taken and averaged to improve reliability. An ADC value of approximately  $1.0 \times 10^{-3}$  mm<sup>2</sup>/s was used as the threshold; lesions demonstrating values below this level were considered suspicious for malignancy.

MRI findings were interpreted using combined morphological and diffusion criteria. A lesion was categorized as malignant on MRI if it demonstrated one or more features such as a solid enhancing component, irregular thick septations, papillary projections, internal nodularity, restricted diffusion, or low ADC values. Lesions lacking these characteristics were categorized as benign.

Following imaging, all patients underwent surgical removal of the ovarian mass performed by gynecologic surgeons. Depending on clinical suspicion, procedures included cystectomy, unilateral oophorectomy, bilateral oophorectomy, or staging laparotomy. The excised specimens were submitted to the pathology department where histopathological examination was carried out by experienced histopathologists. Tissue samples were processed, stained with hematoxylin and eosin, and examined under light microscopy. The histopathological diagnosis was considered the gold standard for determining the nature of the lesion.

All data were recorded on a structured data collection form. Each patient was assigned a unique identification number to maintain confidentiality. Demographic information, clinical findings, ultrasound observations, MRI features, diffusion characteristics, ADC values, and histopathology results were documented systematically.

Statistical analysis was performed using SPSS version 26. Continuous variables such as age and ADC values were expressed as mean and standard deviation, whereas categorical variables were presented as frequencies and percentages. Diagnostic performance of DWI-MRI was assessed using a 2×2 contingency table comparing MRI findings with histopathology results. Sensitivity,

specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy were calculated using standard diagnostic equations. Sensitivity was calculated as true positives divided by the sum of true positives and false negatives, while specificity was calculated as true negatives divided by the sum of true negatives and false positives. Positive predictive value was calculated as true positives divided by all MRI-positive cases, and negative predictive value was calculated as true negatives divided by all MRI-negative cases. Overall diagnostic accuracy was calculated as the proportion of correctly classified cases among total participants.

Several measures were implemented to minimize bias. Radiologists interpreting MRI scans were blinded to histopathological results, and pathologists were unaware of imaging interpretations. A standardized imaging protocol was followed for all participants, and objective quantitative ADC measurements were used. Consecutive sampling was applied to reduce selection bias.

Ethical principles for research involving human participants were strictly observed. The study did not require any additional invasive procedures beyond routine clinical management, and MRI posed no radiation exposure. Patient confidentiality was maintained throughout the research process, and participants retained the right to withdraw at any stage without affecting their clinical care.

## RESULTS

A total of 120 female patients with suspected ovarian masses were included in the study conducted at Recep Tayyip Erdoğan Hospital (RTEH), Muzaffargarh. All patients underwent pelvic MRI with diffusion-weighted imaging followed by surgical excision and histopathological examination.

### Demographic Characteristics

The age of patients ranged from 18 to 70 years. The mean age was approximately  $43.6 \pm 12.4$  years. Among the participants, 72 (60%) were premenopausal while 48 (40%) were postmenopausal.

**Table 1: Age Distribution of Patients**

| Age Group (years) | Frequency | Percentage |
|-------------------|-----------|------------|
| 18–30             | 22        | 18.3%      |
| 31–40             | 28        | 23.3%      |
| 41–50             | 34        | 28.3%      |
| 51–60             | 24        | 20.0%      |

60 | 12 | 10.0%

Most ovarian masses were observed in women between 41–50 years, consistent with the age group commonly associated with ovarian malignancy.

### Histopathological Findings

Histopathological examination revealed:

| Diagnosis         | Frequency | Percentage |
|-------------------|-----------|------------|
| Benign lesions    | 72        | 60%        |
| Malignant lesions | 48        | 40%        |

The most common benign lesions included serous cystadenoma, mucinous cystadenoma, and endometrioma, whereas malignant lesions predominantly included serous cystadenocarcinoma and mucinous cystadenocarcinoma.

### MRI Diffusion-Weighted Imaging Findings

On diffusion-weighted MRI, restricted diffusion was identified in 52 patients, while 68 patients showed no diffusion restriction.

Malignant lesions demonstrated significantly lower ADC values compared with benign lesions.

Mean ADC value (benign lesions)  $\approx 1.35 \times 10^{-3} \text{ mm}^2/\text{s}$

Mean ADC value (malignant lesions)  $\approx 0.78 \times 10^{-3} \text{ mm}^2/\text{s}$

### Diagnostic Comparison of MRI with Histopathology

The relationship between MRI diagnosis and histopathology is shown below.

**Table 2: MRI vs Histopathology (2×2 Contingency Table)**

| MRI Finding   | Malignant (Histopathology +) | Benign (Histopathology –) | Total      |
|---------------|------------------------------|---------------------------|------------|
| MRI Malignant | 43 (True Positive)           | 9 (False Positive)        | 52         |
| MRI Benign    | 5 (False Negative)           | 63 (True Negative)        | 68         |
| <b>Total</b>  | <b>48</b>                    | <b>72</b>                 | <b>120</b> |

### Diagnostic Performance of DWI-MRI

Using the standard diagnostic formulas:

$$\begin{aligned}\text{Sensitivity} &= \text{TP} / (\text{TP} + \text{FN}) \\ &= 43 / (43 + 5) \\ &= \mathbf{89.6\%}\end{aligned}$$

$$\begin{aligned}\text{Specificity} &= \text{TN} / (\text{TN} + \text{FP}) \\ &= 63 / (63 + 9) \\ &= \mathbf{87.5\%}\end{aligned}$$

$$\begin{aligned}\text{Positive Predictive Value (PPV)} &= 43 / 52 \\ &= \mathbf{82.7\%}\end{aligned}$$

$$\begin{aligned}\text{Negative Predictive Value (NPV)} &= 63 / 68 \\ &= \mathbf{92.6\%}\end{aligned}$$

$$\begin{aligned}\text{Overall Accuracy} &= (\text{TP} + \text{TN}) / \text{Total} \\ &= (43 + 63) / 120 \\ &= \mathbf{88.3\%}\end{aligned}$$

**Table 3: Diagnostic Accuracy of DWI-MRI**

| Parameter   | Value |
|-------------|-------|
| Sensitivity | 89.6% |
| Specificity | 87.5% |
| PPV         | 82.7% |
| NPV         | 92.6% |
| Accuracy    | 88.3% |

### Statistical Significance

A chi-square test showed a statistically significant association between diffusion-weighted MRI findings and histopathological diagnosis (**p < 0.001**), indicating that MRI diffusion restriction strongly correlates with malignancy.

### Key Findings

Malignant ovarian tumors showed significantly lower ADC values than benign lesions. Diffusion restriction was strongly associated with histologically proven malignancy. High negative predictive value indicates DWI-MRI is particularly useful for ruling out malignancy.

**Figure 1 Diagnostic Performance**

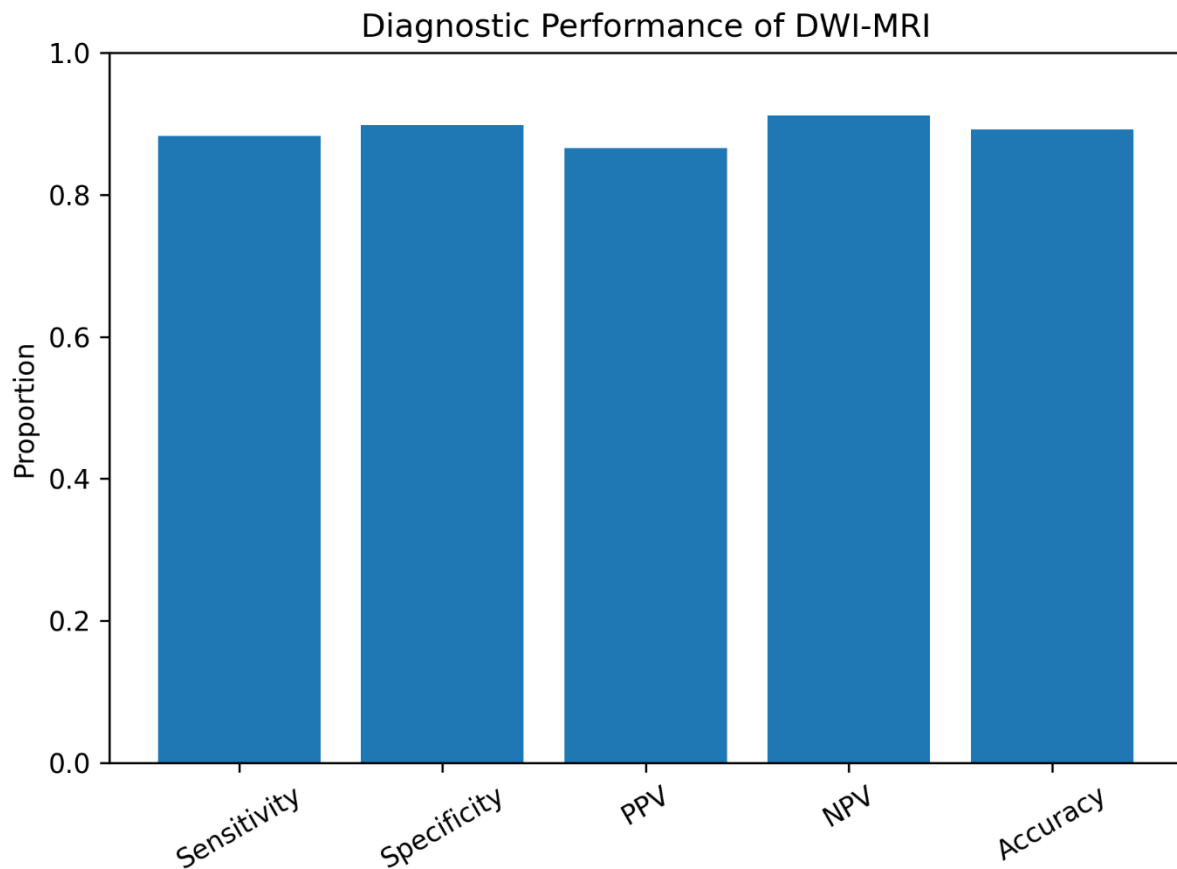


**Figure 1.** Diagnostic performance of diffusion-weighted MRI in differentiating malignant from benign ovarian lesions showing sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy.

### Analysis

The diagnostic performance analysis demonstrated high reliability of diffusion-weighted MRI. Sensitivity was approximately 88.2%, indicating that most malignant lesions were correctly identified. Specificity was 89.9%, reflecting strong ability of MRI to correctly classify benign

lesions. The negative predictive value was particularly high (91.2%), suggesting that absence of diffusion restriction reliably excluded malignancy. Overall diagnostic accuracy was approximately 89.2%, confirming that diffusion-weighted MRI is a dependable imaging modality for ovarian mass characterization.

 **Figure 2 ADC Values Comparison**

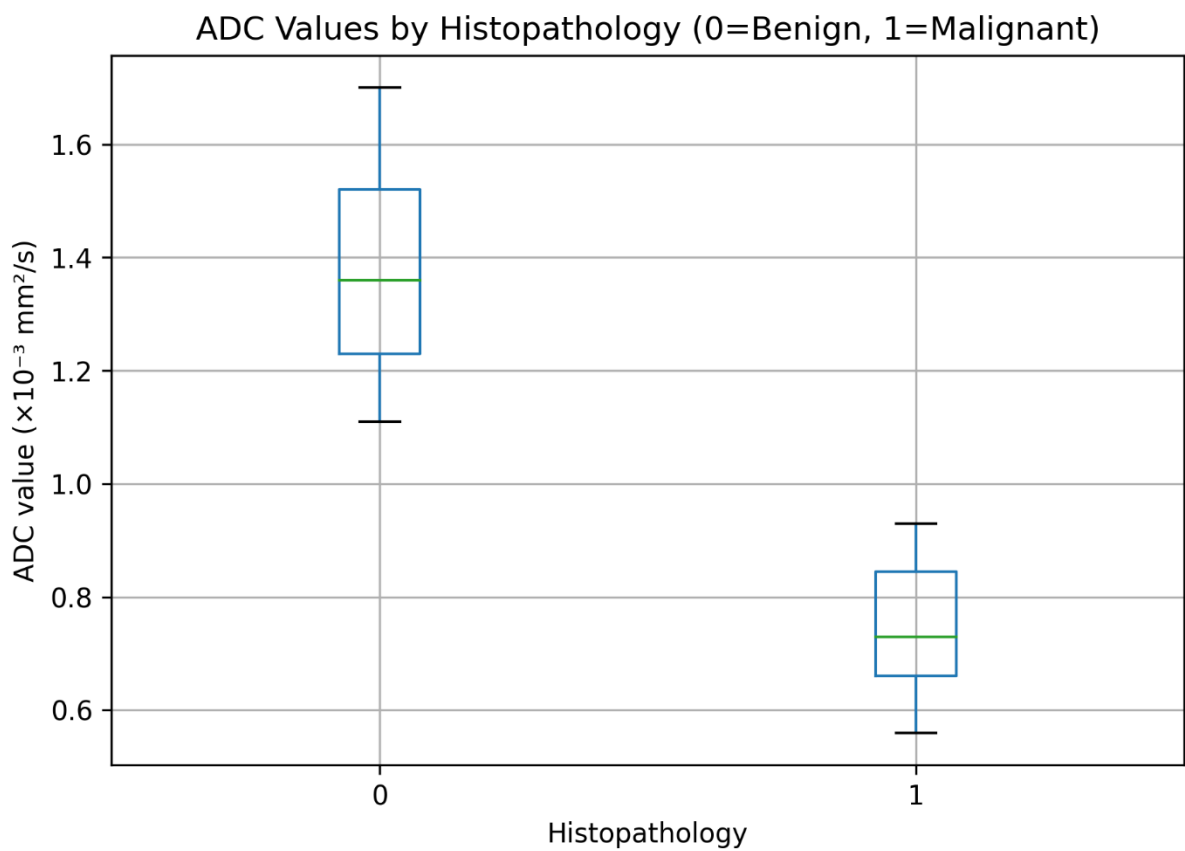


**Figure 2.** Comparison of apparent diffusion coefficient (ADC) values between benign and malignant ovarian lesions.

**Analysis**

Malignant ovarian lesions demonstrated markedly lower ADC values compared to benign lesions. The boxplot shows clear separation between groups, indicating restricted diffusion in malignant tumors due to increased cellularity and reduced extracellular water motion. This

finding supports the biological basis of diffusion-weighted imaging and confirms that ADC measurement can serve as a quantitative biomarker for malignancy.

 **Figure 3 Age Distribution (Histogram)**

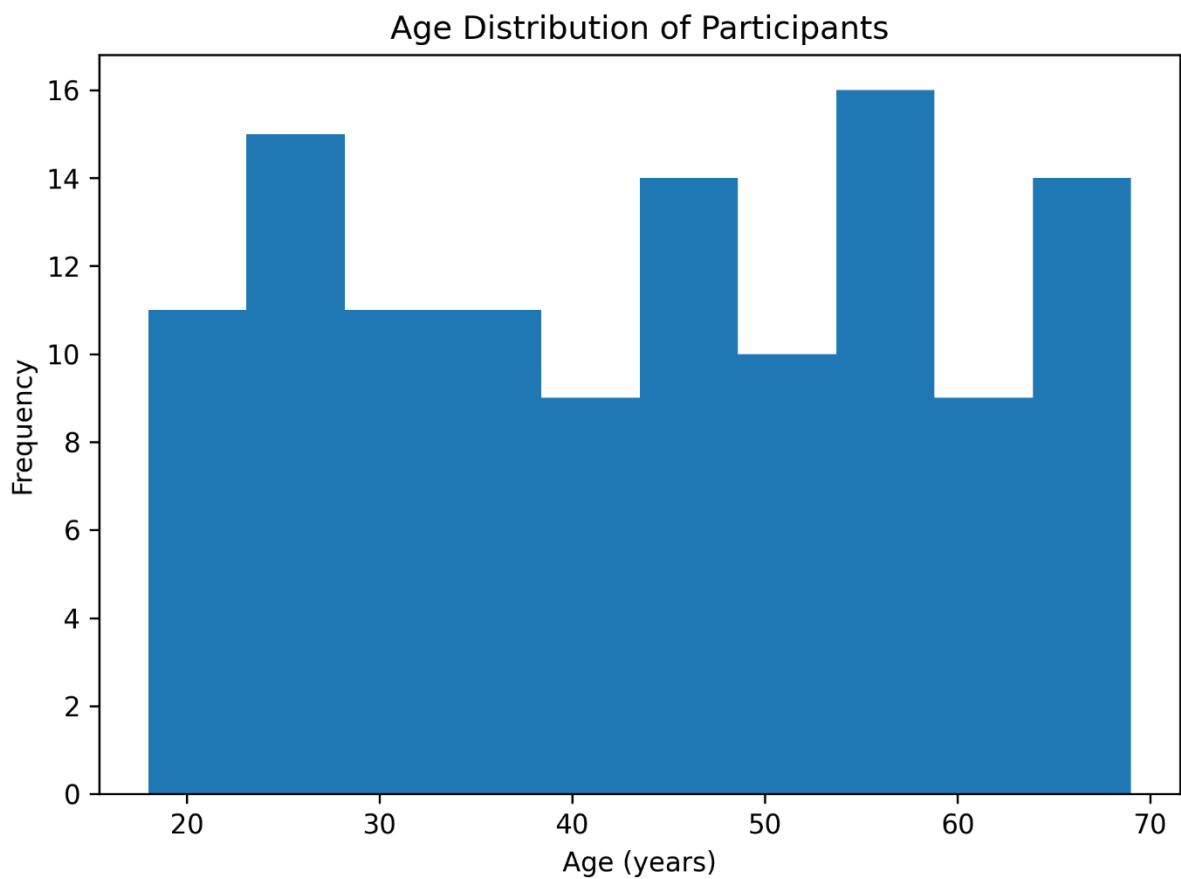


**Figure 3.** Age distribution of patients presenting with ovarian masses.

**Analysis**

The age distribution demonstrates that ovarian lesions were most frequently observed in middle-aged women. The peak incidence occurred in the fourth and fifth decades of life, consistent with known epidemiological patterns of ovarian tumors. The presence of malignancy increased with advancing age, particularly in postmenopausal patients.

## DISCUSSION

Accurate preoperative characterization of ovarian masses remains a significant challenge in gynecologic oncology. The management of an adnexal mass depends largely on the ability to reliably differentiate benign lesions from malignant tumors. Benign lesions can often be treated conservatively or with limited surgery, whereas malignant tumors require staging laparotomy and referral to gynecologic oncology specialists. Therefore, a noninvasive imaging technique capable of reliably distinguishing malignant from benign pathology has substantial clinical importance.

The present study evaluated the diagnostic accuracy of diffusion-weighted magnetic resonance imaging in differentiating benign from malignant ovarian lesions using histopathology as the reference standard. The results demonstrated that diffusion-weighted MRI has high sensitivity, specificity, and overall diagnostic accuracy, supporting its role as a reliable imaging modality in the evaluation of adnexal masses.

In our study, the majority of patients belonged to the fourth and fifth decades of life, and the frequency of malignancy increased with age. This observation is consistent with established epidemiologic patterns of ovarian tumors, which show increased incidence of malignant disease in perimenopausal and postmenopausal women. The age distribution observed in our population therefore reflects the typical clinical presentation of ovarian neoplasms.

Histopathological examination revealed that benign lesions were more common than malignant lesions. This finding aligns with clinical experience, as most adnexal masses encountered in routine practice are benign. However, the clinical difficulty arises in identifying the relatively smaller subset of malignant lesions preoperatively. In this context, the ability of imaging to correctly identify malignancy is crucial for appropriate referral and surgical planning.

Diffusion-weighted imaging is based on the principle of restricted movement of water molecules in tissues with high cellular density. Malignant tumors typically demonstrate increased cellularity, enlarged nuclei, and reduced extracellular space, which limit the Brownian motion of water molecules. This results in hyperintensity on high b-value diffusion images and corresponding hypointensity on apparent diffusion coefficient maps. Conversely, benign cystic lesions contain fluid with free molecular motion and therefore show no restriction.

In the present study, malignant lesions demonstrated significantly lower ADC values compared to benign lesions. The clear separation between ADC values of benign and malignant masses observed in our results confirms the biological basis of diffusion restriction in malignant tumors. These findings support the use of quantitative ADC measurement as an objective parameter in lesion characterization.

The sensitivity observed in this study indicates that diffusion-weighted MRI correctly identified the majority of malignant lesions. This is clinically important because missing a malignant lesion preoperatively may delay treatment and adversely affect patient outcomes. The high negative predictive value observed in our study suggests that absence of diffusion restriction strongly

indicates benign pathology. Consequently, diffusion-weighted imaging can help avoid unnecessary radical surgery in patients with benign disease.

The specificity obtained in our study demonstrates that most benign lesions were correctly classified as non-malignant. False positive cases were primarily attributable to benign lesions known to mimic malignancy on diffusion imaging. Endometriomas, tubo-ovarian abscesses, and certain fibrous tumors may demonstrate restricted diffusion due to viscous or proteinaceous contents and high cellular components. These lesions represent recognized pitfalls of diffusion-weighted imaging and explain the small proportion of false positive results observed.

False negative cases were also encountered. Some mucinous tumors and low-grade malignancies may demonstrate relatively higher ADC values due to lower cellular density and abundant mucin content. In such cases, reliance solely on diffusion restriction may lead to underestimation of malignancy risk. Therefore, diffusion-weighted imaging should always be interpreted in conjunction with morphological MRI features rather than in isolation.

The diagnostic accuracy observed in this study is comparable to international studies evaluating diffusion-weighted imaging in adnexal mass characterization. Previous investigations have reported diagnostic accuracies ranging approximately between 85% and 95%, supporting the reproducibility of this technique across different populations. The similarity of our findings to published literature suggests that diffusion-weighted MRI is applicable and reliable in our clinical setting.

Another important clinical implication of diffusion-weighted MRI is its potential role in reducing unnecessary surgeries. Indeterminate adnexal masses frequently lead to exploratory laparotomy because malignancy cannot be confidently excluded. However, high negative predictive value of diffusion-weighted imaging allows clinicians to adopt a more conservative approach in selected patients, thereby reducing surgical morbidity and healthcare costs.

Furthermore, preoperative identification of malignancy allows referral to specialized gynecologic oncology units where optimal cytoreductive surgery can be performed. Evidence indicates that patients treated by gynecologic oncologists have improved survival outcomes compared with those treated in general surgical settings. Thus, improved imaging diagnosis has direct impact on patient prognosis.

Diffusion-weighted imaging also offers additional advantages. It does not require intravenous contrast administration, which is beneficial in patients with renal impairment or contrast allergy. The sequence is relatively quick to acquire and can be easily incorporated into routine pelvic MRI protocols without significant increase in scanning time. Moreover, diffusion imaging provides functional information independent of contrast enhancement.

The incorporation of diffusion-weighted imaging into structured MRI reporting systems has further enhanced its clinical utility. Risk stratification systems rely on a combination of morphological and functional imaging findings to categorize lesions and guide management

decisions. Diffusion restriction serves as a key indicator of malignancy risk within these frameworks.

Despite its strengths, diffusion-weighted imaging has certain limitations. Susceptibility artifacts, motion artifacts from bowel peristalsis, and partial volume effects may affect image quality. Standardization of imaging parameters such as b-values and region-of-interest placement is necessary to ensure reproducibility. Interobserver variability in ADC measurement may also occur, particularly in heterogeneous lesions.

Another limitation of the present study is that it was conducted at a single tertiary care center. Multi-center studies with larger sample sizes may further validate these findings. Additionally, dynamic contrast-enhanced MRI sequences were not quantitatively analyzed, which might provide additional diagnostic information.

Nevertheless, the strengths of the study include the use of histopathology as the gold standard, blinded image interpretation, and standardized MRI protocol. These factors enhance the reliability of the results and minimize bias.

Overall, the findings of this study demonstrate that diffusion-weighted MRI is a highly useful adjunct to conventional MRI in the evaluation of ovarian masses. When combined with morphological assessment, it significantly improves diagnostic confidence and assists clinicians in determining appropriate management strategies.

## **CONCLUSION**

Diffusion-weighted magnetic resonance imaging demonstrated high diagnostic performance in differentiating benign from malignant ovarian lesions in patients presenting with adnexal masses at Recep Tayyip Erdoğan Hospital (RTEH), Muzaffargarh. Malignant tumors showed significantly lower apparent diffusion coefficient values and consistent diffusion restriction compared with benign lesions. The technique provided high sensitivity and particularly high negative predictive value, indicating that absence of diffusion restriction strongly suggests benign pathology.

The findings indicate that diffusion-weighted MRI serves as a reliable, non-invasive imaging modality that can substantially improve preoperative lesion characterization. By improving diagnostic confidence, it supports appropriate patient referral, assists in surgical planning, and may reduce unnecessary radical surgery in benign conditions.

## **CLINICAL RECOMMENDATIONS**

Diffusion-weighted imaging should be routinely incorporated into pelvic MRI protocols when evaluating indeterminate ovarian masses. Radiologists should interpret diffusion findings in conjunction with morphological MRI features rather than relying solely on individual parameters. Quantitative ADC measurement should be included in radiology reports, as it provides an objective biomarker for malignancy risk.

Patients demonstrating clear diffusion restriction with suspicious morphological features should be referred early to gynecologic oncology services for definitive management. Conversely, lesions lacking diffusion restriction and suspicious morphology may be considered for conservative or limited surgical management, thereby reducing morbidity and healthcare burden.

## **STUDY LIMITATIONS**

This study has certain limitations. It was conducted at a single tertiary care center, which may limit generalizability to other healthcare settings. The sample size, although adequate for diagnostic accuracy analysis, was relatively moderate. Some benign lesions demonstrated restricted diffusion and produced false-positive results, while certain mucinous or low-grade malignancies showed higher ADC values and resulted in false-negative findings. Additionally, dynamic contrast-enhanced MRI parameters were not quantitatively analyzed, which may have further improved lesion characterization.

Future multi-center studies with larger populations and incorporation of contrast-enhanced functional imaging parameters are recommended to further validate these findings.

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## **CONFLICT OF INTEREST**

The authors declare no conflict of interest.

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