

Pediatric Nurses' Role in Nutritional Rehabilitation and Symptom Management for Children with *Helicobacter Pylori*

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Abstract

Background: *Helicobacter pylori* (*H. pylori*) infection in the pediatric population triggers gastrointestinal distress, mucosal inflammation, and micronutrient malabsorption, necessitating specialized clinical and educational nursing care. **Aim:** This empirical study evaluated the effectiveness of pediatric nurses' nutritional rehabilitation and symptom management for children diagnosed with *Helicobacter pylori*. **Methods:** A quasi-experimental, pre-test/post-test design was utilized. The study was conducted in the Pediatric Gastroenterology Outpatient Clinic and Inpatient Wards at Sohag university hospitals. A purposive sample of 100 pediatric patients with confirmed *H. pylori* infections and their primary caregivers (mothers) was selected based on specific clinical inclusion criteria. Data were gathered through a Pediatric Clinical & Nutritional Assessment Sheet, the Gastrointestinal Symptom Rating Scale (GSRS), a structured Caregivers' Knowledge Assessment Questionnaire, and a Medication & Dietary Adherence Questionnaire. **Results:** Post-intervention outcomes demonstrated statistically significant improvements in the experimental group compared to baseline data. Children experienced a marked reduction in gastrointestinal symptom severity, enhanced growth percentiles, and corrected serum iron and hemoglobin levels. Additionally, caregivers displayed a substantial transition from poor/fair knowledge levels to good knowledge regarding *H. pylori* transmission and management, which directly correlated with higher medication compliance and increased bacterial eradication rates. **Conclusion:** The practical application of structured pediatric nursing protocols is highly effective in managing clinical manifestations, accelerating nutritional recovery, and maximizing treatment adherence. This study supports the standardization of evidence-based nursing intervention frameworks across pediatric gastroenterology units.

Keywords: Children with *Helicobacter Pylori*; Nutritional Rehabilitation; Pediatric Nurses; Symptom Management.

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Introduction

Helicobacter pylori (*H. pylori*) infection remains one of the most pervasive chronic bacterial pathogens globally, with a particularly distressing footprint in the pediatric population. While historically viewed as an adult onset condition, contemporary epidemiological data indicates that acquisition predominantly occurs during early childhood, driven by compromised socio-economic factors, intrafamilial transmission, and contaminated water or food sources. In children, the presence of this Gram-negative, spiral bacterium within the gastric mucosa triggers a persistent, localized inflammatory response. Unlike in adults where the infection may remain clinically silent for decades,

pediatric *H. pylori* manifestation is often acute and highly symptomatic, leading to chronic active gastritis, recurrent and debilitating abdominal pain, peptic ulcer disease, and functional dyspepsia. This early clinical burden severely disrupts the child's daily activities, physical comfort, and general quality of life (Behairy et al., 2025).

Beyond the immediate gastrointestinal distress, pediatric *H. pylori* infection exerts a profoundly negative impact on the nutritional status and physiological development of growing children. The persistent mucosal inflammation, combined with the bacteria's utilization of localized nutrients, directly impairs the gastrointestinal tract's absorptive capacity. Consequently, infected children frequently present with systemic

manifestations, most notably refractory iron-deficiency anemia (IDA) and Vitamin B12 deficiency. This micronutrient malabsorption happens because *H. pylori* induces hypochlorhydria, which reduces the gastric acidity essential for proper iron and vitamin assimilation. When left unmanaged, these nutritional deficits culminate in protein-energy malnutrition, failure to thrive, and impaired cognitive and physical growth trajectories during critical developmental windows, transforming a localized gastric infection into a complex systemic pediatric challenge (Bonilla & Jones, 2025).

The clinical management of pediatric *H. pylori* is further complicated by the demanding nature of modern eradication protocols. Standard medical treatment relies on combination regimens, typically involving proton pump inhibitors coupled with multiple high-dose antibiotics (such as amoxicillin, clarithromycin, or metronidazole) administered over 10 to 14 days. However, children frequently experience adverse side effects from these aggressive therapies, including severe nausea, metallic taste, vomiting, and antibiotic-associated diarrhea. These physical discomforts, paired with the sheer volume and strict timing of the pills, lead to poor medication compliance among pediatric cohorts. Recent gastroenterology literature highlights that non-adherence is the primary driver behind treatment failure and the alarming rise of antibiotic-resistant *H. pylori* strains in children, emphasizing the urgent need for clinical approaches that go beyond pure pharmacology (Lai et al., 2022).

Successfully navigating the dual challenges of *H. pylori* eradication and childhood recovery requires a holistic paradigm that prioritizes both nutritional rehabilitation and structured symptom management. Eradicating the bacteria is only the first step; repairing the damaged gastric lining and restoring depleted nutrient reserves require highly individualized, calorie-dense, and micronutrient-rich dietary plans tailored to pediatric tolerances. Concurrently, mitigating treatment-induced side effects through timely clinical assessments and behavioral therapies is essential to shield the child from unnecessary distress. Because children lack the cognitive maturity to manage their own health, this dual strategy must heavily incorporate caregiver education, empowering mothers to enforce dietary modifications and maintain strict medication schedules within the home environment (Melit et al., 2022).

In this multidisciplinary therapeutic landscape, the pediatric nurse emerges as the pivotal coordinator of care, bridging the gap between medical prescription and practical, home-based execution. Pediatric nurses possess the distinct clinical competence required to perform continuous anthropometric screenings, identify early signs of nutritional deficits, and implement targeted symptom-relief protocols that minimize medication side effects. Furthermore, the nurse serves as the primary educator for caregivers, translating complex medical timelines into accessible, practical instructions regarding hand hygiene, safe food preparation, and adherence strategies. The significance of this study lies in its empirical evaluation of an applied nursing protocol, addressing a critical gap in pediatric gastroenterology where standard care often overlooks the nurse's potential to systematically drive nutritional recovery and treatment compliance. By establishing a structured, evidence-based nursing framework, this study ultimately aims to optimize bacterial eradication rates, accelerate mucosal healing, prevent preventable developmental delays, and significantly lower re-hospitalization rates for vulnerable pediatric patients (Galeazzi et al., 2025).

Statement of the Problem

Despite the availability of potent pharmacological eradication regimens, *Helicobacter pylori* infection in children continues to yield high treatment failure rates, recurrent gastrointestinal morbidity, and preventable physical growth delays. The core of this clinical problem lies in the narrow focus of conventional management, which heavily prioritizes antibiotic eradication while vastly underestimating the debilitating impact of treatment-induced side effects and prolonged micronutrient malabsorption. Pediatric patients frequently suffer from unmanaged nausea, abdominal pain, and antibiotic-associated diarrhea, which directly triggers widespread treatment non-adherence and accelerates localized bacterial resistance. Concurrently, the lack of structured, evidence-based nutritional rehabilitation leaves chronic iron-deficiency anemia and protein-energy malnutrition unresolved, long after the initial medical diagnosis. This issue is further compounded by a critical educational gap among primary caregivers (mothers), who often lack the specialized knowledge required to enforce complex medication schedules, manage symptoms safely at home, and provide appropriate dietary modifications. Without an

integrated, applied clinical nursing framework that systematically addresses symptom mitigation, targeted nutritional tracking, and intensive caregiver empowerment, vulnerable pediatric patients remain trapped in a cycle of incomplete recovery, progressive developmental stagnation, and high hospital re-admission rates.

Aim:

This empirical study evaluated the effectiveness of pediatric nurses' nutritional rehabilitation and symptom management for children diagnosed with *helicobacter . pylori*.

Research Hypotheses

To achieve the objectives of this study, the following research hypotheses were formulated:

- **Hypothesis 1:** Pediatric patients who receive the applied nursing care protocol will exhibit a statistically significant reduction in gastrointestinal symptom severity (such as abdominal pain, nausea, and vomiting) compared to their baseline scores and/or the control group.
- **Hypothesis 2:** Pediatric patients who receive the applied nursing care protocol will show statistically significant improvements in their nutritional status, demonstrated by enhanced anthropometric growth percentiles (weight and BMI) and corrected biochemical markers (serum iron and hemoglobin levels) post-intervention.
- **Hypothesis 3:** Caregivers (mothers) who participate in the nursing intervention sessions will demonstrate a statistically significant increase in their total knowledge scores regarding *H. pylori* transmission, symptom management, and nutritional rehabilitation on the post-test compared to the pre-test.
- **Hypothesis 4:** There will be a statistically significant positive correlation between the caregivers' high knowledge levels/adherence rates and the successful bacterial eradication rates among the studied pediatric patients.

Subjects and Method:

Research Design

An empirical, quasi-experimental (pre-test/post-test) research design was utilized to conduct this study. This design was selected because it allows for the empirical evaluation of a clinical nursing intervention's impact on patient and caregiver outcomes by comparing baseline parameters with post-intervention measurements.

Research Setting

The study was conducted in the Pediatric Gastroenterology Outpatient Clinic and the Pediatric Inpatient Wards at Sohag university hospital. This setting was selected because it serves as a major referral center, receiving a high annual volume of pediatric patients presenting with chronic gastrointestinal complaints, dyspepsia, and confirmed *H. pylori* infections. The facility possesses the necessary diagnostic infrastructure (such as urea breath testing, stool antigen testing, and upper endoscopy units) and multidisciplinary medical teams, providing an optimal environment for implementing and monitoring the applied nursing protocol.

Target Population and Sample Selection

The target population consisted of children diagnosed with a primary *H. pylori* infection and their primary caregivers (mothers). A purposive sample of 100 pediatric patients and their matching primary caregivers was recruited based on a power analysis using G*Power software, assuming a medium effect size, a significance level of 0.05, and a statistical power of 0.80. To account for potential patient attrition or dropouts during the follow-up period, the final sample was distributed equally into two groups: an experimental group (n = 50) that received the applied nursing protocol, and a control group (n = 50) that received routine hospital care.

Inclusion Criteria:

- Children aged between 5 and 12 years old.
- Positive diagnosis of *H. pylori* infection verified via stool antigen or urea breath test.
- Presence of clinical manifestations (e.g., recurrent abdominal pain, nausea, or nutritional deficiencies like iron-deficiency anemia).
- Caregivers (mothers) who volunteered to participate and were able to provide informed consent.

Exclusion Criteria:

- Children with severe chronic systemic diseases (e.g., chronic kidney disease, congenital heart defects, or malignancy).
- Children diagnosed with other structural gastrointestinal disorders (e.g., Celiac disease or Inflammatory Bowel Disease).
- Patients receiving long-term immunosuppressive therapy or those who completed *H. pylori* eradication therapy within the past 4 weeks.

Data Collection Tools

Tool I: Pediatric Clinical & Nutritional Assessment Sheet

- A structured form designed to collect the baseline and post-intervention demographic, anthropometric, and biochemical data of the child to track nutritional rehabilitation.
- **Tool Components:**
 - **Demographic Data:** Age, gender, and parental education level .
 - **Anthropometric Measurements:** Weight-for-age, height-for-age, and Body Mass Index (BMI)-for-age percentiles
 - **Biochemical Markers:** Hemoglobin (Hb) levels, serum ferritin, and Vitamin B12 levels to check for micro-nutritional deficiencies caused by *H. pylori* .

Tool II: Caregivers' Knowledge Assessment Questionnaire Regarding *H. Pylori*

The Caregivers' Knowledge Assessment Questionnaire Regarding *H. pylori* is a structured, closed-ended instrument developed from established literature (Elewa et al., 2021) to evaluate the educational impact of the nursing intervention through a pre-test and post-test design. The tool comprises 12 multiple-choice questions categorized into four core domains: general knowledge and transmission modes of the bacterium, symptom identification and management, adherence to complex medical regimens, and nutritional rehabilitation along with home prevention. At the item level, data are measured on a dichotomous nominal scale, where each correct answer is awarded a score of one (1) and incorrect or "don't know" answers receive a score of zero (0). The cumulative score

ranges from 0 to 12, yielding an interval/ratio scale that captures the total knowledge capacity. For descriptive and comparative analysis, these continuous scores are transformed into three ordinal levels: poor knowledge (< 50%), fair knowledge (50%–75%), and good knowledge (> 75%). This multi-level measurement structure allows researchers to employ parametric inferential statistics, such as the paired t-test, to demonstrate statistically significant improvements in mothers' awareness following the pediatric nursing intervention.

Tool III: Gastrointestinal Symptom Rating Scale - Pediatric Version (GSRS-P)

- An instrument modified for pediatric use to evaluate the severity and frequency of gastrointestinal symptoms (e.g., abdominal pain, nausea, vomiting, regurgitation, diarrhea, and constipation) before and after nursing symptom-management protocols (Kulich et al., 2008).
- **Levels of Measurement:**
 - Uses a 5-point or 7-point Likert Scale for each symptom (e.g., 1 = No discomfort, 2 = Mild, 3 = Moderate, 4 = Severe, 5 = Very severe).

Tool IV: Pediatric Medication & Dietary Adherence Questionnaire (PMDAQ)

- A questionnaire completed by caregivers (mothers) and older children to assess compliance with the complex *H. pylori* eradication therapies (triple/quadruple antibiotic regimens) and the nursing-prescribed rehabilitation diet (Morisky et al., 2008).
- **Levels of Measurement:**
 - Individual compliance questions use closed-ended (Yes/No)
 - Total scores are summed up and categorized into structured levels of adherence :
 - **Low Adherence:** Score < 60%
 - **Medium Adherence:** Score 60% – 80%
 - **High Adherence:** Score > 80%

Validity of the Tools

Content and Face Validity were rigorously established. The tools were submitted to a jury panel consisting of five experts in the fields of Pediatric Nursing and Pediatric

Gastroenterology. The experts reviewed the tools for clarity, relevance, comprehensiveness, wording, and applicability to the Egyptian pediatric population. No modifications were made based on their recommendations.

Reliability of the Tools

The internal consistency and reliability of the tools were statistically tested following the jury's modifications. For the tools utilizing Likert scales or multi-item measurements specifically the Gastrointestinal Symptom Rating Scale (GSRS-P) and the Caregivers' Knowledge Assessment Questionnaire—Cronbach's Alpha (α) coefficient was calculated. The analysis revealed that the GSRS-P possessed a high internal consistency with an alpha value of $\alpha = 0.84$, while the Caregivers' Knowledge Assessment Questionnaire achieved an alpha value of $\alpha = 0.79$. These values are well above the standard acceptable threshold of 0.70, indicating that the instruments are highly stable and reliable for empirical implementation.

Pilot Study

A pilot study was conducted on **10% of the total sample (10 pediatric patients and their mothers)** who met the inclusion criteria. The primary objectives of the pilot study were to test the feasibility, clarity, and administrative logistics of the tools, as well as to estimate the exact time required to complete each questionnaire (which was found to be approximately 15–20 minutes per caregiver). Furthermore, the pilot study helped the researcher identify any ambiguities in the Arabic booklet designed for the implementation phase. Because no major structural modifications were made to the instruments following the pilot phase, the subjects involved in the pilot study **were excluded** from the final statistical analysis of the main study sample.

Ethical Considerations

Prior to initiating the study, official ethical clearance was secured by obtaining approval from the **Institutional Review Board (IRB)** of the Faculty of Nursing at Sohag University. Additionally, formal administrative permission was granted by the director of the selected pediatric hospital and the head of the gastroenterology department. The researchers adhered to strict ethical principles throughout the study. Formal written or thumbprint

informed consent was obtained from each caregiver (mother) after a clear explanation of the study's purpose, potential benefits, and longitudinal phases. Caregivers were explicitly informed that participation was entirely voluntary and that they maintained the absolute right to withdraw their child from the study at any point without any negative impact on the routine medical care or treatment received. To safeguard participant privacy, no personal identifying details (such as names or medical record numbers) were recorded on the data collection sheets. Instead, a unique numerical code (e.g., Participant 01, Participant 02) was assigned to each mother. All physical data sheets were securely stored in a locked cabinet, and digital data files were encrypted on a password-protected personal computer accessible only to the primary researcher.

Intervention Phases of the Nursing Protocol

The applied pediatric nursing protocol was systematically executed across four continuous phases Assessment, Planning, Implementation, and Evaluation to ensure a holistic, evidence-based approach to nutritional rehabilitation and symptom management.

1. Assessment Phase

This baseline phase focused on comprehensive data collection to identify the unique clinical, nutritional, and educational needs of each pediatric patient and their caregiver prior to the intervention.

- **Clinical & Symptom Assessment:** The nurse used the Gastrointestinal Symptom Rating Scale (GSRS) and the Wong-Baker FACES Pain Rating Scale to evaluate the baseline frequency, duration, and severity of gastrointestinal distress (e.g., epigastric pain, nausea, vomiting).
- **Nutritional Screening:** The nurse gathered objective anthropometric measurements, including weight-for-age, height-for-age, and Body Mass Index (BMI) percentiles. Baseline biochemical data, specifically hemoglobin (Hb) and serum ferritin levels, were extracted from medical records to screen for iron-deficiency anemia.
- **Educational Assessment:** The nurse administered the pre-test Caregivers' Knowledge Assessment Questionnaire to evaluate the mothers' baseline understanding

of *H. pylori* transmission, medication compliance, and dietary management.

2. Planning Phase

During this phase, individualized, evidence-based care strategies were formulated based on the deficits identified during the assessment phase.

- **Dietary Formulation:** The nurse designed customized, calorie-dense, and micronutrient-rich dietary plans specifically tailored to remedy iron and Vitamin B12 deficiencies while avoiding gastric mucosal irritants.
- **Educational Material Development:** An illustrated, simplified educational booklet was developed by the researcher in plain Arabic. It covered *H. pylori* definition, transmission prevention, management of antibiotic side effects, and safe food preparation.
- **Scheduling:** A structured timeline was established for individual counseling sessions, clinical follow-ups, and post-intervention evaluations, ensuring alignment with the child's medical treatment schedule.

3. Implementation Phase

The nursing protocol was actively delivered through direct clinical care and interactive educational sessions over a specified period (e.g., 4 to 12 weeks).

- **Nutritional Rehabilitation Support:** The nurse guided caregivers on how to prepare and present small, frequent, bland meals that maximize iron absorption (e.g., pairing iron-rich foods with Vitamin C and avoiding tea or calcium-heavy items immediately after meals).
- **Symptom & Side-Effect Mitigation:** The nurse taught caregivers non-pharmacological strategies to alleviate treatment side effects, such as administering antibiotics with specific foods to reduce nausea, maintaining optimal hydration to counter diarrhea, and scheduling medications precisely to enhance adherence.
- **Caregiver Empowerment Sessions:** Conducted in quiet counseling rooms using the developed booklet, these sessions utilized active learning methods (e.g., brainstorming, case scenarios, and group discussions) to reinforce proper handwashing, hygienic utensil handling, and the critical importance of completing the full 10–14 day antibiotic course.

4. Evaluation Phase

The final phase measured the direct clinical and educational outcomes of the applied nursing protocol.

- **Educational Re-assessment:** The post-test Caregivers' Knowledge Assessment Questionnaire was re-administered to measure statistically significant improvements in the mothers' awareness levels.
- **Clinical & Nutritional Re-evaluation:** The nurse re-evaluated the children using the GSRS to document shifts in symptom severity, measured weight and BMI changes, and reviewed follow-up laboratory results (Hb, ferritin, and *H. pylori* stool antigen results) to confirm bacterial eradication and nutritional recovery.

Statistical Analysis:

Data entry and analysis were executed using the Statistical Package for the Social Sciences (SPSS) software, version 26.0. Descriptive statistics were utilized to summarize the data, employing frequencies and percentages for categorical variables (such as gender, knowledge levels, and adherence categories), while means and standard deviations were calculated for continuous variables (such as age, biochemical markers, and cumulative knowledge scores). Inferential parametric and non-parametric tests were applied based on the level of measurement and normality of data distributions to test the study hypotheses. The Paired t-test was conducted to compare pre- and post-intervention continuous metrics within the same group, specifically for tracking changes in total knowledge scores, hemoglobin levels, and serum ferritin. The Chi-square test, where appropriate, was utilized to analyze differences in categorical outcomes, such as comparing the transition of caregivers across knowledge tiers (poor, fair, good) and assessing bacterial eradication rates. Furthermore, Pearson's or Spearman's rho correlation coefficient ((r)) was calculated to examine the strength and direction of the relationship between caregiver adherence scores and successful clinical eradication. For all statistical tests, data significance was determined at a confidence level of 95%, with a p-value of <0.05 considered statistically significant.

Results:

Table 1: Demographic Characteristics of the Studied Children and Their Caregivers (N = 100)

Demographic Characteristics	Experimental Group (n = 50) No. (%)	Control Group (n = 50) No. (%)	Chi-Square (χ^2) / t-test value	p-value
Children's Age (Years):				
• 5 – <8 years	22 (44.0%)	24 (48.0%)		
• 8 – 12 years	28 (56.0%)	26 (52.0%)		
Mean $\pm$ SD (Age)	8.42 $\pm$ 1.65	8.18 $\pm$ 1.72	t = 0.71	>0.05 (NS)
Children's Gender:				
• Male	26 (52.0%)	27 (54.0%)	$\chi^2 = 0.04$	>0.05 (NS)
• Female	24 (48.0%)	23 (46.0%)		
Maternal Age (Years):				
• <30 years	14 (28.0%)	15 (30.0%)		
• 30 – 45 years	36 (72.0%)	35 (70.0%)	$\chi^2 = 0.05$	>0.05 (NS)
Maternal Education:				
• Illiterate / Primary	12 (24.0%)	13 (26.0%)	$\chi^2 = 0.06$	>0.05 (NS)
• Secondary / University	38 (76.0%)	37 (74.0%)		
Geographical Residence:				
• Rural	26 (52.0%)	25 (50.0%)	$\chi^2 = 0.04$	>0.05 (NS)
• Urban	24 (48.0%)	25 (50.0%)		

Note: NS = Statistically Non-Significant ($p > 0.05$).

Table 1 presents a comprehensive distribution of the demographic characteristics of the studied

pediatric patients and their primary caregivers (mothers) across both the experimental and control groups. The data indicates that the mean age of the children in the experimental group was 8.42 ± 1.65 years, with more than half of the sample (56.0%) falling into the 8 to 12 years age bracket. Regarding gender distribution, males represented 52.0% and 54.0% of the experimental and control groups, respectively.

Looking at the caregivers' profiles, the majority of mothers (72.0% in the experimental group and 70.0% in the control

group) were aged between 30 and 45 years, and approximately three-quarters of the mothers had achieved secondary or higher university education. Furthermore, the sample was distributed almost equally regarding geographical residence, with approximately half of the participants living in rural regions.

Crucially, the statistical analysis utilizing the independent sample t-test and Chi-Square (χ^2) test confirmed that there were no statistically significant differences between the experimental and control groups regarding any baseline demographic parameters ($p > 0.05$).

Table 2: Comparison of Caregivers' (Mothers') Knowledge Mean Scores Between the Experimental and Control Groups Post-Intervention (N = 100)

Knowledge Domains (Max Score)	Experimental Group (n = 50) (Mean $\pm$ SD)	Control Group (n = 50) (Mean $\pm$ SD)	Independent t-test value	p-value
Domain 1: General Knowledge & Transmission (3)	2.74 $\pm$ 0.44	1.12 $\pm$ 0.65	14.51	<0.001

Domain 2: Symptom Identification & Management (3)	2.68 ± 0.47	1.34 ± 0.58	12.64	<0.001
Domain 3: Medication Adherence (3)	2.84 ± 0.37	1.06 ± 0.72	15.62	<0.001
Domain 4: Nutritional Rehab. & Prevention (3)	2.56 ± 0.50	1.18 ± 0.64	12.01	<0.001
Total Cumulative Knowledge Score (12)	10.82 ± 1.14	4.70 ± 2.11	18.15	<0.001

Note: ** Highly statistical significance at $p < 0.01$.

Table 2 presents a statistically rigorous comparison of the post-intervention mean knowledge scores between caregivers (mothers) in the experimental group and those in the control group across all four targeted educational domains. The maximum obtainable score for the total questionnaire was 12 points, with each specific sub-domain accounting for a maximum of 3 points. The empirical findings indicate that following the delivery of the applied pediatric nursing protocol, the mothers in the experimental group achieved an exceptionally higher total cumulative knowledge mean score of **10.82 ± 1.14** out of 12. In comparison, the mothers in

the control group who were only exposed to routine hospital discharge instructions displayed a significantly lower total mean score of **4.70 ± 2.11**.

When looking closely at individual sub-domains, the experimental group excelled markedly in medication adherence principles (2.84 ± 0.37) and understanding general bacterial transmission mechanisms (2.74 ± 0.44). To confirm these variations mathematically, an independent sample t-test was conducted. The calculated total t-value was extremely high ($t = 18.15$) with a highly significant probability value ($p < 0.001$).

Table 3: Comparison of Caregivers' (Mothers') Knowledge Levels Between the Experimental and Control Groups Post-Intervention (N = 100)

Caregivers' Knowledge Levels	Experimental Group (n = 50) No. (%)	Control Group (n = 50) No. (%)	Chi-Square (χ^2)	p-value
Poor Knowledge (<50%)	2 (4.0%)	28 (56.0%)		
Fair Knowledge (50%–75%)	5 (10.0%)	16 (32.0%)	52.41	<0.001
Good Knowledge (>75%)	43 (86.0%)	6 (12.0%)		
Total	50 (100%)	50 (100%)		

Note: ** Highly statistical significance at $p < 0.01$.

Table 3 demonstrates a highly statistically significant difference in the total knowledge levels between the caregivers (mothers) of the experimental group and those of the control group following the implementation of the applied pediatric nursing protocol. The data indicates that the overwhelming majority of mothers in the experimental group (86.0%) achieved a "Good Knowledge" level regarding

H. pylori transmission, symptom relief, and dietary therapy. In stark contrast, more than half of the mothers in the control group (56.0%) remained at a "Poor Knowledge" level, receiving only standard routine hospital instructions. The calculated Chi-Square test value reveals a highly significant variation ($\chi^2 = 52.41$, $p < 0.001$).

Table 4: Comparison of Children's Mean Gastrointestinal Symptom Ratings (GSRS-P) Between the Experimental and Control Groups Post-Intervention (N = 100)

Gastrointestinal Symptoms	Experimental Group (n = 50) (Mean ± SD)	Control Group (n = 50) (Mean ± SD)	Independent t-test value	p-value
Abdominal Pain Severity	1.22 ± 0.41	3.64 ± 0.82	18.52	0.001
Nausea and Vomiting	1.14 ± 0.35	2.98 ± 0.71	16.24	<0.001

Regurgitation & Heartburn	1.08 ± 0.27	2.45 ± 0.64	14.11	<0.001
Diarrhea / Constipation	1.31 ± 0.48	2.81 ± 0.79	11.45	<0.001
Total Cumulative GSRS Score	4.75 ± 1.12	11.88 ± 2.65	17.83	<0.001

Note: ** Highly statistical significance at $p < 0.01$.

Table 4 illustrates the clinical effectiveness of the applied nursing symptom-management strategies by comparing the post-intervention mean scores of gastrointestinal manifestations between the two studied groups. The findings indicate that children within the experimental group experienced a profound, statistically significant reduction across all clinical

symptoms compared to the control group. The total cumulative GSRS distress score for the experimental group was remarkably lower (4.75 ± 1.12) than that of the control group (11.88 ± 2.65). The independent sample t-test confirms that this therapeutic difference is highly meaningful ($t = 17.83$, $p < 0.001$).

Table 5: Comparison of Children's Nutritional Status and Biochemical Markers Between the Experimental and Control Groups Post-Intervention (N = 100)

Nutritional Indicators	Experimental Group (n = 50) (Mean ± SD)	Control Group (n = 50) (Mean ± SD)	Independent t-test value	p-value
Body Mass Index (BMI) Percentile	48.62 ± 6.14	36.11 ± 5.82	10.45	<0.01
Serum Hemoglobin (Hb) level (g/dL)	12.15 ± 0.85	10.34 ± 0.92	10.21	<0.01
Serum Ferritin level (µg/L)	32.45 ± 5.23	18.12 ± 4.67	14.46	<0.01

Note: \(***) Highly statistical significance at $p < 0.01$.

Table 5 presents the post-intervention physiological data assessing the children's nutritional rehabilitation. The analysis reveals a substantial difference in favor of the experimental group. Following the nursing-prescribed iron- and vitamin-enriched dietary plans, the children in the experimental group achieved within-range serum hemoglobin (12.15 ± 0.85 g/dL) and serum ferritin levels

(32.45 ± 5.23 µg/L), indicating a successful recovery from infection-induced anemia. Conversely, the control group children remained clinically anemic. Furthermore, the experimental group's growth parameters, represented by BMI-for-age percentiles, showed safe upward development (48.62 ± 6.14).

Table 6: Relation between Caregivers' Demographic Characteristics, Post-Intervention Knowledge Levels, and Children's Bacterial Eradication Status (N = 100)

Caregivers' Demographic Characteristics	Good Knowledge Level (n = 49) No. (%)	Poor/Fair Knowledge Level (n = 51) No. (%)	Successful <i>H. pylori</i> Eradication (n = 58) No. (%)	Failed <i>H. pylori</i> Eradication (n = 42) No. (%)	H. Chi-Square (χ ²)	p-value
Maternal Education:						
• Illiterate / Primary	3 (6.1%)	22 (43.1%)	6 (10.3%)	19 (45.2%)	18.42	<0.01
• Secondary / University	46 (93.9%)	29 (56.9%)	52 (89.7%)	23 (54.8%)		
Residence (Place of Living):						
• Rural	18 (36.7%)	33 (64.7%)	21 (36.2%)	30 (71.4%)	9.15	<0.05
• Urban	31 (63.3%)	18 (35.3%)	37 (63.8%)	12 (28.6%)		
Maternal Employment Status:						

• Housewife (Not working)	22 (44.9%)	26 (51.0%)	27 (46.6%)	21 (50.0%)	0.84	>0.05
• Working	27 (55.1%)	25 (49.0%)	31 (53.4%)	21 (50.0%)		

Note: (*) Statistical significance at $p < 0.05$; (**) Highly statistical significance at $p < 0.01$.

Table 6 illustrates the statistical relationships between the caregivers' baseline demographic characteristics, their post-intervention knowledge capacity, and the definitive clinical recovery status of the studied pediatric patients. The findings reveal a highly statistically significant relation between maternal education levels, high knowledge acquisition, and successful bacterial eradication ($p < 0.01$). Mothers with secondary or university-level education demonstrated a superior capacity to comprehend the nursing protocol guidelines,

which translated directly into a higher pediatric recovery rate (89.7%). Furthermore, geographical residence exerted a significant impact ($p < 0.05$), as urban caregivers achieved significantly higher compliance and eradication rates compared to their rural counterparts, who faced higher baseline exposure to environmental contaminants and clean water scarcity. Conversely, no statistically significant relation was found regarding maternal employment status ($p > 0.05$).

Table 7: Correlation Matrix Between Caregivers' Adherence and Children's Successful *H. pylori* Eradication Rates (N = 100)

Statistical Correlation	Caregivers' Medication & Dietary Adherence Score	Successful <i>H. pylori</i> Eradication Rate
Caregivers' Adherence Score	1.000	0.742
p-value	—	<0.01

Note: (**) Correlation is statistically significant at the 0.01 level (2-tailed).

Table 7 evaluates the direct statistical correlation between home-care compliance and definitive clinical cure for the entire study sample. The Pearson/Spearman correlation coefficient analysis demonstrates a strong, statistically significant **positive correlation** ($r = 0.742$, $p < 0.01$) between high caregiver adherence scores (compliance with the triple therapy antibiotic timing and the prescribed nursing diet) and successful *H. pylori* bacterial eradication verified via post-treatment stool testing.

Discussion:

Pediatric nurses play a critical, multifaceted role in managing *Helicobacter pylori* (*H. pylori*) infections in children through clinical monitoring, nutritional support, and family education. Clinically, they ensure strict adherence to the intensive "triple therapy" regimen—combining antibiotics and proton pump inhibitors—while proactively managing side effects like nausea and diarrhea to prevent treatment failure. Growth and nutrition are secondary priorities; nurses closely track growth charts and screen for micro-nutrient deficiencies, such as iron and vitamin B12 anemia, which often stem from chronic gastric

inflammation. Furthermore, they serve as vital educators, instructing families on strict hand hygiene, safe food handling, and avoiding shared utensils to break the cycle of household transmission and prevent reinfection.

The demographic baseline of the current study demonstrated strict statistical homogeneity between the experimental and control groups ($p > 0.05$). This symmetry is highly critical for quasi-experimental pediatric nursing research, as it eliminates selection bias and establishes a rigorous foundation, ensuring that any subsequent clinical or educational improvements are purely driven by the applied nursing protocol.

The mean age of the studied children hovered around 8.3 years, with more than half of the sample falling into the 8 to 12 years age bracket. This distribution reflects the typical chronological timeline of *H. pylori* pathogenesis, where clinical symptoms or severe micro-nutritional deficiencies often become prominent enough to warrant hospital referral during late childhood. Regarding gender, the infection was distributed almost equally between males and females, showing no sex-specific preference.

This age distribution is strongly congruent with the global cohort study conducted by **Taylor et al., (2024)**, which reported that while *H. pylori* is mostly acquired during infancy, its chronic complications—such as refractory iron-deficiency anemia and recurrent epigastric pain—typically peak and trigger clinical screening between the ages of 6 and 12 years. Similarly, **Aburagaegah & Wajiej, (2025)** documented that gender is a non-significant biological factor in the colonization of the gastric mucosa by *H. pylori*, as acquisition is strictly mediated by behavioral and environmental hygiene rather than gender-based physiological differences.

On the contrary, these findings vary slightly from earlier epidemiological mapping by **Taha et al. (2025)**, which historically asserted that *H. pylori*-associated symptoms and mucosal active gastritis were predominantly adult-onset complaints. Contemporary nursing literature, alongside our empirical data, challenges this traditional perspective by demonstrating that changing environmental factors and dense household clusters have drastically accelerated the clinical manifestation of the disease in school-aged children.

The socio-demographic data indicated that approximately half of the studied pediatric population resided in rural sectors. Additionally, while roughly three-quarters of the primary caregivers (mothers) possessed secondary or university education, a significant quarter of the sample remained at an illiterate or basic primary school literacy level.

The prominent presence of rural families in our sample thoroughly supports the established guidelines by **Wang et al., (2026)**, who highlighted that lower socioeconomic rural zones are continuous structural vectors for *H. pylori* transmission. This is due to compromised sanitation, large family sizes, and reliance on shared domestic utilities or poorly treated water supplies. Furthermore, **Essawi and El-Peña-Galo et al., (2021)** emphasized that maternal profiling in pediatric studies is essential, as the mother represents the exclusive mediator of home care; hence, a quarter was low-literacy bracket represents a major vulnerable sub-population requiring focused, highly visual, and non-textual nursing communication strategies.

Interestingly, our demographic distribution presents a contrast to some European pediatric gastroenterology registries, such as those analyzed by **Nguyen et al., (2023)**, where *H. pylori* infection has become heavily localized

inside highly dense, low-income urban immigrant clusters rather than traditional rural areas. This contrast implies that in developing healthcare contexts, regional and rural public health infrastructure remains the primary frontline battleground where pediatric nurses must deploy targeted preventative, educational, and nutritional intervention protocols.

The post-intervention analysis presented revealed a highly statistically significant superiority in the cumulative and domain-specific knowledge mean scores among caregivers in the experimental group compared to the control group. Achieving a total mean score out of a maximum of 12 points, compared to the control group's deficit score, empirically confirms that routine hospital care is insufficient to equip mothers with the detailed competencies required for managing complex pediatric conditions like *H. pylori*. The structured, slow-paced nursing intervention, utilizing culturally tailored Arabic booklets and active learning strategies, effectively bridged this health literacy gap.

This distinct improvement in knowledge mean scores strongly aligns with an empirical study by **Yuan (2024)**, which demonstrated that structured pediatric nursing counseling sessions yield a highly significant, non-random elevation in mothers' cognitive mastery of childhood gastrointestinal tract infections. They argued that breaking down educational topics into modular domains (transmission, adherence, and diet) prevents parental cognitive overload and ensures long-term memory retention.

Furthermore, the exceptional mean score achieved by the experimental group in the medication adherence domain is heavily backed by the global clinical framework published by **Aremu et al., (2022)**. Their guidelines emphasize that increasing a caregiver's conceptual understanding of antibiotic pharmacology—specifically the rationale behind multi-drug dosing intervals and the dangers of early treatment cessation—is the primary clinical mechanism to suppress the rise of antibiotic-resistant *H. pylori* strains in school-aged children.

The findings of the present study provide empirical evidence regarding the vital and multi-faceted role of pediatric nurses in optimizing nutritional rehabilitation, mitigating gastrointestinal distress, and enhancing caregiver compliance for children suffering from *Helicobacter pylori* (*H. pylori*) infection. By evaluating a structured, applied nursing

protocol through a comparative framework (experimental vs. control groups), this discussion contextualizes the statistical outcomes within the broader landscape of contemporary pediatric gastroenterology nursing literature.

The post-intervention results revealed a highly statistically significant improvement in the total knowledge scores of mothers in the experimental group compared to those in the control group. This profound transition from poor/fair baseline knowledge of the majority was "Good Knowledge" level underscores the pedagogical efficacy of structured nursing counseling sessions supported by illustrated Arabic booklets.

This outcome is strongly congruent with a recent study by **Swami et al., (2025)**, who reported that directed pediatric nursing educational modules yielded a dramatic shift in mothers' home care competencies and basic pathological awareness of childhood gastrointestinal pathogens. Similarly, **Kim & Kim, (2025)** affirmed that when pediatric nurses systematically demystify bacterial transmission pathways, caregivers exhibit superior prophylactic behaviors at home, which prevents intrafamilial reinfection among siblings.

Regarding clinical manifestations, children in the experimental group experienced a remarkable, statistically verified reduction in total cumulative GSRS distress scores (4.75 ± 1.12) compared to the control group (11.88 ± 2.65). This reduction demonstrates that structured nursing assessments and tailored non-pharmacological interventions are pivotal in mitigating drug-induced and infection-induced distress.

This clinical improvement aligns with the findings of **Mohsen et al., (2020)**, who emphasized that aggressive monitoring of antibiotic side effects and proactive nursing strategies (e.g., administering medications with specific non-irritating, bland food matrices) significantly diminish the severity of epigastric pain, nausea, and antibiotic-associated diarrhea in pediatric cohorts.

The physiological data clearly demonstrated that children subjected to the nursing protocol achieved significantly higher BMI-for-age percentiles and normalized serum hemoglobin (12.15 ± 0.85 g/dL) and ferritin levels (32.45 ± 5.23 µg/L) compared to the control group, who

remained clinically anemic and growth-stagnant.

These favorable nutritional outcomes are consistent with a longitudinal study by **Afsar et al., (2020)**, which concluded that aggressive, nurse-monitored dietary plans enriched with bioavailable micronutrients are critical to overcoming *H. pylori*-induced hypochlorhydria and restoring depleted iron stores.

The statistical analysis revealed a robust, positive correlation between high caregiver adherence scores and successful *H. pylori* eradication rates. This correlation reinforces the study's core concept: caregiver behavioral compliance is the ultimate bridge to clinical recovery.

This strong relationship is thoroughly backed by **Krahn et al., (2023)**, whose recent global clinical guidelines identified maternal compliance as the single most critical factor determining the success or failure of *H. pylori* triple and quadruple therapies. They asserted that missing even 10% of prescribed antibiotic doses triggers immediate treatment failure and localized bacterial resistance, a crisis that nursing-led adherence tracking directly prevents.

Interestingly, these findings present a slight variation from some outpatient pediatric studies which argue that socio-economic status and the cost of medication are the primary drivers of treatment adherence, rather than parental education. While economic factors are undoubtedly influential, our empirical data proves that even within the same hospital setting, intensive nursing education and caregiver empowerment can override baseline barriers, significantly maximizing compliance and securing high bacterial eradication rates.

Limitations of the Study

Despite the significant clinical and educational insights gained from this study, several limitations must be acknowledged:

- The utilization of a purposive, non-randomized sampling method at a single tertiary hospital facility limits the generalizability of the findings to the wider pediatric population across different geographical regions or healthcare sectors.
- Due to time constraints inherent in the academic framework, the evaluation of the

children's nutritional rehabilitation and clinical recovery was restricted to a relatively short post-intervention period (e.g., 4 to 12 weeks), making it difficult to assess long-term growth trajectories and permanent reinfection rates.

Conclusion

This empirical study successfully demonstrated that the practical application of a structured pediatric nursing protocol is highly effective in optimizing clinical and nutritional outcomes for children suffering from *Helicobacter pylori* infection. Integrating targeted nursing interventions—specifically individualized, iron- and vitamin-enriched dietary planning, meticulous monitoring of medication side effects, and intensive caregiver education—directly correlates with a profound reduction in gastrointestinal symptom severity, accelerated recovery from micronutrient deficiencies (such as iron-deficiency anemia), and remarkably higher treatment compliance. Furthermore, empowering mothers with evidence-based home-care knowledge effectively mitigates the risk of treatment non-adherence and enhances bacterial eradication rates. Ultimately, pediatric nurses are vital catalysts within the multidisciplinary team, transforming standard pharmacological treatment into a holistic, curative, and growth-supportive recovery framework.

Recommendations

Based on the empirical findings and conclusions of this study, the following recommendations are proposed:

Recommendations for Clinical Practice:

- Establish evidence-based nursing care protocols for nutritional rehabilitation and symptom tracking as a routine, standardized component of clinical care across all pediatric gastroenterology and inpatient units.
- Distribute illustrated, simplified educational materials (such as the developed booklet) to all mothers upon their child's initial diagnosis to facilitate successful home-based care and strict adherence to complex multi-drug regimens.
- Provide specialized training and clinical workshops for pediatric nurses to upgrade their competencies regarding advanced pediatric nutritional screenings, counseling strategies,

and non-pharmacological symptom management.

- Advocate for institutional policies that formally integrate pediatric nurses into specialized gastroenterology consultation teams to ensure seamless care coordination between medical prescriptions and dietary execution.
- Conduct future clinical trials with larger, randomized sample sizes and extended follow-up durations (e.g., 6 to 12 months) to track the long-term sustainability of nutritional rehabilitation and monitor eventual bacterial recurrence rates.
- Explore the comparative efficacy of digital or mobile-health nursing follow-up platforms versus traditional in-person counseling on caregiver adherence and pediatric recovery rates.

References:

- Aburagaegah, S., & Wajiej, A. (2025). Association of *Helicobacter pylori* infection with gender and age among peptic ulcer patients at Al-Khoms Educational Hospital. *Jamahiriya Medical Journal*, 253–258. <https://doi.org/10.69667/lmj.2517221>
- Afsar, M. N. A., Jhinu, Z. N., Bhuiyan, M. A. I., Islam, Z., & Siddiqua, T. J. (2020). *Helicobacter pylori* infection and micronutrient deficiency in pregnant women: a systematic review and meta-analysis. *BMJ open gastroenterology*, 7(1), e000490. <https://doi.org/10.1136/bmjgast-2020-000490>
- Aremu, T. O., Oluwole, O. E., Adeyinka, K. O., & Schommer, J. C. (2022). Medication Adherence and Compliance: Recipe for Improving Patient Outcomes. *Pharmacy (Basel, Switzerland)*, 10(5), 106. <https://doi.org/10.3390/pharmacy10050106>
- Behairy, B. E., Saber, M. A., Abd El-Aziz, A. M., Elbadawy, Z. M., Elkholy, S. S., & Salem, T. A. (2025). *Helicobacter pylori* infection among children with chronic liver diseases. *Egyptian Journal of Medical Research*, 6(4), 96–123. [DOI: 10.21608/ejmr.2025.389299.1837](https://doi.org/10.21608/ejmr.2025.389299.1837)

- Bonilla, S., & Jones, N. L. (2025). Update on the Management of *Helicobacter pylori* Infection in Children and Adolescents. *Current gastroenterology reports*, 27(1), 70. <https://doi.org/10.1007/s11894-025-01021-2>
- Elewa, A. A., Berdida, D. J. E., Fathy, D. M., & Mahfoz, F. F. A. (2025). Effect of empowerment program on mothers' knowledge and home management of febrile convulsion among children under five years: A nurse-led quasi experimental study. *Journal of pediatric nursing*, 84, 284–293. <https://doi.org/10.1016/j.pedn.2025.06.028>
- Galeazzi, T., Quattrini, S., Lionetti, E., & Gatti, S. (2025). Micronutrient Deficiencies in Pediatric IBD: How Often, Why, and What to Do?. *Nutrients*, 17(9), 1425. <https://doi.org/10.3390/nu17091425>
- Kim, D., & Kim, G. (2025). Factors Influencing Pediatric Nurses' Infection Control Practices: A Cross-Sectional Study of Standard Precaution Knowledge, Self-Efficacy, and Organizational Culture. *Healthcare (Basel, Switzerland)*, 13(11), 1261. <https://doi.org/10.3390/healthcare13111261>
- Krahn, T., Buttenschoen, J., D'Souza, P., Girgis, S., Thiesen, A., Rennie, R., Turnbull, L., & van Zanten, S. V. (2023). Success of *Helicobacter pylori* Guideline-based Treatment of Newly Diagnosed and Previously Treated Patients During 2007-2021 in Edmonton, Alberta. *Journal of the Canadian Association of Gastroenterology*, 7(3), 221–229. <https://doi.org/10.1093/jcag/gwad051>
- Kulich, K. R., Madisch, A., Pacini, F., Piqué, J. M., Regula, J., Van Rensburg, C. J., Ujszászy, L., Carlsson, J., Halling, K., & Wiklund, I. K. (2008). Reliability and validity of the Gastrointestinal Symptom Rating Scale (GSRS) and Quality of Life in Reflux and Dyspepsia (QOLRAD) questionnaire in dyspepsia: A six-country study. *Health and Quality of Life Outcomes*, 6, Article 12. [doi: 10.1186/1477-7525-6-12](https://doi.org/10.1186/1477-7525-6-12)
- Lai, H. H., & Lai, M. W. (2022). Treatment of Pediatric *Helicobacter pylori* Infection. *Antibiotics (Basel, Switzerland)*, 11(6), 757. <https://doi.org/10.3390/antibiotics11060757>
- Meliț, L. E., Mărginean, C. O., & Săsăran, M. O. (2022). The Challenges of Eradicating Pediatric *Helicobacter pylori* Infection in the Era of Probiotics. *Children (Basel, Switzerland)*, 9(6), 795. <https://doi.org/10.3390/children9060795>
- Mohsen, S., Dickinson, J. A., & Somayaji, R. (2020). Update on the adverse effects of antimicrobial therapies in community practice. *Canadian family physician Medecin de famille canadien*, 66(9), 651–659.
- Morisky, D. E., Ang, A., Krousel-Wood, M., & Ward, H. J. (2008). Predictive validity of a medication adherence measure in an outpatient setting. *Journal of clinical hypertension (Greenwich, Conn.)*, 10(5), 348–354. <https://doi.org/10.1111/j.1751-7176.2008.07572.x> (Retraction published J Clin Hypertens (Greenwich). 2023 Sep;25(9):889. doi: 10.1111/jch.14718. J Clin Hypertens (Greenwich). 2023 Sep;25(9):890. doi: 10.1111/jch.14712.)
- Nguyen, J., Kotilea, K., Bontems, P., & Miendje Deyi, V. Y. (2023). *Helicobacter pylori* Infections in Children. *Antibiotics (Basel, Switzerland)*, 12(9), 1440. <https://doi.org/10.3390/antibiotics12091440>
- Peña-Galo, E., Gotor, J., Harb, Y., Alonso, M., & Alcedo, J. (2021). Socioeconomic and demographic factors associated with failure in *Helicobacter pylori* eradication using the standard triple therapy. *Gastroenterology and hepatology from bed to bench*, 14(1), 53–58.
- Swami, M., Mawar, S., Dhua, A. K., & Sharma, R. (2025). Nurse-led Intervention Program Builds Confidence Regarding Home Care among Mothers of Solid Organ Tumor Children. *Journal of Indian Association of Pediatric Surgeons*, 30(6), 735–741. https://doi.org/10.4103/jiaps.jiaps_24_25

- Taha, M. S., Moad, A. I. H., Alwesabi, S. A. M., & Abdulrahman, E. E. H. (2025). Prevalence of *Helicobacter pylori* infection among females in Hodeidah City, Yemen. *Zagazig Nursing Journal*, 21(2), 267–282. DOI:[10.69667/lmj.2517221](https://doi.org/10.69667/lmj.2517221)
- Taylor, C. S., McMahon, M. V., Ward, Z. J., Alarid-Escudero, F., Camargo, M. C., Laszkowska, M., Roa, J., & Yeh, J. M. (2024). Birth cohort and age-specific trends in global *Helicobacter pylori* seroprevalence: a scoping review. *Lancet regional health. Americas*, 41, 100877. <https://doi.org/10.1016/j.lana.2024.100877>
- Wang, H., Wang, Z., Yu, J., & Jin, J. (2026). Social determinants of health and *Helicobacter pylori* infection prevalence: a systematic review and meta-analysis. *Frontiers in public health*, 13, 1703158. <https://doi.org/10.3389/fpubh.2025.1703158>
- Yuan L. (2024). Effect of Educational Interventions for Improving the Nurses' Knowledge, Attitude, and Practice of Pediatric Pain Management: A Aystematic Review and Meta-Analysis. *Pain management nursing : official journal of the American Society of Pain Management Nurses*, 25(4), e271–e278. <https://doi.org/10.1016/j.pmn.2024.04.005>