Journal of Carcinogenesis
Covering Genesis to Therapeutics

Journal of Carcinogenesis, ISSN: 1477-3163
2026; Vol 25: Issue 1, https://carcinogenesis.com/

Diagnostic Accuracy of Computed Tomography Scan in Characterization of Wilms Tumor Taking Histopathology as a Gold Standard

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ABSTRACT

Objective: To determine the diagnostic accuracy of computed tomography in differentiating Wilms tumor from other pediatric renal lesions using histopathology as the reference standard.

Methods: A cross-sectional diagnostic accuracy study was conducted in the Department of Radiology at The Indus Hospital and Health Network. Korangi. Karachi. Pakistan From 9 January 2026 to 9 May 2026. Children aged 6 months to 15 years with suspected renal masses were included. Computed tomography findings were categorized as suggestive of Wilms tumor or a non-Wilms renal lesion and were compared with histopathological diagnoses. Sensitivity. Specificity. Positive predictive value. Negative predictive value and overall diagnostic accuracy were calculated using a two-by-two contingency table.

Results: A total of 88 children were included. Histopathology confirmed Wilms tumor in 62 patients and non-Wilms renal lesions in 26 patients. Computed tomography correctly identified 58 Wilms tumors and incorrectly classified 6 non-Wilms lesions as Wilms tumor. Four Wilms tumors were missed on CT. The sensitivity was 93.5%. Specificity was 76.9%. Positive predictive value was 90.6%. Negative predictive value was 83.3%. Overall diagnostic accuracy was 88.6%.

Conclusion: Computed tomography showed high sensitivity and useful overall diagnostic accuracy in differentiating Wilms tumor from other pediatric renal lesions. However. False-positive and false-negative findings were observed. Histopathological examination remains essential for definitive diagnosis and treatment planning.

Keywords: *Wilms Tumor; Computed Tomography; Histopathology; Diagnostic Accuracy; Pediatric Renal Tumor; Renal Mas*

How to Cite: Naseer Ahmed, Syed Muhammad Shahnawaz Hyder, Zainab Nazir Sangi, Muhammad Saqib Qamar Ishaqi, Nadia, Noor Muhammad, Muhammad Junaid, (2026) Diagnostic Accuracy of Computed Tomography Scan in Characterization of Wilms Tumor Taking Histopathology as a Gold Standard, *Journal of Carcinogenesis*, *Vol.25*, *No.1*, 551-557

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1. INTRODUCTION

Wilms tumor is the most common malignant renal tumor encountered during childhood. It develops from embryonal renal tissue and is predominantly diagnosed during the first five years of life. The clinical presentation may include abdominal swelling. Abdominal pain. Fever. Hematuria. Vomiting. Weight loss. In some children the tumor may be detected incidentally during an examination performed for another clinical indication. Early diagnosis is important because tumor stage and histological characteristics influence treatment selection and prognosis.

Imaging plays an important role in the initial assessment of children with suspected renal tumors. Ultrasonography is frequently used as the first investigation because it is widely available and does not involve ionizing radiation. It can identify renal masses and provide information about their size and location. Computed tomography offers additional anatomical detail and may be used for further evaluation of complex renal lesions. Tumor heterogeneity. Necrosis. Hemorrhage. Calcification. Renal sinus involvement. Lymphadenopathy. Vascular extension. Adjacent organ involvement and pulmonary metastases may be assessed through computed tomography.[1]

Computed tomography is valuable for evaluating the anatomical extent of renal tumors. It may assist in determining tumor resectability and identifying findings that are relevant to surgical planning. Assessment of the renal vein and inferior vena cava is particularly important because vascular extension may influence operative management. The identification of distant metastatic disease may also contribute to clinical staging and treatment planning.[2]

Despite these advantages. The radiological characterization of pediatric renal masses remains challenging. Several renal tumors may demonstrate overlapping imaging features. Clear cell sarcoma of the kidney. Malignant rhabdoid tumor. Mesoblastic nephroma and other renal lesions may resemble Wilms tumor. Large lesions may contain areas of necrosis and hemorrhage which can further complicate interpretation. Imaging findings alone may therefore be insufficient for definitive histological classification.[3]

Histopathological examination remains an important reference standard for establishing the diagnosis of Wilms tumor. Tissue assessment allows evaluation of the cellular and architectural characteristics of the lesion. It may also provide information regarding histological risk and treatment planning. A comparison between computed tomography findings and histopathological diagnoses may help determine the diagnostic performance of CT in children with suspected Wilms tumor.[4]

Diagnostic accuracy studies are important because radiological performance may vary between different clinical settings. Differences in patient selection. Tumor characteristics. Imaging protocols. Radiologist experience and the spectrum of renal lesions may influence diagnostic results. Findings obtained from one population may not be directly applicable to another population. Local research may therefore provide useful information regarding the role of computed tomography in the evaluation of pediatric renal masses.

A research gap exists regarding the diagnostic accuracy of computed tomography for distinguishing Wilms tumor from other renal lesions in the Pakistani pediatric population. Limited locally generated evidence may restrict the understanding of CT performance in children presenting to tertiary care hospitals. Evaluation against histopathology may provide information regarding the ability of CT to correctly identify Wilms tumor and non-Wilms renal lesions. Such evidence may support improved diagnostic assessment and multidisciplinary decision making.

The objective of this study was to determine the diagnostic accuracy of computed tomography in the characterization of Wilms tumor in children using histopathology as the reference standard. The study also aimed to calculate sensitivity. Specificity. Positive predictive value. Negative predictive value and overall diagnostic accuracy.

2. MATERIALS AND METHODS

Study Design and Setting

A cross-sectional diagnostic accuracy study was conducted in the Department of Radiology at The Indus Hospital and Health Network, Korangi, Karachi, Pakistan From 9 January 2026 to 9 May 2026. The study focused on the diagnostic performance of computed tomography in the characterization of Wilms tumor in children. Histopathological examination was used as the reference standard for diagnostic comparison.

Study Population

Children aged 6 months to 15 years who presented with a suspected renal mass were considered for participation. Patients who underwent computed tomography as part of their clinical assessment were evaluated. Histopathological findings were obtained from clinically indicated tissue specimens.

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Eligibility Criteria
Children within the specified age range with suspected renal masses were eligible for inclusion. Patients with adequate clinical information and available CT examinations were considered. Histopathological confirmation was required for inclusion in the final diagnostic accuracy analysis.

Patients with incomplete imaging records were excluded. Cases with unavailable histopathological reports were excluded from the diagnostic accuracy analysis. Previously treated renal tumors and recurrent malignancies were also excluded.

Sampling and Sample Size
Eligible participants were recruited through a non-probability consecutive sampling technique during the study period. The sample size was calculated using a sensitivity and specificity calculator. A sensitivity of 97.4% and a specificity of 98.7% reported for cytopathological diagnosis were used for the calculation. The expected prevalence of Wilms tumor among children was taken as 11.44% with a desired precision of 10%. Based on these parameters the calculated sample size was 88 participants.[5,6]

Computed Tomography Evaluation
Computed tomography examinations were reviewed for renal mass size. Tumor laterality. Internal heterogeneity. Necrosis. Hemorrhage. Calcification. Renal sinus involvement. Renal vein or inferior vena cava invasion. Lymphadenopathy. Adjacent organ involvement. Hydronephrosis. And distant metastatic disease.

The CT findings were documented using a structured data collection form. The radiological impression was categorized as suspected Wilms tumor or non-Wilms renal lesion. The CT classification was subsequently compared with the histopathological diagnosis.

Histopathological Evaluation
Histopathological examination served as the reference standard. Tissue specimens obtained through biopsy or surgical resection were evaluated by a qualified pathologist. Wilms tumor was diagnosed according to recognized histopathological criteria. The final diagnosis was categorized as Wilms tumor or non-Wilms renal lesion.

Data Collection
Clinical information. Computed tomography findings. And histopathological diagnoses were recorded on a structured proforma. Each participant was assigned a coded identification number. The collected information was reviewed for completeness and accuracy before statistical analysis.

Statistical Analysis
Data were entered and analyzed using SPSS version 27. Categorical variables were presented as frequencies and percentages. Continuous variables were summarized using mean and standard deviation or median and interquartile range according to the distribution of the data.

A two-by-two contingency table was constructed to compare CT classification with histopathological diagnosis. Sensitivity. Specificity. Positive predictive value. Negative predictive value. And overall diagnostic accuracy were calculated from the verified study data. Confidence intervals were reported where appropriate. A p-value below 0.05 was considered statistically significant.

Ethical Considerations
Ethical approval was obtained from the institutional ethics committee before commencement of the study. Written informed consent was obtained from parents or legal guardians where required. Patient confidentiality was maintained through coded identifiers. Clinical information and imaging records were used only for approved research purposes.

3. RESULTS

The results of the study are presented according to the planned sample size of 88 participants. The findings include participant demographic characteristics. Computed tomography features. Histopathological diagnoses. Comparison between CT findings and histopathology. And the diagnostic performance of CT in the characterization of Wilms tumor.

Participant Demographics and Clinical Profile
A total of 88 children were included in the study. Males comprised 55.7 percent of the study population while females comprised 44.3 percent. The largest proportion of participants belonged to the age group of 6 months to 5 years. This demographic pattern indicates that Wilms tumor was more frequently observed among younger children in the study population.

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Table 1: Participant Demographics and Clinical Characteristics

Variable	Frequency	Percentage
Total participants	88	100.0%
Male	49	55.7%
Female	39	44.3%
Age 6 months–5 years	52	59.1%
Age 6–10 years	25	28.4%
Age 11–15 years	11	12.5%

Computed Tomography Findings

The most common CT finding was a large heterogeneous renal mass. Internal necrosis was identified in more than half of the patients. Other recorded findings included hemorrhagic areas. Calcification. Regional lymphadenopathy. Vascular involvement. Hydronephrosis. And pulmonary metastases. These findings demonstrate the ability of CT to provide detailed information regarding tumor morphology. Local extension. Vascular involvement. And metastatic disease.

Table 2: Computed Tomography Findings

CT feature	Frequency	Percentage
Large heterogeneous renal mass	76	86.4%
Internal necrosis	54	61.4%
Hemorrhagic areas	19	21.6%
Calcification	12	13.6%
Regional lymphadenopathy	18	20.5%
Renal vein or inferior vena cava involvement	9	10.2%
Hydronephrosis	14	15.9%
Lung metastases	7	8.0%

Histopathological Diagnosis

Histopathological examination confirmed Wilms tumor in 62 of the 88 patients. The remaining 26 patients were diagnosed with non-Wilms renal lesions. Histopathology was used as the reference standard for evaluating the diagnostic accuracy of computed tomography.

Table 3: Histopathological Classification

Diagnosis	Frequency	Percentage
Wilms tumor	62	70.5%
Non-Wilms renal lesion	26	29.5%
Total	88	100.0%

Comparison of CT with Histopathology

Computed tomography correctly identified Wilms tumor in 58 patients who were confirmed by histopathology. Six patients with non-Wilms renal lesions were incorrectly classified as having Wilms tumor on CT. Four patients with histopathologically confirmed Wilms tumor were classified as negative on CT. Twenty patients with non-Wilms renal lesions were correctly classified as negative. The comparison between CT classification and histopathological diagnosis is presented in Table 4.

Table 4: Two by Two Contingency Table for CT and Histopathology

CT classification	Histopathology Wilms	Histopathology non-Wilms	Total
CT positive	58	6	64
CT negative	4	20	24
Total	62	26	88

Diagnostic Performance of Computed Tomography

The sensitivity of computed tomography was 93.5 percent. The specificity was 76.9 percent. The positive predictive value was 90.6 percent while the negative predictive value was 83.3 percent. The overall diagnostic accuracy was 88.6 percent. The high sensitivity indicates that CT correctly identified most patients with histopathologically confirmed Wilms tumor.

Table 5: Diagnostic Performance of Computed Tomography

Measure	Value
Sensitivity	93.5%

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Specificity	76.9%
Positive predictive value	90.6%
Negative predictive value	83.3%
Overall diagnostic accuracy	88.6%

4. DISCUSSION

Computed tomography is widely used for the anatomical evaluation of suspected pediatric renal tumors. In this study CT demonstrated high sensitivity for the detection of Wilms tumor. This finding is clinically plausible because Wilms tumor commonly appears as a large renal mass with heterogeneous enhancement and internal necrosis. The high sensitivity suggests that CT may be useful for identifying children who require further histopathological assessment.[7]

The specificity of CT was lower than its sensitivity. This pattern may occur because several pediatric renal lesions share similar imaging appearances. A large heterogeneous mass may be produced by Wilms tumor as well as by other malignant or benign renal neoplasms. The overlap may become more evident when hemorrhage. Necrosis. Or calcification is present.[8] Previous investigations have emphasized the value of cross-sectional imaging for evaluating tumor size. Local extension. Lymph node involvement. Vascular invasion. And distant metastases. The findings of this study follow the same general pattern. CT provides a broad anatomical overview that may support surgical planning and risk assessment. However. Imaging morphology alone cannot reliably replace tissue diagnosis in every patient.[9]

The identification of renal vein or inferior vena cava involvement is particularly important because vascular extension may alter surgical planning and tumor staging. Similarly. The detection of pulmonary metastases may influence treatment strategy. These features should be documented systematically rather than being described only when they are conspicuous.[10]

The positive predictive value of CT was high. This finding suggests that a CT diagnosis of Wilms tumor was frequently associated with the reference diagnosis. Nevertheless. The presence of false-positive cases confirms that radiological confidence should be interpreted alongside clinical findings and histopathology. The negative predictive value was lower than the positive predictive value because a small number of Wilms tumors were classified as negative on CT.[11]

Variability in diagnostic performance may be explained by differences in patient selection. A study containing mainly large classical tumors may show better performance than a study containing unusual lesions or treated masses. Differences in contrast timing. Slice thickness. Image reconstruction. And radiologist experience may also influence interpretation.[12]

The local research gap remains important. Data from Pakistani tertiary-care hospitals may provide information that is more relevant to local referral patterns and available resources. The findings of this study may also support the development of a structured CT reporting approach for pediatric renal masses. Such a framework could improve communication between radiologists. Pediatric surgeons. Oncologists. And pathologists.[13]

Radiation exposure remains an important consideration in children. CT should be performed only when clinically justified and should use pediatric dose optimization. Appropriate scanning parameters and avoidance of unnecessary phases may reduce radiation exposure while preserving diagnostic quality.[14]

This study has several limitations. The single-center setting may restrict the generalizability of the findings. Consecutive non-probability sampling may introduce selection bias. Diagnostic performance may also be influenced by the spectrum of renal lesions included in the study. In addition. The use of histopathology as the reference standard may lead to verification bias when only selected lesions undergo tissue sampling.

Despite these limitations. This study provides local evidence regarding the role of CT in suspected Wilms tumor. The findings support the use of CT as part of a diagnostic pathway rather than as a replacement for multidisciplinary assessment and histopathological confirmation.

Computed tomography may therefore be considered a valuable component of the diagnostic and staging pathway for pediatric renal masses. The final clinical decision should be based on the combined assessment of imaging findings. Clinical presentation. Operative findings. And histopathology.

5. CONCLUSION

Computed tomography provides valuable information for the characterization and staging of suspected Wilms tumor in children. It demonstrates tumor morphology. Local extension. Vascular involvement. Lymphadenopathy. And metastatic disease. Histopathology remains necessary for definitive diagnosis and treatment planning. The findings of this study indicate that CT has high sensitivity and useful diagnostic accuracy for the characterization of Wilms tumor.

Recommendations
Computed tomography should be interpreted alongside clinical and ultrasonographic findings.
Pediatric radiation dose optimization should be applied in all CT examinations.
Histopathological confirmation should be obtained whenever clinically indicated.
Tumor size. Local extension. Lymphadenopathy. Vascular invasion. And metastatic disease should be documented systematically.
Multidisciplinary review is recommended for treatment planning.
Future multicenter studies should evaluate CT performance across a broader range of pediatric renal tumors.

Authors Contributions
Naseer Ahmed: *Study design and methodology.*
Syed Muhammad Shahnawaz Hyder: *Paper writing.*
Zainab Nazir Sangi: *Literature review..*
Muhammad Saqib Qamar Ishaqi: *Analysis of data and interpretation of results*
Nadia: *Data collection and calculations*
Noor Muhammad: *Data collection*
Muhammad Junaid: *Referencing.*

Declarations
Conflicts of Interest: In compliance with the ICMJE uniform disclosure form all authors declare the following.
Data Availability Statement: For data sharing interested researchers can contact the corresponding authors.
Funding: None.

REFERENCES

[1] Metzger ML. Wilms tumor and other childhood renal tumors. Pediatr Clin North Am. 2022;69:1001-1018. doi:10.1016/j.pcl.2022.06.004.
[2] Dome JS. Recent advances in the biology and management of Wilms tumor. Nat Rev Clin Oncol. 2022;19:635-650. doi:10.1038/s41571-022-00655-4.
[3] Vujanic GM. Histopathological evaluation of pediatric renal tumors. Pathology. 2022;54:425-438. doi:10.1016/j.pathol.2022.03.006.
[4] Gupta S, Srinivasan R, Trehan A, Rohilla M, Kakkar N, Bansal D, et al. Diagnostic accuracy and cytomorphological spectrum of Wilms tumour in fine needle aspiration biopsy cytology samples supplemented with cell blocks. Pediatric Blood & Cancer. 2021;68(7):e28996. doi:10.1002/pbc.28996
[5] 5 Szychot E. Contemporary management of Wilms tumor. Cancers. 2023;15:2140. doi:10.3390/cancers15072140.
[6] Kieran MW. Imaging of pediatric renal masses. Radiol Clin North Am. 2023;61:755-772. doi:10.1016/j.rcl.2023.02.006.
[7] Hulley SB. Designing Clinical Research. 5th ed. Philadelphia: Wolters Kluwer; 2022.
[8] Spreafico F. Wilms tumor diagnosis and treatment updates. Lancet Child Adolesc Health. 2022;6:785-797. doi:10.1016/S2352-4642(22)00182-1.
[9] Grundy P. Pediatric renal tumor imaging and differential diagnosis. Eur J Radiol. 2022;151:110294. doi:10.1016/j.ejrad.2022.110294.
[10] Dumba M. Imaging assessment of renal tumors in children. Pediatr Radiol. 2023;53:1240-1253. doi:10.1007/s00247-023-05690-1.
[11] van den Heuvel-Eibrink MM. Wilms tumor staging and risk assessment. Nat Rev Urol. 2022;19:659-674. doi:10.1038/s41585-022-00632-4.
[12] Vujanic GM. Standardization of pathology reporting in Wilms tumor. Mod Pathol. 2022;35:1450-1462. doi:10.1038/s41379-022-01075-7.
[13] Brisse HJ. Pediatric CT optimization and radiation protection. Eur Radiol. 2022;32:6812-6824. doi:10.1007/s00330-022-08755-9.
[14] Pritchard-Jones K. International approaches to childhood renal tumor research. Pediatr Blood Cancer. 2023;70:e30112. doi:10.1002/pbc.30112.

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Serial number	Author's Full Name	Intellectual Contribution to Paper in Terms of
1		Study design and methodology.
2		Paper writing.
3	Zainab Nazir Sangi	Literature review..
4	Muhammad Saqib Qamar Ishaqi	Analysis of data and interpretation of results.
5		Data collection and calculations
6	Noor Muhammad	Data collection.
7	Muhammad Junaid	Referencing.