

PREVALENCE, SURGICAL MANAGEMENT, AND OUTCOME OF INTUSSUSCEPTION IN CHILDREN: A COMPREHENSIVE SYSTEMATIC REVIEW

*^{1,2}Syarifah Tiara Aisyah Sabrina, ^{1,2}Muchammad Jalaluddin Machalli, ^{2,4}Shafira Nuraziza, ^{3,5}Eza Melinda

¹ Faculty of Medicine, Padjadjaran University, Bandung City, Indonesia

² Arjawinangun Regional General Hospital, Cirebon Regency, Indonesia

³ Faculty of Medicine, Muhammadiyah University, Special Region of Jakarta, Indonesia

⁴ Faculty of Medicine, General Achmad Yani University, Bandung City, Indonesia

⁵ Rafflesia General Hospital, Bengkulu, Indonesia

Correspondence Author:
tiara.machalli@gmail.com

ABSTRACT

Background: Intussusception is the invagination of a segment of bowel into an adjacent segment resulting into an intestinal obstruction. It is the most common acquired cause of intestinal obstruction in children under the age of 2 years.

The aim: The aim of this study to show about prevalence, surgical management, and outcome of intussusception in children.

Methods: By the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. This search approach, publications that came out between 2014 and 2024 were taken into account. Several different online reference sources, like Pubmed, SagePub, and Sciencedirect were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.

Result: Ten publications were found to be directly related to our ongoing systematic examination after a rigorous three-level screening approach. Subsequently, a comprehensive analysis of the complete text was conducted, and additional scrutiny was given to these articles.

Conclusion: Nonoperative management of intussusception should be adopted in carefully selected cases of intussusception in this subregion as it will help to reduce the financial burden on the parents while surgical management should be reserved for the complicated cases.

Keyword: Intussusception, invagination, children, prevalence, surgical.

INTRODUCTION

Intussusception is defined as the invagination of a portion of the intestine into itself and is one of the most common causes of abdominal emergencies in infancy and childhood, with an incidence of 74 per 100,000 among children <1 year of age. Several studies have reported on numerous potential risk factors, although some of them are still controversial. Symptoms such as fever and blood in stool and the absence of vomiting have been reportedly associated with recurrent intussusception (RI) in some studies, whereas other studies either did not find any associations or presented a contrary conclusion. Pathological lead point (PLP) was also regarded as a risk factor for RI in some studies; however, the majority of cases of intussusception were idiopathic, leading to a difficulty in collecting adequate samples from RI patients to verify it with convincing research data.^{1,2}

The diagnosis of intussusception is challenging due to a wide variety of clinical presentations and overlaps with other abdominal conditions, a situation that often leads to delay in diagnosis. It is assumed that the delayed diagnosis of intussusception increases the incidence of surgical treatment and the risk of complications.^{3,4}

Successful management of intussusception depends on early recognition and diagnosis, adequate fluid resuscitation and prompt reduction. The treatment of intussusception has evolved from primarily operative management to the preference for non-operative reduction with either air or barium contrast. Non-operative reductions of intussusception had been shown to decrease length of hospitalization, shorten recovery, and reduce the risk of complications associated with major abdominal surgery. Reports from some developing countries however indicate that for some ill-defined reasons, operative treatment is still routinely performed for intussusceptions.^{3,5}

The treatment of choice for intussusception in children is currently nonsurgical with radiological reduction under sonographic or fluoroscopic control. In developing countries, surgical therapy is frequently employed as the primary option for managing infants and children with intussusception due to the delayed presentation and presence of bowel gangrene. Mortality relating to the management of intussusception in infants and children is less than 1% in the developed countries. In developing countries, management of intussusception in infants and children is associated with considerably higher mortality. Present study consisted of 212 children below the age of 12-years, who were operated upon for intussusception during the study period of 21 years, with a brief review of the literature.⁶⁻⁸

METHODS

Protocol

By following the rules provided by Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, the author of this study made certain that it was up to par with the requirements. This is done to ensure that the conclusions drawn from the inquiry are accurate.

CRITERIA FOR ELIGIBILITY

For the purpose of this literature review, we compare and contrast prevalence, surgical management, and outcome of intussusception in children. It is possible to accomplish this by researching of prevalence, surgical management, and outcome of intussusception in children. As the primary purpose of this piece of writing, demonstrating the relevance of the difficulties that have been identified will take place throughout its entirety.

In order for researchers to take part in the study, it was necessary for them to fulfil the following requirements: 1) The paper needs to be written in English, and it needs to determine about prevalence, surgical management, and outcome of intussusception in children. In order for the manuscript to be considered for publication, it needs to meet both of these requirements. 2) The studied papers include several that were published after 2014, but before the time period that this systematic review deems to be relevant. Examples of studies that are not permitted include editorials, submissions that do not have a DOI, review articles that have already been published, and entries that are essentially identical to journal papers that have already been published.

SEARCH STRATEGY

We used "prevalence, surgical management, and outcome of intussusception in children." as keywords. The search for studies to be included in the systematic review was carried out using the PubMed, Sage Journal, and Science Direct databases by inputting the words: *("Intussusception"[MeSH Subheading] OR "Children"[All Fields] OR "Prevalence"[All Fields]) AND ("Invagination"[All Fields] OR "Risk factor"[All Fields]) AND ("Management"[All Fields]) OR ("Outcome"[All Fields])* used in searching the literature.

DATA RETRIEVAL

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources for their article and selected those studies. After looking at a number of different research, which all seemed to point to

the same trend, this conclusion was drawn. All submissions need to be written in English and cannot have been seen anywhere else.

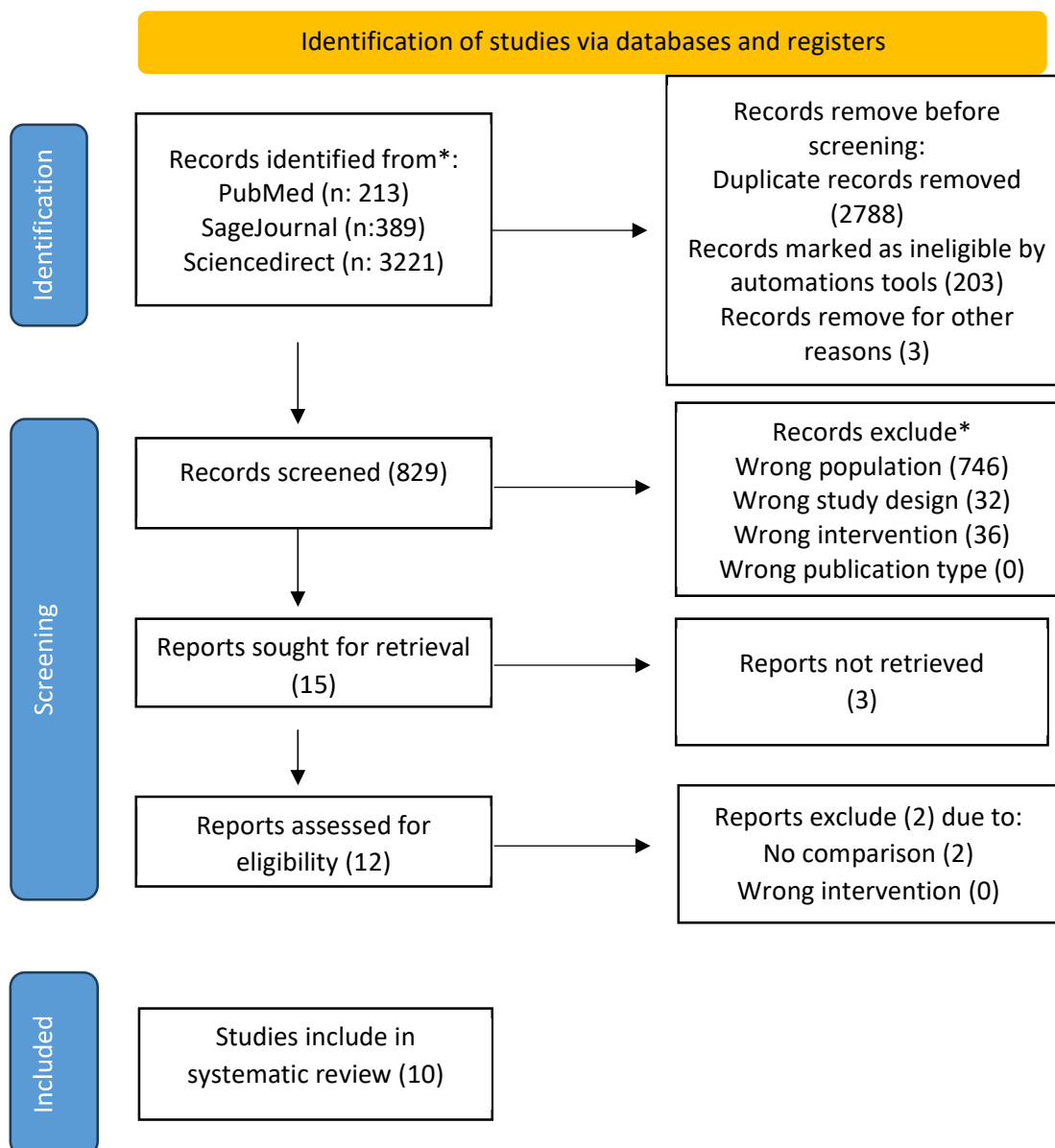


Figure 1. Article search flowchart

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

QUALITY ASSESSMENT AND DATA SYNTHESIS

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised in the process of selecting papers for further assessment. in order to simplify the process as much as feasible when selecting papers to evaluate. Which earlier investigations were carried out, and what elements of those studies made it appropriate to include them in the review, are being discussed here.

RESULT

Using reputable resources like Science Direct, PubMed, and Sage Journal, our research team first gathered 3823 publications. A thorough three-level screening strategy was used to identify only ten papers as directly relevant to our ongoing systematic evaluation. Next, a thorough study of the entire text and further examination of these articles were selected. Table 1 compiles the literature that was analyzed for this analysis in order to make it easier to view.

Table 1. The literature include in this study

AUTHOR	ORIGIN	METHOD	SAMPLE	RESULT
Zewde, Y et al., 2024⁹	Ethiopia	This retrospective cross-sectional study included the medical records of 103 children treated for intussusception from 2018 to 2020.	103	In total, 84 (81.6%) patients were released with a favorable outcome. Ileocolic intussusception was a positive predictor, with a nine-fold higher likelihood of a favorable outcome than other types of intussusception [adjusted odds ratio (AOR), 9.16; 95% confidence interval (CI), 2.39–21.2]. Additionally, a favorable outcome was three times more likely in patients who did than did not undergo manual reduction (AOR, 3.08; 95% CI, 3.05–5.48). Patients aged <1 year were 96% less likely to have a positive outcome than those aged >4 years (AOR, 0.04; 95% CI, 0.03–0.57).
Lee, EH et al., 2020¹⁰	Korea	Data from the Korean National Health Insurance Service database on all patients <18 years old diagnosed with intussusception from 2007 to 2017 were analyzed.	34688	A total of 34,688 cases were identified among 30,444 patients. The overall incidence was 28.3/100,000 person-years with a male predominance. Most cases (83.1%) occurred in children <3 years old, with an annual incidence of 195.2, 200.1, and 118.6 cases per 100,000 children in their first, second, and third year of life, respectively. The median age at the first occurrence was 18.7 months, and it was higher in boys than in girls. The post-discharge recurrence rate was 10.6% (3,226/30,444) and the in-hospital recurrence rate was 6.1% (1,842/30,444). The total recurrence rate (post-discharge recurrence and/or in-hospital recurrence) was 15.0% (4,580/30,444). Enema reduction was successful in 90.0% of cases. Enema reduction was more successful in girls than in boys. A total of 3,296 (10.8%) patients underwent 3,481 surgeries, including 735 (21.1%) laparoscopic surgeries. Post-discharge recurrence and

				surgery were significantly affected by age, sex, and hospital type. Mortality was noted in nine cases (0.03%).
Xuan, NT et al., 2020¹¹	Vietnam	This prospective study was carried out in 118 consecutive patients under two years of age. Patients presented with symptoms and signs of acute intestinal obstruction and a diagnosis of ileocaecal intussusception confirmed by ultrasound were included in this study.	118	There were 70 boys and 48 girls ranging in age from three months to two years with a median of 12.5 months. Clinical presentation included abdominal pain (100%), vomiting (82.2%), bloody stool (11.9%), and a palpable mass (43.2%). Patients hospitalized with the symptoms and signs for less than 24 hours accounted for 80.5% of the cases. The overall success rate of pneumatic reduction was 98.3%. Late hospital admission (≥ 24 hours from illness onset), bloody stool, and presenting with the classic triad of symptoms of intussusception were found as the factors that correlated to the surgical management outcome. All patients recovered well without any complications. The median of postoperative hospital stay of two days for the pneumatic reduction group and six days for the operation group.
Cox, S et al., 2021¹²	South Africa	Patients ≤ 3 years presenting with intussusception between September 2013 and December 2017 were prospectively enrolled at all sites.	476	Four hundred seventy-six patients were enrolled, [54% males, median age 6.5 months (IQR 2.6–32.6)]. Vomiting (92%), bloody stool (91%), abdominal mass (57%), fever (32%) and a rectal mass (29%) represented advanced disease: median symptom duration was 3 days (IQR 1–4). Initial reduction attempts included pneumatic reduction (66%) and upfront surgery (32%). The overall non-surgical reduction rate was 28% and enema perforation rate was 4%. Surgery occurred in 334 (70%), 68 (20%) patients had perforated bowel, bowel resection was required in 61%. Complications included recurrence (2%) and nosocomial sepsis (4%). Length of stay (LOS) was significantly longer in patients who developed complications. Six patients died—a mortality rate of 1%.

<p>Tesfaye, DD. Et al., 2022¹³</p>	<p>Ethiopia</p>	<p>An institutional-based retrospective cross-sectional study was conducted from November 01 to 30, 2021, among children admitted and managed for acute intussusception .</p>	<p>86</p>	<p>In this chart review of children, 13.3% (95% CL: 11.8–14.8) died. The median age of the study participant was 13 months. The majority, 72% were male and 76% were less than 24 months old. Regarding the clinical profile; abdominal pain (94.7%), vomiting (93.3%), bloody diarrhea (70.7%), and abdominal distention (76.0%) were the most common clinical presentations. Age less than 24 months [$X^2=8.13$ (df = 1); $p=0.004$], preoperative vital signs [$X^2=19.21$ (df = 2); $p=0.000$], intraoperative findings [$X^2=18.89$ (df = 1); $p=0.000$], and postoperative complications [$X^2=14.60$ (df = 1); $p=0.000$] were significantly associated with treatment outcome of acute intussusception.</p>
<p>Bhatt, P et al., 2020¹⁴</p>	<p>USA</p>	<p>National Inpatient Sample database was analyzed from 2005-2014 to identify pediatric (≤ 18 years) intussusceptions along with procedures such as enema and/or surgical intervention.</p>	<p>21835</p>	<p>Out of 21,835 intussusception hospitalizations requiring enema or surgical intervention, 14,415 (66%) had surgical intervention; 90% of which (12,978) had no preceding enema. Surgical intervention rates among intussusception hospitalizations varied by age (highest < 1 year), gender (male > females) and race (Hispanics > Whites and Blacks). During the study period, overall surgical intervention rate remained stable (2.2 to 1.7, $P=0.07$) although it declined in those under 1 year of age. Children with severe disease, gastrointestinal comorbidities over the age of 4 years had increased odds of surgical intervention, whereas hospitalization in large and urban teaching hospitals had decreased odds of surgical intervention. Length of stay and hospital cost remained stable from 2005-2014.</p>
<p>Wu, TH et al., 2022¹⁵</p>	<p>Taiwan</p>	<p>This observational retrospective study included children who were admitted to the pediatric emergency department</p>	<p>584</p>	<p>In total, 584 children with intussusception were admitted to the pediatric emergency department; 129 of these children underwent surgery. Multivariate analysis revealed the following independent predictors of bowel resection for intussusception: symptoms</p>

		with intussusception .		for at least 2 days before surgery (OR = 6.863; $p = 0.009$), long intussusception (OR = 5.088; $p = 0.014$), pathological lead point (OR = 6.926; $p = 0.003$), and intensive care unit admission (OR = 11.777; $p = 0.001$) were factors independently associated with bowel resection.
Li, Y et al., 2023 ¹⁶	China	This retrospective study included pediatric patients with acute intussusception admitted to the Department of Pediatric Surgery, Qilu Hospital (Qingdao), Cheeloo College of Medicine, Shandong University, from January 2014 to December 2019.	402	A total of 402 infants/children were included (301 males and 101 females) with a mean age of 2.4 ± 1.5 years (2 months to 9 years). Thirty patients (7.5%) had a history of cold food intake, diarrhea, and upper respiratory infection before disease onset. Paroxysmal abdominal pain and crying occurred in 338 patients (84.1%). Eight patients (2.0%) had the typical triad, 167 (41.5%) had vomiting, 24 (6.0%) had bloody stools, and 273 (67.9%) had palpable abdominal mass. The average intussusception depth was 4.0 ± 1.4 cm. Air enema reduction was performed in 344 cases: 335 (97.3%) were successful. Fifty-eight patients were treated with intravenous phloroglucinol (2 mg/kg), and 53 (91.4%) were successful. Sixty-five patients suffered relapses, with a relapse rate of 16.8%.
PaedSurg Africa Research Collaboration ., 2021 ¹⁷	Africa	A multicentre, international, prospective cohort study was undertaken in hospitals providing paediatric surgical care across SSA.	1407	1407 children from 51 hospitals in 19 countries across SSA were studied: 111 with gastroschisis, 188 anorectal malformation, 225 intussusception, 250 appendicitis and 633 inguinal hernia. Mortality was significantly higher in SSA compared with HICs for all conditions: gastroschisis (75.5% vs 2.0%), anorectal malformation (11.2% vs 2.9%), intussusception (9.4% vs 0.2%), appendicitis (0.4% vs 0.0%) and inguinal hernia (0.2% vs 0.0%), respectively. Mortality was 41.9% (112/267) among neonates, 5.0% (20/403) in infants and 1.0% (7/720) in children. Paediatric surgical condition, higher American Society of Anesthesiologists score at

				primary intervention, and needing/receiving a blood transfusion were significantly associated with mortality on multivariable analysis.
Osmanliu, E et al., 2021¹⁸	Canada	This retrospective observational study occurred at a tertiary care paediatric hospital with a consecutive sample of all children with ileocolic intussusception September 2015 through September 2018.	103	There were 103 cases of ileocolic intussusception (among 257,282 visits) during the study period. The median time between diagnostic confirmation and initiation of reduction was 36 minutes. This was shorter for transferred patients and children with intravenous access prior to ultrasound. One perforation was identified at the beginning of reduction, without hemodynamic instability. Six children (5.8%) underwent either open (n=4) or laparoscopic surgery (n=2) for reduction failure.

DISCUSSION

Intussusception remains a common cause of bowel obstruction in infants and young children, and it is a major source of significant morbidity and mortality if not promptly treated. The classical cases of intussusception are readily diagnosed clinically with reported accuracy of about 50%, but intussusception may mimic other conditions in children such as gastroenteritis which has a high prevalence in the tropics thus giving a confusing picture. The accepted management of intussusception consists of adequate resuscitation, radiological confirmation of diagnosis, and radiological reduction for uncomplicated cases with surgical intervention as a last resort. Children treated at tertiary hospitals have higher rates of nonoperative reduction than children treated at peripheral hospitals. Despite recent improvements in radiological techniques, the diagnosis of intussusception and success in its nonoperative reduction has been suboptimal in tertiary care facilities in the developed countries.¹⁹⁻²¹

The clinical presentation of intussusception is variable but generally marked by abdominal pain and signs of bowel obstruction. In the pediatric population, it is one of the most common abdominal emergencies. Children younger than 2 years classically present with acute onset colicky abdominal pain, knees drawn to chest, with excessive irritability and crying. The child may return to their usual level of activity between bouts, or they may appear listless and lethargic as the pain becomes progressively more intense. Shortly after the onset of pain, vomiting may occur. Nearly half of cases progress to stool mixed with blood and mucus, giving it a “currant jelly” appearance. Physical exam may reveal a palpable “sausage-shaped mass” in the right upper quadrant or epigastric region of the abdomen, but the mass is only detected in approximately 60% of cases. The classic pediatric triad of abdominal pain, palpable abdominal mass, and bloody stool is quite rare, present in less than 15% of cases.²²⁻²⁴

Intussusception is managed surgically, with manual reduction or resection, or nonoperatively by air, hydrostatic or contrast enema. Delays in presentation and treatment of serious surgical diseases, including intussusception, are common in low-resource countries due to limited access to care. In a study from Nigeria only 7.7% of patients presented within 24 hours of onset of intussusception symptoms. Late presentation of intussusception cases is considered a risk factor for gangrene and death, increasing the need for surgery and predicting the failure of non-operative reduction. It also increases the chances of sepsis, multiple organ dysfunction and death. In this analysis we describe the time intervals from onset of symptoms to definitive treatment of infants with intussusception in Zimbabwe. As an exploratory analysis, we considered the relationship between delayed presentation and gangrene.^{25,26}

CONCLUSION

Although mortality is reducing, a high rate of bowel resection is a consequence of delayed presentation and effort should be made to make an early diagnosis of intussusception and make prompt referral to improve outcome. Nonoperative management of intussusception should be adopted in carefully selected cases of intussusception in this subregion as it will help to reduce the financial burden on the parents while surgical management should be reserved for the complicated cases.

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