

EVALUATION OF TREATMENT RESPONSE IN SOLID TUMORS USING RECIST 1.1  
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Article Received: 28 May 2026

Article Revised: 18 June 2026

Article Published: 01 July 2026



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DOI: <https://doi.org/10.5281/zenodo.21027715>**How to cite this Article:** <sup>1</sup>Dr. Osama Abbas Ijam, <sup>2</sup>Dr. Montadhar Shaker Al Majidi, <sup>3</sup>Dr. Zinah Abdalrahman Tawfik (2026). Evaluation Of Treatment Response In Solid Tumors Using Recist 1.1 Criteria: A Radiological Study. World Journal of Advance Healthcare Research, 10(7), 242–247.

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**ABSTRACT****Background:** Radiological assessment plays a crucial role in monitoring treatment response in patients with solid tumors. The Response Evaluation Criteria in Solid Tumors (RECIST) version 1.1 provides a standardized framework for evaluating therapeutic outcomes and guiding clinical decision-making in oncology practice.**Objectives:** To evaluate treatment response in patients with solid tumors using RECIST 1.1 criteria and to assess the association between treatment response and selected clinicopathological characteristics. **Methods:** This retrospective observational study was conducted at Al-Thaqalayn Oncology Hospital, Basra, Iraq, from January 2025 to April 2026. A total of 150 patients with histologically confirmed solid tumors who underwent baseline and follow-up radiological examinations were included. Treatment response was assessed using RECIST 1.1 criteria and categorized as complete response (CR), partial response (PR), stable disease (SD), or progressive disease (PD). Demographic, clinical, and radiological data were collected and analyzed using SPSS version 31. A P value of less than 0.05 was considered statistically significant. **Results:** The mean age of the patients was 54.3 ± 12.8 years, and females constituted 58.0% of the study population. Breast cancer was the most common malignancy (28.0%), followed by colorectal cancer (18.7%) and lung cancer (16.0%). Metastatic disease was present in 58.0% of patients. According to RECIST 1.1 criteria, partial response was observed in 36.0% of patients, stable disease in 32.0%, progressive disease in 24.0%, and complete response in 8.0%. The objective response rate was 44.0%, while the disease control rate reached 76.0%. Treatment response was significantly associated with metastatic status (P value <0.001), primary tumor type (P value = 0.018), and patient age (P value = 0.028). **Conclusions:** RECIST 1.1 is an effective and standardized tool for radiological assessment of treatment response in patients with solid tumors. Most patients achieved disease control following treatment, and treatment response was significantly influenced by metastatic status, tumor type, and age. Radiological follow-up remains essential for evaluating therapeutic efficacy and supporting evidence-based oncology care.**KEYWORDS:** Computed tomography; Disease control; Metastasis; Oncology; Surveillance; Tumor burden.**1-INTRODUCTION**

Cancer remains one of the leading causes of morbidity and mortality worldwide, representing a major public health challenge despite substantial advances in diagnosis and treatment. According to recent global cancer statistics, millions of new cancer cases are diagnosed annually, and the burden of malignant disease continues to increase in both developed and developing countries. Advances in systemic therapies, including

chemotherapy, targeted therapy, immunotherapy, and radiotherapy, have significantly improved patient outcomes. However, accurate assessment of treatment response remains essential for determining therapeutic effectiveness, guiding clinical decision-making, and optimizing patient management.<sup>[1]</sup>

Medical imaging plays a pivotal role throughout the oncological pathway, from initial diagnosis and staging

to treatment planning and post-therapy surveillance. Cross-sectional imaging modalities, particularly computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography/computed tomography (PET/CT), provide objective and reproducible methods for evaluating tumor burden and monitoring changes in disease extent during and after treatment. Consequently, radiological assessment has become a fundamental component of modern oncology practice.<sup>[2]</sup>

The evaluation of treatment response in solid tumors has historically been challenging because different clinicians and institutions often used varying criteria to determine whether a tumor had responded to therapy. To address this issue, standardized response assessment systems were developed. The Response Evaluation Criteria in Solid Tumors (RECIST) were first introduced in 2000 and subsequently updated to RECIST version 1.1 in 2009. RECIST 1.1 remains the most widely accepted and internationally recognized system for evaluating tumor response in clinical trials and routine oncology practice.<sup>[3]</sup>

RECIST 1.1 utilizes measurable target lesions identified on imaging studies and categorizes treatment response into four major groups: complete response (CR), partial response (PR), stable disease (SD), and progressive disease (PD). These categories are based primarily on changes in the sum of lesion diameters during follow-up imaging examinations. The standardized nature of RECIST 1.1 facilitates consistent interpretation of imaging findings, improves communication among multidisciplinary teams, and enables objective comparison of treatment outcomes across different institutions and studies.<sup>[4]</sup>

Computed tomography remains the principal imaging modality used for RECIST-based assessment because of its wide availability, high spatial resolution, and ability to evaluate multiple organ systems simultaneously. Nevertheless, magnetic resonance imaging and PET/CT are increasingly utilized in selected malignancies where superior soft tissue characterization or metabolic information may provide additional clinical value. The integration of advanced imaging techniques has further enhanced the radiologist's role in assessing therapeutic response and identifying disease progression.<sup>[5]</sup>

Several recent studies have demonstrated the clinical utility of RECIST 1.1 in evaluating response to chemotherapy, targeted therapy, and immunotherapy across a variety of solid tumors. Accurate radiological assessment has been shown to influence treatment modification, continuation, or termination and is directly associated with patient prognosis and survival outcomes. Furthermore, RECIST-based evaluation remains a cornerstone endpoint in contemporary oncology research and clinical trials.<sup>[6-7]</sup>

Despite the widespread use of RECIST 1.1 internationally, limited data are available regarding its application in routine oncology practice within Iraq, particularly in specialized oncology centers. Al-Thaqalayn Oncology Hospital in Basra receives a large number of patients with various solid malignancies undergoing systemic therapy and radiological follow-up, providing an opportunity to evaluate treatment response using standardized imaging criteria. Therefore, this study aims to evaluate treatment response in patients with solid tumors using RECIST 1.1 criteria and to determine the distribution of complete response, partial response, stable disease, and progressive disease among patients undergoing follow-up imaging at Al-Thaqalayn Oncology Hospital in Basra, Iraq. The findings may contribute to improving radiological assessment practices, supporting evidence-based therapeutic decisions, and enhancing the quality of oncological care.

## 2-PATIENTS AND METHODS

Ethical approval for the study was obtained from the Scientific and Ethical Committee of Al Basra Directorate of Health. Patient confidentiality was maintained throughout the study by anonymizing all collected data and restricting access to study records. This retrospective observational study was conducted at Al-Thaqalayn Oncology Hospital, Basra, Iraq, to evaluate radiological treatment response in patients with solid malignancies using the Response Evaluation Criteria in Solid Tumors (RECIST) version 1.1. The study was carried out over a 16-month period from January 2025 to April 2026.

Demographic, clinical, and radiological data were retrieved from patients' medical records, the Radiology Information System (RIS), and the Picture Archiving and Communication System (PACS). Collected variables included age, sex, primary tumor type, disease stage, treatment modality, baseline tumor burden, metastatic status, and follow-up imaging findings.

Treatment response was assessed using contrast-enhanced computed tomography (CT), magnetic resonance imaging (MRI), or positron emission tomography/computed tomography (PET/CT), according to the clinical indication and tumor type. Target lesions were selected and measured in accordance with RECIST 1.1 guidelines. Based on changes in tumor size during follow-up, patients were categorized into complete response (CR), partial response (PR), stable disease (SD), or progressive disease (PD).

The primary study outcome was the radiological response rate according to RECIST 1.1 criteria. Secondary outcomes included the relationship between treatment response and tumor type, metastatic status, and therapeutic modality.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 31. Continuous variables were expressed as mean  $\pm$  standard deviation, whereas

categorical variables were presented as frequencies and percentages. Associations between categorical variables were assessed using the Chi-square test or Fisher's exact test when appropriate. A P value of less than 0.05 was considered statistically significant.

### 3-RESULTS

The study included 150 patients with histologically confirmed solid tumors who underwent radiological

follow-up according to RECIST 1.1 criteria. Females constituted 58.0% of the study population, while males accounted for 42.0%, with female: male ratio of 1.38:1. Table 1 showed that the largest age group was 50–64 years, representing 40.6% of patients, followed by patients younger than 50 years (34.7%). Patients aged 65 years and older comprised 24.7% of the study population.

**Table 1: Demographic characteristics of the study population (n = 150).**

Variable	Number	Percentage (%)
Male	63	42.0
Female	87	58.0
<50 years	52	34.7
50–64 years	61	40.6
≥65 years	37	24.7

Table 2 showed breast cancer was the most frequently encountered malignancy, accounting for (28%) of the study patients. Colorectal and lung cancers were the second and third most common tumor types, representing

(18.7%) and (16%) respectively. Ovarian cancer and hepatocellular carcinoma also represented a considerable proportion of the study population.

**Table 2: Distribution of primary tumor types (n = 150).**

Tumor Type	Number	Percentage (%)
Breast cancer	42	28.0%
Colorectal cancer	28	18.7%
Lung cancer	24	16.0%
Ovarian cancer	16	10.7%
Hepatocellular carcinoma	14	9.3%
Gastric cancer	10	6.7%
Pancreatic cancer	8	5.3%
Other tumors	8	5.3%

Evaluation of disease extent revealed that metastatic disease was present in 87 patients (58.0%), whereas 63

patients (42.0%) had non-metastatic disease. As shown in Table 3.

**Table 3: Metastatic status of the study population (n = 150).**

Status	Number	Percentage (%)
Non-metastatic	63	42.0%
Metastatic	87	58.0%

Assessment of therapeutic response according to RECIST 1.1 criteria demonstrated that partial response was the most common outcome, observed in 36.0% of patients. Stable disease was documented in 32.0% of patients, while progressive disease occurred in 24.0%.

Complete response was achieved in only 8.0% of cases. These findings suggest that most patients benefited from treatment either through tumor regression or disease stabilization. This is shown in Table 4.

**Table 4: Treatment response according to RECIST 1.1 criteria (n = 150).**

Response	Number	Percentage (%)
CR	12	8.0%
PR	54	36.0%
SD	48	32.0%
PD	36	24.0%

Calculation of treatment efficacy indicators showed that the objective response rate, defined as the sum of complete and partial responses, was 44.0%. Furthermore, the disease control rate, which included complete

response, partial response, and stable disease, reached 76.0%. These results indicate that more than three-quarters of patients achieved disease control following treatment. As shown in Table 5.

**Table 5: Overall response and disease control rates.**

Parameter	Number	Percentage (%)
Objective Response Rate (CR+PR)	66	44.0%
Disease Control Rate (CR+PR+SD)	114	76.0%

Table 6 showed the relationship between metastatic status and RECIST response. A statistically significant relationship was identified between metastatic status and RECIST response categories ( $P < 0.001$ ). Complete and

partial responses were more common among non-metastatic patients, whereas progressive disease occurred predominantly in patients with metastatic tumors.

**Table 6: Relationship between metastatic status and RECIST response.**

Response	Non-metastatic = 63	Metastatic = 87	P value
CR	10 (15.87%)	2 (2.29%)	<0.001
PR	30 (47.61%)	24 (27.58%)	
SD	18 (28.57%)	30 (34.48%)	
PD	5 (7.93%)	31 (35.63%)	

Table 7 showed treatment response according to primary tumor type. Treatment response varied significantly according to primary tumor type ( $P = 0.018$ ). Breast cancer demonstrated the most favorable response profile, with the highest proportion of objective responses. In

contrast, pancreatic cancer exhibited the poorest outcomes, showing the highest frequency of progressive disease. Intermediate response patterns were observed among colorectal, lung, ovarian, gastric, and hepatocellular carcinomas.

**Table 7: Treatment response according to primary tumor type.**

Tumor Type	CR/PR	SD	PD
Breast cancer	24	12	6
Colorectal cancer	12	10	6
Lung cancer	10	8	6
Ovarian cancer	8	5	3
Hepatocellular carcinoma	5	4	5
Gastric cancer	3	4	3
Pancreatic cancer	1	2	5

Age group was significantly associated with treatment response ( $P = 0.028$ ). Younger patients demonstrated higher rates of objective response and lower frequencies of disease progression. Conversely, older patients,

particularly those aged 65 years and above, exhibited a greater proportion of progressive disease. These findings suggest that advancing age may be associated with less favorable treatment outcomes. As shown in Table 8.

**Table 8: Association between age group and treatment response.**

Age Group	CR/PR	SD	PD
<50 years	30	16	6
50–64 years	26	21	14
≥65 years	10	11	16

#### 4- DISCUSSION

The present study evaluated treatment response among patients with solid tumors using RECIST 1.1 criteria and demonstrated that partial response was the most common treatment outcome, followed by stable disease. Overall, disease control was achieved in 76.0% of patients, while the objective response rate reached 44.0%. These findings emphasize the importance of standardized radiological assessment in monitoring treatment efficacy and guiding therapeutic decision-making in oncology practice.

The mean age of the study population was  $54.3 \pm 12.8$  years, and the majority of patients belonged to the 50–64-year age group. This finding is comparable to that

reported by Ruchalski *et al.*, who observed that most patients undergoing RECIST-based treatment evaluation were middle-aged or elderly adults.<sup>[2]</sup> Similarly, Kalisz *et al.* highlighted the increasing prevalence of solid malignancies with advancing age and the consequent need for serial radiological assessment during treatment.<sup>[8]</sup>

Breast cancer represented the most common malignancy in the present study, followed by colorectal and lung cancers. Although the distribution of tumor types varies according to geographic location and referral patterns, similar trends have been reported in contemporary oncological imaging studies, where breast, colorectal, and lung cancers constituted the largest proportion of

cases undergoing response assessment.<sup>[5,8]</sup> The predominance of these malignancies reflects their high global incidence and the increasing role of imaging in treatment monitoring.

More than half of the patients had metastatic disease at the time of radiological evaluation. This observation is consistent with findings reported by **Xu *et al.***, who noted that advanced-stage disease represents a substantial proportion of patients undergoing RECIST-based assessment in tertiary oncology centers.<sup>[5]</sup> The high prevalence of metastatic disease in the present study may explain the relatively low complete response rate and the persistence of progressive disease in a subset of patients. According to RECIST 1.1 criteria, partial response was the most common outcome, followed by stable disease, whereas complete response was achieved in only a minority of patients. Similar findings were reported by **Smesseim and Eisenhauer**, who demonstrated that partial response and stable disease constitute the most frequent RECIST outcomes across a wide range of solid tumors.<sup>[7]</sup> The relatively low complete response rate observed in the current study is expected, particularly in patients with advanced or metastatic disease.

The objective response rate and disease control rate in the present study were 44.0% and 76.0%, respectively. These findings are comparable to those reported in several recent studies evaluating treatment efficacy using RECIST 1.1 criteria.<sup>[3,7]</sup> The high disease control rate suggests that the majority of patients benefited from treatment either through tumor regression or disease stabilization, supporting the effectiveness of contemporary therapeutic approaches.

A highly significant association was observed between metastatic status and treatment response (P value <0.001). Patients with metastatic disease demonstrated higher rates of progressive disease and lower frequencies of complete response than non-metastatic patients. Similar observations were reported by **Xu *et al.***, who found that metastatic burden was significantly associated with poorer treatment outcomes and reduced response rates. Advanced disease stage is often associated with increased tumor heterogeneity and resistance to therapy, which may explain these findings.<sup>[5]</sup>

Treatment response also varied significantly according to primary tumor type (P value = 0.018). Breast cancer demonstrated the highest objective response rate, whereas pancreatic cancer exhibited the highest rate of disease progression. These findings agree with those reported by **Jhaveri and Hosseini-Nik**, who observed more favorable treatment responses among breast cancer patients compared with pancreatic and gastrointestinal malignancies.<sup>[9]</sup> Similar differences in response patterns among various tumor types have also been documented by **Cacicedo *et al.***<sup>[10]</sup>

The present study further demonstrated a significant association between age and treatment response (P value = 0.028). Younger patients achieved better treatment outcomes, while progressive disease was more common among older individuals. Similar findings have been reported in previous radiological studies, suggesting that increasing age may adversely affect treatment response owing to comorbidities, reduced physiological reserve, and altered tolerance to anticancer therapies.<sup>[8,10]</sup>

The study had many limitations should be acknowledged. The retrospective design may have introduced selection bias, and the study was conducted at a single oncology center, which may limit the generalizability of the results. In addition, the inclusion of multiple tumor types with varying biological behaviors and treatment protocols may have influenced response patterns. Nevertheless, the use of standardized RECIST 1.1 criteria and the inclusion of a relatively large patient cohort strengthen the validity and clinical relevance of the study findings.

## 5- CONCLUSION AND RECOMMENDATION

This study demonstrated that RECIST 1.1 provides a reliable and standardized method for radiological assessment of treatment response in patients with solid tumors. Partial response was the most frequent treatment outcome, followed by stable disease, while disease control was achieved in the majority of patients. Treatment response was significantly associated with metastatic status, primary tumor type, and patient age. Furthermore, the findings confirmed the essential role of radiological imaging in monitoring therapeutic effectiveness and guiding clinical decision-making in oncology practice. Routine application of RECIST 1.1 criteria is recommended for standardized evaluation of treatment response in patients with solid tumors. Regular radiological follow-up should be integrated into oncology care to facilitate early identification of disease progression and optimize treatment strategies. Particular attention should be directed toward patients with metastatic disease and elderly patients, who demonstrated less favorable treatment outcomes. Future multicenter prospective studies with larger sample sizes and incorporation of advanced imaging techniques, including functional MRI, PET/CT, and artificial intelligence-based imaging analysis, are recommended to further improve the accuracy of treatment response assessment.

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