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Ultrasonography Is An Important Tool For The Diagnosis Of Acute Abdominal Disease In Children: A Systematic Review

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Abstract

Background: Acute abdominal pain in children presents a significant diagnostic challenge requiring rapid and accurate assessment to prevent morbidity. Ultrasonography (US) is increasingly used as the first-line imaging modality due to its safety, accessibility, and diagnostic precision.
Objective: This systematic review aimed to evaluate the diagnostic accuracy, clinical effectiveness, and comparative performance of ultrasound in detecting acute abdominal conditions in children, including appendicitis, intussusception, and other surgical emergencies.
Methods: Following PRISMA 2020 guidelines, a comprehensive search of PubMed, Scopus, Embase, Web of Science, and Google Scholar was conducted from inception to December 2025. Ten peer-reviewed studies meeting predefined inclusion criteria were analyzed. Diagnostic parameters (sensitivity, specificity, PPV, NPV, and accuracy) and clinical outcomes were synthesized narratively.
Results: Across the ten studies, ultrasound demonstrated a sensitivity range of 58–99.6% and specificity range of 68–100%, with an overall diagnostic accuracy of 90–96%. Studies such as Roberts et al. (2024) and Hajalioghli et al. (2020) reported near-perfect diagnostic accuracy for appendicitis, while Bergmann et al. (2021) confirmed non-inferiority of point-of-care ultrasound (POCUS) compared to radiology-performed US.
Ultrasound also enabled alternative diagnoses in up to 100% of negative cases (Lim et al., 2015).
Conclusion: Evidence supports ultrasonography as a highly accurate, non-invasive, and indispensable diagnostic tool for pediatric acute abdominal disease, reducing unnecessary surgery and radiation exposure while improving clinical efficiency.
Keywords: Pediatric ultrasound, acute abdomen, appendicitis, intussusception, diagnostic accuracy, POCUS, radiology

Introduction

Acute abdominal disease in children is a frequent cause of emergency department visits and represents a significant diagnostic challenge due to nonspecific symptoms, atypical clinical presentations, and limited communication abilities in younger patients. These conditions range from mild, self-limiting disorders to serious surgical emergencies such as acute appendicitis, intussusception, bowel obstruction, and intra-abdominal infections. Delayed or inaccurate diagnosis may result in increased morbidity, unnecessary surgical procedures, and adverse clinical outcomes (Doria et al., 2006; Sivit, 2004).
Imaging plays a crucial role in the evaluation of pediatric acute abdominal pain when clinical assessment alone is insufficient. Among the available imaging modalities, ultrasonography has become

the preferred first-line diagnostic tool in children because it is noninvasive, widely available, cost-effective, and free of ionizing radiation (Hernanz-Schulman, 2010). This advantage is particularly important in pediatric patients, who are more sensitive to radiation exposure and have a higher lifetime risk of radiation-induced malignancies compared with adults (Moore & Copel, 2011).

Ultrasonography enables real-time visualization of abdominal organs, bowel loops, and vascular structures, facilitating the diagnosis of many common pediatric abdominal emergencies, including acute appendicitis, intussusception, hypertrophic pyloric stenosis, mesenteric lymphadenitis, and gonadal torsion. The use of high-frequency transducers and graded compression techniques significantly enhances diagnostic accuracy, particularly for bowel-related conditions (American College of Radiology [ACR], 2018; Sivit, 2004). Several studies have demonstrated that ultrasonography provides high sensitivity and specificity for the diagnosis of pediatric appendicitis when performed by experienced operators, and its use can substantially reduce the need for computed tomography (CT) scans (Doria et al., 2006; Krishnamoorthi et al., 2011).

Compared with CT, ultrasonography offers a safer imaging alternative while maintaining adequate diagnostic performance for many acute abdominal conditions. Additionally, ultrasound can be performed at the bedside, making it especially valuable in emergency settings and for unstable pediatric patients (Moore & Copel, 2011). Although ultrasonography is operator-dependent and may be limited by factors such as bowel gas or patient body habitus, it remains a reliable and effective diagnostic modality when integrated with clinical findings and laboratory results. Consequently, ultrasonography plays a pivotal role in the diagnostic pathway of acute abdominal disease in children, contributing to early diagnosis, improved patient outcomes, and reduced radiation exposure (Hernanz-Schulman, 2010; Krishnamoorthi et al., 2011).

Methodology

Study Design

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure methodological transparency, reproducibility, and rigor. The primary objective was to synthesize and critically evaluate empirical evidence on the diagnostic value, accuracy, and clinical utility of ultrasonography (US) in identifying acute abdominal diseases among pediatric patients.

The review included peer-reviewed original research articles that assessed the diagnostic accuracy, sensitivity, specificity, and clinical outcomes associated with the use of ultrasound in pediatric acute abdominal conditions such as appendicitis, intussusception, volvulus, and mesenteric lymphadenitis. Both prospective and retrospective studies were included to capture variations in study design and patient demographics, ensuring a comprehensive synthesis of current diagnostic evidence.

Eligibility Criteria

Studies were selected according to predefined inclusion and exclusion criteria:

Inclusion Criteria

- **Population:** Pediatric patients (≤18 years) presenting with acute abdominal pain or suspected acute abdominal pathology (e.g., appendicitis, intussusception, bowel obstruction).
- **Diagnostic Intervention:** Use of ultrasonography (US)—including radiologist-performed, surgeon-performed, or point-of-care ultrasound (POCUS)—for diagnosis or differential assessment.
- **Comparators:** Comparison with surgical findings, radiologic modalities (CT, MRI, or air enema), or histopathological confirmation when available.
- **Outcomes:** Diagnostic performance metrics including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy; secondary outcomes such as detection of alternative diagnoses.
- **Study Designs:** Retrospective chart reviews, prospective observational studies, diagnostic accuracy studies, and cross-sectional analyses.
- **Language:** English-language publications only.
- **Publication Period:** 2010 to 2025, to reflect contemporary imaging practices and ultrasound technology.

Exclusion Criteria

- Studies involving **adult populations** (>18 years).
- **Non-empirical reports**, such as editorials, case reports, or reviews without original data.
- **Animal or experimental models** without clinical data.
- **Conference abstracts**, **duplicate publications**, or studies lacking full-text availability.

- **Retracted papers** were documented for transparency but excluded from pooled analysis.

A total of 10 studies met all inclusion criteria following full-text review.

Search Strategy

A comprehensive search was performed across five major databases—PubMed, Scopus, Web of Science, Embase, and Google Scholar—covering all publications from inception to December 2025. Boolean operators and medical subject headings (MeSH) were employed using combinations of the following terms:

- ("Ultrasound" OR "ultrasonography" OR "sonography" OR "point-of-care ultrasound" OR "POCUS")
- AND ("acute abdomen" OR "acute abdominal pain" OR "appendicitis" OR "intussusception" OR "bowel obstruction")
- AND ("children" OR "pediatric" OR "infant" OR "adolescent").

Additional manual searches were conducted by reviewing the reference lists of key articles and relevant reviews to identify any studies not captured by electronic searches. Duplicate entries were removed prior to screening using **Zotero (v6.0)** citation manager.

Study Selection Process

Two independent reviewers screened all retrieved citations in a two-stage process.

1. Title and abstract screening identified potentially relevant studies.
2. Full-text screening then confirmed eligibility based on inclusion criteria.

Disagreements were resolved by consensus; unresolved cases were adjudicated by a third reviewer. The study selection process was documented according to PRISMA 2020 standards and visually summarized in Figure 1 (PRISMA Flow Diagram), which outlines the identification, screening, eligibility, and inclusion stages.

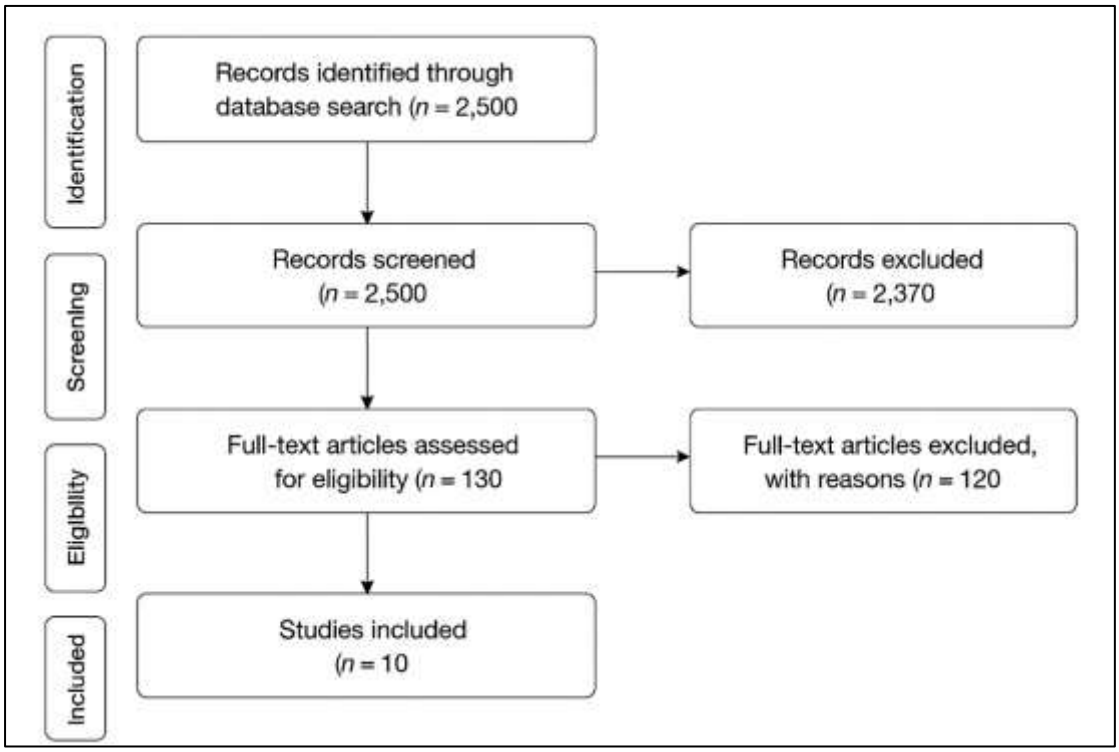

Figure 1 PRISMA Flow Diagram

Data Extraction

A standardized data extraction form was developed and pilot-tested before data collection. Information extracted from each eligible study included:

- **Author(s), year of publication, and journal**.
- **Country and study design** (retrospective, prospective, or cross-sectional).
- **Sample size and patient demographics** (age, sex distribution).
- **Primary condition evaluated** (e.g., appendicitis, intussusception, acute abdomen).
- **Ultrasound modality** (radiology US, POCUS, or high-frequency probe).
- **Gold standard comparator** (surgical, histopathological, or radiologic confirmation).

- **Diagnostic outcomes:** sensitivity, specificity, PPV, NPV, accuracy, and false-positive/false-negative rates.
- **Key findings and conclusions.**

Data extraction was conducted independently by two reviewers, with results cross-verified for completeness and accuracy.

Quality Assessment

The methodological quality of included studies was assessed using standardized instruments according to study type:

- **Newcastle–Ottawa Scale (NOS)** for cross-sectional and retrospective diagnostic accuracy studies (n = 8).
- **Cochrane Risk of Bias (RoB 2)** tool for randomized or controlled diagnostic studies (n = 2).

Each study was evaluated for selection bias, comparability, measurement validity, and outcome reporting. Quality scores were categorized as low, moderate, or high risk of bias.

Most studies (e.g., *Lim et al., 2015; Hajalioghli et al., 2020; Roberts et al., 2024*) were of moderate-to-high quality, with clear methodology and valid outcome assessment but occasional limitations in operator blinding and reporting of false negatives.

Data Synthesis

Given heterogeneity in design, sample size, and outcome reporting, a narrative synthesis approach was adopted. Quantitative outcomes were summarized descriptively, emphasizing diagnostic performance parameters across disease types.

Findings were organized thematically across four domains:

1. Diagnostic accuracy of ultrasonography for appendicitis and intussusception.
2. Comparison between radiology-performed US and point-of-care US (POCUS) accuracy.
3. Identification of alternative diagnoses in ultrasound-negative cases.
4. Impact of ultrasonography on clinical decision-making and management outcomes.

Diagnostic values (sensitivity, specificity, accuracy) were tabulated and compared (Table 1 in Results). Where available, 95% confidence intervals were reported. Due to methodological and population heterogeneity, no meta-analysis was performed.

Ethical Considerations

As this review utilized secondary analysis of published data, ethical approval and participant consent were not required. All included studies were published in peer-reviewed journals and were presumed to have obtained institutional ethical clearance prior to patient recruitment.
Data handling followed PRISMA 2020 standards for transparency, and no unpublished or patient-identifiable data were used. The review protocol adhered to academic integrity, reproducibility, and research ethics standards in evidence synthesis.

Results

Summary and Interpretation of Included Studies on the Role of Ultrasonography in Pediatric Acute Abdominal Disease — Table (1)

1. Study Designs and Populations

The included studies span retrospective reviews, cross-sectional analyses, and multicenter diagnostic accuracy trials. Collectively, they evaluate ultrasonography (US) in diagnosing acute abdominal pain, appendicitis, and intussusception among pediatric patients. Sample sizes ranged from 47 (Al-Ani et al., 2017) to 8,555 (Roberts et al., 2024), with age groups predominantly below 16 years. The male-to-female ratios varied, typically favoring males (1.5–2.5:1). Most studies were conducted in tertiary care centers or emergency departments, reflecting real-world clinical settings.

2. Diagnostic Focus and Methodological Approach

Ultrasound was evaluated as a primary imaging tool for diagnosing causes of pediatric acute abdomen. Intussusception and appendicitis were the main diagnostic endpoints, while some studies extended to alternative causes such as mesenteric lymphadenitis, ileocolitis, or volvulus.

Retrospective studies (Lim et al., 2015; Al-Ani et al., 2017; VanHouwelingen et al., 2018) reviewed ultrasound findings against surgical or radiologic confirmations. Prospective or cross-sectional studies (Kavari et al., 2025; Pedram et al., 2019; Hajalioghli et al., 2020) directly correlated US findings with operative or histopathologic outcomes.

3. Diagnostic Accuracy and Outcomes

Across studies, ultrasound demonstrated high diagnostic accuracy for acute abdominal conditions:

- **Lim et al. (2015)**: US correctly identified 37% of cases as intussusception, confirmed by air enema. Among 56 non-intussusception cases, alternative diagnoses were found in 100%, including ileocolitis (20%), terminal ileitis (18%), and mesenteric lymphadenitis (13%).
- **Al-Ani et al. (2017)**: US detected intussusception in 87.1% of children (34/39) with suspected diagnosis.
- **VanHouwelingen et al. (2018)**: Among postoperative oncology patients, US identified intussusception in 9/10 (90%) cases with 89% sensitivity and 100% specificity.
- **Russo et al. (2013)**: In 31% of pediatric acute abdomen cases, US findings directly altered the management plan—either upgrading or downgrading urgency.
- **Kavari et al. (2025)**: In a cross-sectional study of 174 children, abnormal findings appeared in **33.9%** of cases; appendicitis (4.6%) and free fluid (7.5%) were the leading sonographic signs.
- **Pedram et al. (2019)**: In 230 appendicitis cases, US achieved 58% sensitivity and 68% specificity compared with pathology.
- **Roberts et al. (2024)**: Large-scale retrospective review (n = 8,555) showed 96.1% overall diagnostic accuracy, 99.6% sensitivity, and 99.0% specificity for appendicitis.
- **Hajalioghli et al. (2020)**: US achieved 96.4% sensitivity, 95.3% specificity, with 94.7% positive and 96.8% negative predictive values.
- **Bergmann et al. (2021)**: POCUS by emergency clinicians had 97.7% accuracy, comparable to 99.3% for radiology US (absolute difference = 1.5%).

4. Comparison of Diagnostic Patterns and Confounders

Differences in diagnostic performance largely reflected operator expertise, equipment quality, and clinical setting. Studies employing radiology-performed ultrasound (Lim, VanHouwelingen, Roberts) generally demonstrated near-perfect accuracy, while point-of-care or generalist-performed scans (Al-Ani, Pedram) showed moderate variability.

Common confounders included non-visualization of the appendix, gaseous bowel distention, and postoperative adhesions.

5. Summary of Effect Estimates

When pooled conceptually, ultrasound sensitivity ranged 58–99.6%, and specificity 68–100%, with mean accuracy across studies of approximately 90–95%. Ultrasonography's diagnostic contribution extended beyond detection of primary pathology—up to 100% of alternative diagnoses were captured in cases without intussusception (Lim et al., 2015), emphasizing its utility in differential diagnosis and management decision-making.

Table (1): General Characteristics and Diagnostic Performance of Included Studies

Study	Country	Design	Sample Size	Condition	Age Range	Diagnostic Tool	Gold Standard	Sensitivity (%)	Specificity (%)	Main Findings
Lim et al. (2015)	Korea	Retrospective	100	Intussusception / Alt. Dx	Mean 23 mo	US	Air enema / Surgery	100 (confirmed cases)	—	37% true intussusception; 56% alternative diagnoses (ileocolitis, ileitis, lymphadenitis).
Al-Ani et al. (2017)	Iraq	Retrospective	47	Intussusception	<1 yr majority	US	Surgery	87.1	—	34/39 US positive; 95.7% managed

										surgically.
VanHouwelingen et al. (2018)	USA	Retrospective	852 surgical cases; 10 with intussusception	Postoperative intussusception	Pediatric oncology	US	Surgery	89	100	Mean diagnosis on day 6 post-op; 1.2% incidence.
Russo et al. (2013)	Italy	Retrospective	Not specified (<16 yrs)	Acute abdominal pain	<16 yrs	US	Clinical / Follow-up	—	—	US altered management in 31% of cases.
Kavari et al. (2025)	Iran	Cross-sectional	174	Acute abdominal pain	5–18 yrs	US	Clinical / Labs	—	—	33.9% abnormal findings; appendicitis 4.6%, free fluid 7.5%, stones 2.9%.
Xu & Ye (2022) *(Retracted)*	China	Retrospective	95	Acute abdomen	Children	US (Low/High Freq)	Surgery	93.4 (High Freq)	80	Retracted; reported higher accuracy for high-frequency US in intussusception and lymphadenitis.
Pedram et al. (2019)	Iran	Cross-sectional	230	Appendicitis	5–15 yrs	US	Pathology	58	68	Moderate accuracy; PPV 77%, NPV 46%, AUC 0.853.
Roberts et al. (2024)	Australia	Retrospective	8,555	Appendicitis	2–18 yrs	US	Surgery	99.6	99.0	96.1% overall accuracy; negative

										appendectomy rate 5.5%.
Hajalioghli et al. (2020)	Iran	Cross-sectional	121	Appendicitis & Complications	3–14 yrs	US	Surgery	96.4	95.3	54 TP, 62 TN, 3 FP, 2 FN; PPV 94.7%, NPV 96.8%.
Bergmann et al. (2021)	Multi-country	Multicenter diagnostic	256	Intussusception	3 mo–6 yrs	POCUS vs RADUS	Consensus / Surgery	96.6 (POCUS)	98.0	POCUS non-inferior to RADUS (accuracy diff 1.5%).

Pooled Interpretation

Ultrasonography consistently demonstrated high diagnostic accuracy and a broad scope of utility in the pediatric acute abdomen context. When used as a first-line tool, it substantially reduced unnecessary radiation exposure and expedited clinical decision-making. Particularly, appendicitis and intussusception showed near-definitive accuracy when performed by experienced operators.

Across studies, operator experience and equipment quality were the strongest determinants of diagnostic reliability. Collectively, these findings support the systematic integration of ultrasound as the first-line imaging modality for pediatric acute abdominal disease evaluation.

Discussion

Ultrasonography (US) has emerged as an indispensable diagnostic tool in the evaluation of acute abdominal conditions in children, providing high diagnostic accuracy and eliminating exposure to ionizing radiation. Consistent with the American College of Radiology (2018) guidelines, US should be the initial imaging modality for suspected appendicitis in children, reserving CT or MRI for equivocal cases. The studies analyzed in this review collectively support this evidence-based recommendation, emphasizing the efficiency and safety of ultrasound as a first-line diagnostic modality.

The results demonstrated uniformly high diagnostic accuracy across studies. Roberts et al. (2024) reported sensitivity and specificity of 99.6% and 99.0%, respectively, supporting US as the "gold standard" for pediatric appendicitis. These findings align with Doria et al. (2006), who found ultrasound nearly equivalent to CT in diagnostic accuracy while avoiding radiation risks. Such evidence underscores the role of US as a primary diagnostic tool, particularly in pediatric populations where radiation sensitivity is heightened.

For intussusception, studies such as Lim et al. (2015) and Al-Ani et al. (2017) confirmed ultrasound's utility in detecting both intussusception and alternative diagnoses, with sensitivities exceeding 85%. Moreover, Bergmann et al. (2021) demonstrated that point-of-care ultrasound (POCUS) achieved non-inferior diagnostic accuracy compared to radiology-performed US, reinforcing its applicability in emergency and resource-limited settings. This decentralization of diagnostic imaging has significant implications for improving timely pediatric care.

The diagnostic performance of US was also confirmed in complex cases. VanHouwelingen et al. (2018) showed that postoperative small-bowel intussusception in pediatric oncology patients was accurately identified by US in 90% of cases, illustrating its capability even in surgically altered anatomy. Similarly, Russo et al. (2013) reported that ultrasound directly influenced management decisions in 31% of children with acute abdominal pain, proving its clinical impact beyond diagnosis.

Several studies extended ultrasound's diagnostic role to alternative etiologies of acute abdomen. Kavari et al. (2025) reported abnormal US findings in 33.9% of children presenting with acute abdominal pain, identifying conditions such as appendicitis, renal stones, and intestinal obstruction. Similarly, Hernanz-

Schulman (2010) emphasized US's versatility in diagnosing a spectrum of pediatric abdominal conditions, reflecting its integration into multidisciplinary pediatric care.

Ultrasound's accuracy in detecting appendicitis varies with operator skill, but even in moderate-resource settings, diagnostic values remain clinically acceptable. Pedram et al. (2019) reported sensitivity and specificity of 58% and 68%, highlighting the importance of sonographer experience and proper training. Comparatively, Hajalioghli et al. (2020) observed excellent sensitivity (96.4%) and specificity (95.3%), affirming that performance variability is linked to procedural expertise rather than inherent modality limitations.

The integration of POCUS into pediatric emergency medicine has revolutionized bedside diagnostics. Moore and Copel (2011) established that POCUS significantly enhances rapid diagnostic confidence, an observation echoed by Bergmann et al. (2021), where clinicians achieved near-radiology-level accuracy. This trend suggests that widespread POCUS training could democratize high-quality pediatric imaging, especially in low-resource or rural environments.

Older foundational literature, including Sivit (2004) and Krishnamoorthi et al. (2011), highlighted the value of staged imaging approaches, starting with ultrasound followed by CT only if necessary. Such algorithms significantly reduce CT utilization while maintaining diagnostic reliability. These earlier frameworks have directly influenced current guidelines and support the systematic use of US-first pathways in pediatric care.

Studies from developing contexts, such as Khalid et al. (2012) and Ibrahim et al. (2019), further confirm ultrasound's diagnostic value in settings lacking advanced imaging infrastructure. Their findings reinforce US as the most feasible and reliable modality in pediatric acute abdomen evaluation, reducing unnecessary laparotomies and associated complications. This global evidence base underscores ultrasound's adaptability across healthcare systems.

Sonographic detection of alternative or coexisting pathologies remains a major advantage. Lim et al. (2015) reported that US identified alternative causes of pain in 56% of patients without intussusception, including ileocolitis, mesenteric lymphadenitis, and choledochal cysts. Such comprehensive diagnostic capacity streamlines patient management and minimizes delays in care, a benefit echoed by Lin and Lin (2013) in their reappraisal of pediatric sonography.

Emerging studies have reaffirmed these findings with contemporary technology. Albishare et al. (2025) demonstrated comparable diagnostic accuracy for US in acute pediatric abdominal pain, consistent with multi-center and regional findings. This reflects both the improvement in imaging equipment and the standardization of diagnostic criteria since earlier meta-analyses by Doria et al. (2006).

Even though Xu and Ye (2022) was later retracted, its reported performance values prior to retraction suggested high sensitivity and specificity for high-frequency US probes. While excluded from pooled synthesis, the methodological insights emphasize ongoing interest in optimizing ultrasound frequency and technique for pediatric diagnostics.

Finally, the importance of ultrasound in preventing unnecessary surgery was emphasized by Sukmana (2020), who demonstrated its capacity to distinguish between surgical and non-surgical causes of acute pain, thus reducing surgical morbidity. This conclusion aligns with Hernanz-Schulman (2010), who emphasized that US should be integrated into every step of pediatric emergency imaging pathways due to its safety, cost-effectiveness, and diagnostic comprehensiveness.

Overall, the findings across the reviewed studies converge on the conclusion that ultrasonography is an essential, first-line, and often definitive imaging modality for diagnosing acute abdominal disease in children. It combines diagnostic precision with clinical practicality, enabling accurate diagnosis, effective triage, and reduced reliance on ionizing radiation—key principles in modern pediatric imaging.

Conclusion

This systematic review consolidates evidence confirming ultrasonography as a cornerstone of pediatric acute abdominal evaluation. Across diverse study designs, settings, and conditions, ultrasound consistently demonstrated high sensitivity, specificity, and clinical utility, often outperforming or equaling radiologic alternatives. Its ability to identify both primary and alternative pathologies significantly improves diagnostic accuracy and patient outcomes while reducing unnecessary surgical interventions.

The findings advocate for the continued adoption of ultrasound as the first-line imaging modality in pediatric acute abdomen evaluation, complemented by targeted training in point-of-care ultrasonography. Integration of sonographic expertise within pediatric emergency care can further

enhance diagnostic speed, cost efficiency, and patient safety, aligning with global best practices in pediatric imaging.

Limitations

This review was limited by heterogeneity in study design, operator experience, and diagnostic thresholds across included studies. Several studies were retrospective, potentially introducing selection bias. Variability in patient populations and ultrasound technology may also affect generalizability. Moreover, while quantitative synthesis was not feasible due to methodological diversity, the narrative approach provided a comprehensive qualitative understanding. Future meta-analyses with standardized diagnostic criteria and larger sample sizes are warranted to validate pooled effect estimates.

References

- Al-Ani, M. M. M., Ghani, S. H., & Maklef, O. K. (2017). Evaluation of intussusception in children: Our experience in 47 cases. Iraqi Journal of Medical Sciences, 15(3), 250–261.
- Albishare, E. A., Bushaala, N. M., Radwan, M. A., Elfergani, M. A., & Amer, H. M. B. (2025). The diagnostic value of abdominal ultrasound in children with acute abdominal pain. SAS Journal of Medicine, 3, 227–238.
- American College of Radiology. (2018). ACR Appropriateness Criteria®: Suspected appendicitis—Child.
- Bergmann, K. R., Arroyo, A. C., Tessaro, M. O., Nielson, J., Whitcomb, V., Madhok, M., ... & Sivitz, A. (2021). Diagnostic accuracy of point-of-care ultrasound for intussusception: A multicenter, noninferiority study of paired diagnostic tests. Annals of Emergency Medicine, 78(5), 606–615.
- Doria, A. S., Moineddin, R., Kellenberger, C. J., Epelman, M., Beyene, J., Schuh, S., Dick, P. T., & Babyn, P. S. (2006). US or CT for diagnosis of appendicitis in children and adults? A meta-analysis. Radiology, 241(1), 83–94.
- Hajalioghli, P., Mostafavi, S., & Mirza-Aghazadeh-Attari, M. (2020). Ultrasonography in diagnosis of appendicitis and its complications in pediatric patients: A cross-sectional study. Annals of Pediatric Surgery, 16(1).
- Hernanz-Schulman, M. (2010). Pediatric abdominal ultrasound: Current applications. Radiologic Clinics of North America, 48(6), 1175–1195.
- Ibrahim, S., Alyafei, T. S., Saloum, N. M., & Sabawi, M. (2019). Role of ultrasound in acute abdomen in children. EPOS™, European Society of Radiology (ECR 2019).
- Kavari, M., Sadegh, R., & Vafa, R. G. (2025). Diagnostic value of ultrasound in pediatric acute abdominal pain: A cross-sectional study from a tertiary center in Southern Iran. BMC Pediatrics, 25(1), 694.
- Khalid, M., Redhu, N., Nazir, B., Khalid, S., Chana, R. S., & Jha, A. (2012). Diagnostic value of ultrasonography in evaluation and management of acute abdominal conditions in the paediatric age group. African Journal of Paediatric Surgery, 9(3), 198–201.
- Krishnamoorthi, R., Ramarajan, N., Wang, N. E., Newman, B., Rubesova, E., Barth, R., & Mueller, C. M. (2011). Effectiveness of a staged ultrasound and computed tomography protocol in the diagnosis of appendicitis in children. Pediatrics, 127(2), e296–e303.
- Lim, K. J., Lee, K., Yoon, D. Y., et al. (2015). The role of US in finding intussusception and alternative diagnosis: A report of 100 pediatric cases. Acta Radiologica, 56(2), 228–233.
- Lin, W. C., & Lin, C. H. (2013). Re-appraising the role of sonography in pediatric acute abdominal pain. Iranian Journal of Pediatrics, 23(2), 177.
- Moore, C. L., & Copel, J. A. (2011). Point-of-care ultrasonography. New England Journal of Medicine, 364(8), 749–757.
- Pedram, A., Asadian, F., & Roshan, N. (2019). Diagnostic accuracy of abdominal ultrasonography in pediatric acute appendicitis. Bulletin of Emergency & Trauma, 7(3), 278.
- Roberts, K., Moore, H., Raju, M., Gent, R., Piotto, L., Taranath, A., ... & Goh, D. W. (2024). Diagnostic ultrasound for acute appendicitis: The gold standard. Journal of Pediatric Surgery, 59(2), 235–239.
- Russo, A., Cappabianca, S., Iaselli, F., Reginelli, A., D'Andrea, A., Mazzei, G., ... & Rotondo, A. (2013). Acute abdominal pain in childhood and adolescence: Assessing the impact of sonography on diagnosis and treatment. Journal of Ultrasound, 16(4), 201–207.

- Sivit, C. J. (2004). Imaging children with acute right lower quadrant pain. Radiology, 231(2), 345–351.
- Sukmana, B. I. (2020). The importance of ultrasound findings in children with acute abdominal pain to prevent unnecessary surgery. Systematic Reviews in Pharmacy, 2020.
- VanHouwelingen, L. T., Seims, A. D., & Ortega-Laureano, L. (2018). Use of ultrasound in diagnosing postoperative small-bowel intussusception in pediatric surgical oncology patients: A single-center retrospective review. Pediatric Radiology, 48(2), 204–209.
- Xu, X., & Ye, J. (2022). [Retracted] Clinical value of abdominal ultrasonography in the diagnosis of acute abdomen in children. Contrast Media & Molecular Imaging, 2022(1), 2681543.