**Original article**

# Diagnostic and therapeutic outcomes of pediatric colonoscopies in Jordanian children

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## Abstract

**Background:** Pediatric colonoscopy is a crucial tool for diagnosing and treating children with colonic diseases. Data from low-volume centers are scarce and, most of the time, not represented in literature. This study aimed to review colonoscopy indications, diagnostic yield, therapeutic interventions, and outcomes in children who underwent a colonoscopy procedure at a university hospital in North Jordan.

**Methods:** A retrospective review was conducted on children who underwent colonoscopies between January 2014 and January 2020. Demographic data, procedure indications, and colonoscopy and histopathological findings were collected from patient hospital charts. The appropriateness of colonoscopy indications was judged according to published guidelines.

**Results:** We identified 119 procedures performed in 105 children (females: 39 [37.1%]; mean age: 98.2 ± 51.2 months) in our review. The most common cause for undergoing a colonoscopy procedure was lower gastrointestinal bleeding (55 [46.2%]), followed by chronic diarrhea and abdominal pain (17 [14.3%] and 16 [13.4%], respectively). A normal endoscopy was reported in 50 (42.0%) procedures. The most commonly reported abnormalities were polyps and inflammatory bowel disease. Polypectomies were performed in 21 patients during 26 (21.8%) procedures. Most of the polyps were rectal polyps (15 [71.4%]), and all of them were of juvenile pathology. Appropriate colonoscopy indications were associated with a higher rate of an abnormal endoscopy.

**Conclusion:** Low-volume centers share a similar spectrum of disorders reported by larger centers. Our study found that the most common colonoscopy indications were rectal bleeding and diarrhea, and the most common findings were colonic inflammation and colorectal polyps. Complying with guideline recommendations will improve the diagnostic yield of colonoscopies.

## Keywords

Colonoscopy, endoscopy, pediatric colonoscopy, polyp, polypectomy, inflammation.

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## How to cite

## Background

A colonoscopy provides important diagnostic and therapeutic information and can be used to evaluate children with lower gastrointestinal symptoms. Since the introduction of endoscopy, significant efforts have been made to tailor the procedure to be applicable to children. Compared to adults, children have a different spectrum of indications and pathologies, in addition to technical specificities [1]. Trained pediatric colonoscopists, the use of specific pediatric scopes, and proper sedation have increased the number of procedures and improved their safety [2]. Moreover, carefully selecting patients to undergo colonoscopy by complying with published guidelines on colonoscopy indications can improve diagnostics [3].

Lower gastrointestinal bleeding, chronic diarrhea, and unexplained anemias are the most common indications for pediatric colonoscopy [4], while polyps and colonic inflammation are the most common endoscopic findings [2]. Colonoscopic data and experience from low-volume centers are under-represented in medical literature. At the same time, low-resource countries might have a different spectrum of disorders or diseases behavior. Reports from such centers will uncover their practice and explore their epidemiology. This reporting will impact the practice quality of these centers and enrich the literature with new experience.

This retrospective study aimed to describe the demographics and clinical characteristics of children who underwent colonoscopy at a university hospital in North Jordan by analyzing their endoscopic and histopathological findings and the effect of indication appropriateness on the colonoscopy yield.

## Methods

### Patients

This retrospective review included children (< 18 years of age) who underwent sigmoidoscopy/colonoscopy in the Gastroenterology Unit at King Abdullah University Hospital between January 2014 and January 2020. Electronic hospital charts were reviewed to obtain patient demographics, endoscopic charts, and pathological reports. The study was approved by the IRB committee at the Faculty of Medicine and the Research Committee of Jordan University of Science and Technology (JUST) (no. 20190077).

### Diagnosis conditions

A colonoscopy was defined as normal when the colonoscopy report mentioned no abnormality or minor abnormality, when the findings did not contribute to the patient's illness, and when histopathological examination results were normal. A colonoscopy was defined as abnormal when the colonoscopy report mentioned an abnormality in any of the examined areas and was confirmed on histopathological examination. An indication was considered appropriate if the procedure indication was in compliance with the Pediatric Gastroenterology Endoscopy Guidelines by the ESGE, ESPGHAN, 2016 [3]. An indication was considered inappropriate if the procedure indication was not in compliance with the Pediatric Gastroenterology Endoscopy Guidelines by the ESGE, ESPGHAN, 2016 [3].

To make comparisons between normal and abnormal colonoscopies, when patients underwent multiple endoscopic procedures, only the first diagnostic procedure was included, while those who underwent prior gastrointestinal surgeries were excluded. In the case of patients who underwent colonoscopy outside our facility, the procedure was not considered.

### Colonoscopy preparation

The patient received either an in-patient or outpatient preparation depending on the patient's age and the cooperation of the family. Two days prior to the procedure, the patient was advised to begin a clear fluid diet. Children below the age of 8 years were admitted the day before the procedure. On the day before the procedure, patients were

made to drink a solution of polyethylene glycol (PEG, 64 g) dissolved in water (1,200 mL) at a rate of 250 mL every 30 minutes. The stool output was checked in the afternoon, and another PEG solution was administered if the stool output contained solid components. At night, a saline enema was performed if solids particles were still present in the stool. If the patient could not drink the solution, the solution was administered through a nasogastric tube. Dulcolax® was used after consulting with the treating physician according to the progression of the colonoscopy preparation.

*Colonoscopy procedure*

Scheduled pediatric colonoscopy procedures were completed during specific sessions with the help of trained pediatric endoscopy technicians. The procedures were performed by two senior pediatric gastroenterologists (E.A., N.R.) using an Olympus pediatric colonoscope (Olympus Corporation, Tokyo, Japan). An Olympus gastroscope (Olympus Corporation, Tokyo, Japan) was used for young infants.

The procedure was performed under conscious sedation. Sedation started with midazolam intravenously (IV) (0.1 mg/kg) over 2-3 minutes and was followed by either ketamine IV (1 mg/kg) in children < 6 years or fentanyl IV (1 µg/kg) in children > 6 years. Further dosing was considered according to the patient's level of comfort and maximum dose of the medications. The procedure was performed in the left lateral position. Position change and abdominal pressure were applied according to the procedure progression. In case a colorectal polyp was found, a snare polypectomy was performed and the polyp tissue was sent for histopathological examination.

*Statistical analysis*

Data were analyzed using IBM® SPSS® Statistics 20.0 software (IBM Co., Armonk, NY, USA). Descriptive data were reported as percentages of the total, and categorical data as means ± standard deviation (SD). Paired t-test, Chi-square test, and Fisher's exact test were used as appropriate to compare categories. A p-value of < 0.05 was considered significant.

**Results**

We identified 119 procedures performed in 105 patients. Thirty-nine (37.1%) patients were female, with a mean age of 98.2 ± 51.2 months (age range: 1 month-18 years). Of the 119 procedures, 112 were colonoscopies and 5 were sigmoidoscopies, whereas, in the remaining 2 cases, the scope did not pass the rectum due to poor preparation (**Tab. 1**).

In the majority of the cases, there was a single procedure (101 [84.9%]) and a single indication (99 [83.2%]) (**Tab. 1**). The most common indication for colonoscopy was lower gastrointestinal bleeding (55 [46.2%]), followed by chronic diarrhea and abdominal pain (17 [14.3%] and 16 [13.4%], respectively) (**Tab. 2**). A normal endoscopy was reported in 50 (42.0%) procedures. The most commonly reported abnormalities were polyps and inflammatory bowel disease, 26 (21.8%) of the procedures for both pathologies. A cecal tumor was noted as an unusual finding in 1 patient (**Tab. 3**).

After excluding sigmoidoscopies, follow-up procedures, and post-gastrointestinal surgeries, a comparison of features between normal and abnormal colonoscopy showed that children with abnormal colonoscopies tended to be younger, although this was not statistically significant. Neither sex nor the number of indications contributed to the yield of the colonoscopy. In our cohort, rectal bleeding

**Table 1.** Colonoscopy patient demographics (n = 119) [a].

| Characteristics | | | n (%) or mean ± SD [95% CI] |
|---|---|---|---|
| **Patients (n = 105)** | **Age, months** | | 98.2 ± 51.2 [89.0-107.4] |
| | **Age distribution** | < 60 mo. | 36 (30.2%) |
| | | 60-120 mo. | 39 (32.8%) |
| | | > 120 mo. | 44 (37.0%) |
| | **Females** | | 39 (37.1%) |
| **Procedures (n = 119)** | **Type of procedure** | Colonoscopy | 112 (94.1%) |
| | | Sigmoidoscopy | 5 (4.2%) |
| | | Poorly prepared (did not proceed beyond the rectum) | 2 (1.7%) |
| | **Number of procedures** | 1 | 101 (84.9%) |
| | | 2 | 5 (4.2%) |
| | | 3 | 1 (0.8%) |
| | | 5 | 1 (0.8%) |
| | **Number of indications** | 1 | 99 (83.2%) |
| | | 2 | 15 (12.6%) |
| | | 3 | 5 (4.2%) |
| | **Rate of terminal ileum intubation (excluding therapeutic polypectomy and sigmoidoscopy) (n = 89)** | | 56 (63%) |

[a] We identified 119 procedures performed in 105 patients.

**Table 2.** Distribution of colonoscopy indications (n = 119)[a].

| Indication | n (%) |
|---|---|
| Lower gastrointestinal bleeding | 55 (46.2%) |
| Chronic diarrhea (bloody and non-bloody) | 17 (14.3%) |
| Abdominal pain | 16 (13.4%) |
| Oral ulcers | 8 (6.7%) |
| Anemia | 7 (5.9%) |
| Follow-up of IBD | 6 (5.0%) |
| Failure to thrive/weight loss | 4 (3.4%) |
| Polyposis | 4 (3.4%) |
| Constipation/encopresis | 3 (2.5%) |
| Allergy | 3 (2.5%) |
| Perianal lesions, itching | 3 (2.5%) |
| Melena | 2 (1.7%) |
| Abnormal radiological findings | 1 (0.8%) |
| Abdominal distention | 1 (0.8%) |
| Foreign body retrieval | 1 (0.8%) |
| Recurrent intussusception | 1 (0.8%) |
| Others | 3 (2.5%) |

[a] Some patients had more than one indication.

**Table 3.** Patient colonoscopy yields (n = 119).

| Yield | n (%) |
|---|---|
| Normal endoscopy | 50 (42.0%) |
| Polyps | 26 (21.8%) |
| Inflammatory bowel disease (first presentation or follow-up) | 26 (21.8%) |
| Focal active colitis | 5 (4.2%) |
| Solitary rectal ulcer syndrome | 3 (2.5%) |
| Hemangiomas | 3 (2.5%) |
| CMPA | 1 (0.8%) |
| Cecal tumor | 1 (0.8%) |
| Others[a] | 6 (5.0%) |

CMPA: cow's milk protein allergy.
[a] Non-conclusive findings due to either poor preparation, Hirschsprung's disease, surgical site abnormality, or mild histopathology changes.

**Table 4.** Comparison between normal and abnormal colonoscopies features (n = 103)[a].

| | | Normal colonos-copy (n = 50) | Abnormal colonos-copy (n = 53) | p-value |
|---|---|---|---|---|
| Age, months | | 102 ± 56.3 [86.9-118.1] | 84.0 ± 46.1 [71.7-96.3] | 0.07 |
| Age distribution | < 60 mo. | 13 (26%) | 23 (43.9%) | 0.064 |
| | 60-120 mo. | 19 (38%) | 19 (35.8%) | 0.818 |
| | > 120 mo. | 20 (40%) | 11 (20.8%) | **0.036** |
| Female | | 20 (40%) | 14 (26.4%) | 0.146 |
| Number of indications | 1 | 41 (82%) | 43 (81%) | 0.896 |
| | 2 | 8 (16%) | 7 (13.2%) | 0.688 |
| | 3 | 1 (2%) | 3 (5.7%) | 0.335 |
| Depth of testing | Rectosig-moid | 50 (100%) | 53 (100%) | - |
| | Colon | 50 (100%) | 49 (92.5%) | **0.044** |
| | Cecum | 44 (88%) | 31 (58.5%) | **0.001** |
| | Terminal ileum | 37 (74%) | 23 (43.4%) | **0.002** |
| Top indications | Lower gastro-intestinal bleeding | 18 (36%) | 34 (64.1%) | **0.005** |
| | Abdominal pain | 10 (20%) | 7 (13.2%) | 0.355 |
| | Chronic diarrhea | 7 (14%) | 9 (17%) | 0.675 |
| | Oral ulcers | 7 (14%) | 3 (5.7%) | 0.159 |
| | Anemia | 3 (6%) | 3 (5.7%) | 0.948 |

Data are presented as n (%) or mean ± SD [95% CI].
[a] Patients with a known diagnosis, patients who underwent gastrointestinal surgeries, or patients with poor preparation were excluded.

**Table 5.** Predictability of positive endoscopy yields according to indication appropriateness (n = 103)[a].

| | Positive endoscopic yield | Negative endoscopic yield |
|---|---|---|
| Appropriate indication | 48 | 34 |
| Inappropriate indication | 5 | 16 |
| Sensitivity | 75% | - |
| Specificity | 32% | - |
| Positive predictive value | 55.8% | - |
| Negative predictive value | 76.2% | - |

[a] Patients with a known diagnosis, patients who underwent gastrointestinal surgeries, or patients with poor preparation were excluded.

was associated with a higher chance of an abnormal colonoscopy (p = 0.005). The other indications were not significantly different between the normal and abnormal yield. Normal colonoscopies went deeper than abnormal endoscopies, which was statistically significant (**Tab. 4**).

Twenty-one (20%) procedures had inappropriate indications according to the Pediatric Gastroenterology Endoscopy Guidelines by the ESGE, ESPGHAN, 2016 [3]. Appropriate indications were associated with a higher rate of abnormal endoscopies. Appropriate indications had a sensitivity of 75% and a negative predictive value of 76.2% (**Tab. 5**).

During this study period, 26 polypectomies were performed in 21 patients. A majority of patients were male (17 [81.0%]), and in the majority of patients the polyps were rectal polyps (15 [71.4%]).

Two patients (9.5%) in our study had multiple polyps; one of them was diagnosed with Juvenile Polyposis Syndrome (JPS). Interestingly, all patients in our study, except for the patient with JPS, presented with rectal bleeding. The patient with JPS presented with anemia, chronic non-bloody diarrhea, and lower limb edema. Colonoscopy was planned to exclude inflammatory bowel disease; surprisingly, multiple, variable sizes polyps involving the whole colon were identified (**Fig. 1**). The patient required multiple sessions of polypectomies, which then resolved his symptoms. The patient had no family history of polyposis, and genetic testing for mutations in the *SMAD4*, *BMPPR1A*, and *PTEN* genes was all negative.

All removed polyps were histologically examined and determined to be juvenile polyps. One procedure was complicated by secondary oozing and required cauterization (**Tab. 6**).
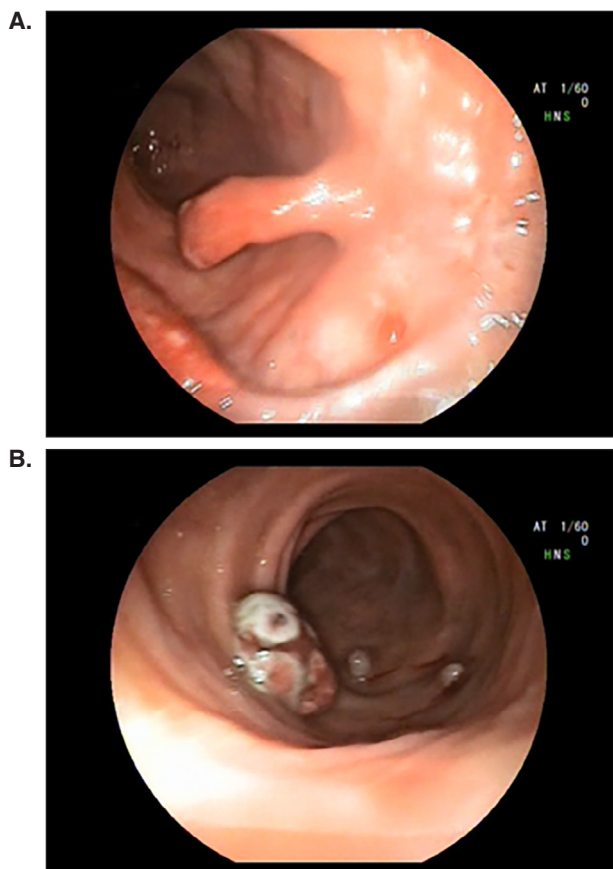
**Table 6.** Polyps' characteristics (n = 26) [a].

| Characteristics | | n (%) or mean ± SD [95% CI] |
|---|---|---|
| Age, months | | 64.5 ± 32.1 [52.161-76.839] |
| Female:male ratio (n = 21) | | 4:17 |
| Type of polyp (n = 21) | Solitary | 19 (90.5%) |
| | Multiple | 2 (9.5%) |
| Site of polyp (n = 21) | Rectum | 15 (71.4%) |
| | Rectosigmoid | 2 (9.5%) |
| | Colonic | 2 (9.5%) |
| | Multiple sites | 2 (9.5%) |
| Pathology (n = 26) | Juvenile polyp | 26 (100%) |
| Presentation (n = 26) | Lower gastrointestinal bleeding | 21 (80.8%) |
| | Diarrhea, anemia and edema | 1 (3.8%) |
| | Scheduled (polyposis) | 4 (15.4) |
| Complications (n = 26) | Secondary oozing (required cauterization) | 1 (3.8%) |

[a] During the study period, 26 polypectomies were performed in 21 patients.



**Figure 1.** Multiple polyps in a child with Juvenile Polyposis Syndrome (JPS) (**A**, right colon; **B**, left colon).

## Discussion

Pediatric colonoscopy provides physicians with diagnostic and therapeutic opportunities. Our report describes the colonoscopy practice in our community and highlights the features of colorectal polyps and predictability of appropriate colonoscopy indication on the diagnostic yield. Our study also showed that complying with the published guidelines improves the diagnostic yield of pediatric colonoscopy. Although the specificity is poor, an appropriate indication carries good sensitivity in predicting abnormal colonoscopies.

Our study found that the most common indications of pediatric colonoscopy were lower gastrointestinal bleeding, diarrhea, and abdominal pain. Previous studies consistently reported lower gastrointestinal bleeding as the most common indication for colonoscopies [5-8]. Wu et al. reported in their study that the highest diagnostic yield was in patients who presented with lower gastrointestinal bleeding [5]. El-Mouzan et al. also found a high diagnostic yield in patients who presented with rectal bleeding [9]. In our cohort, rectal bleeding was associated with a higher chance of an abnormal colonoscopy (p = 0.005). The other

indications were not significantly different between the normal and abnormal yield. The other common indications were diarrhea, abdominal pain, and anemia, which may reflect the peculiar pathologies of each community. The overall diagnostic yield of colonoscopy in our cohort was 52%. This is lower than that previously reported [5, 6, 10, 11] and could be explained by the relatively high rate of inappropriate colonoscopy indications compared to the published guidelines [3].

In our study, the depth of colonoscopy was variable, and normal colonoscopy was associated with deeper procedures, which was statistically significant. An ileal intubation was performed in almost two-thirds of the procedures; however, these numbers are less than the reported cases from Western countries [10]. However, our rates do remain within those reported in a Taiwanese study, in which 54.4% of patients received an ileal intubation [5], and a Chinese report, in which the rate was 81.7% [6], and are also similar to the Malaysian reported rate of 68% [11]. We suspect this is related to both patient and physician causes. All patients in our study received a colonoscopy under sedation. Patients who were easily diagnosable had a shorter examination duration and thereby experienced less discomfort and had a decreased chance for complications. The rate of ileal intubation in normal colonoscopy in our patients reached 74%, which confirmed our theory.

A large majority of patients (98.3%) had sufficient preparation; two patients had poor preparations, which limited the advancement beyond the rectum during the procedure. This was presumably caused by poor adherence to the treatment protocol, specifically not drinking the preparation at home.

Colorectal polyps represent a major cause of painless lower gastrointestinal bleeding in children [12-14]. Most colorectal polyps are solitary, are present in the rectosigmoid area, and are histologically diagnosed as juvenile polyps. Most children with colorectal polyps have no genetic predisposition and carry a low to negligible cancer risk [15, 16]. In a large series of Chinese children, Wei et al. reported that 95% of juvenile polyps were found in the rectosigmoid colon, while the left side and the rest of the colon harbored only 5% of these polyps [16]. Moreover, Haghi Ashtiani et al. reported that 94% of colorectal polyps in Iranian children were solitary and 87% were located in the rectosigmoid area [12]. Our numbers are in agreement with these reports, as 90.5% of our children had solitary polyps and 80.9% were found in the rectum and rectosigmoid area.

There is a discrepancy in the current literature regarding whether a colonoscopy needs to be completed after identifying a polyp in the rectosigmoid area [16]. The reported rate of proximal polyps differs from less than 10% [6] to 32% [17]. Completing the procedure can put patients at risk for further discomfort, over-sedation, and prolong the procedure time, which could increase the chance of colonoscopy complications (i.e., perforation). However, halting the procedure may risk not identifying an additional proximal polyp, which could lead to the persistence of symptoms and possibly repeating the procedure with more associated risks [17].

Multiple polyps and polyposis syndromes represent the minority of colorectal polyps [13, 18]. Wu et al. reported that multiple polyps affected 7.7% of Taiwanese children with polyps [5]. Haghi Ashtiani et al. reported that multiple polyps were present in almost 5% of Iranian polyp patients [12]. Two patients (9.5%) in our study had multiple polyps; one of them was diagnosed with JPS. Polypectomy is a safe procedure, and complications such as perforations and bleeding are rare [13-18]. In our study, 1 patient developed oozing on the second day and required cauterization.

Although we cannot draw strong conclusions from our study, we suspect that the rate of proximal polyps differs between communities. Our small study cohort presented with some peculiarities, such as being predominantly male and having only juvenile histology. Subsequent studies conducted on larger patient cohorts are needed to conclude whether it is safer to perform pan-colonoscopies even if polyps are found in the distal colon.

## Conclusions

Pediatric colonoscopy is an important tool for diagnosis and therapeutic interventions. Our retrospective analysis indicated that the most common colonoscopy indications are rectal bleeding and diarrhea, and the most common yields are colonic inflammation and colorectal polyps. Although most polyps are solitary and colorectal, it is advised to perform a full colonoscopy. Complying with the guideline recommendations will improve the diagnostic yield of colonoscopies.

## Informed consent

## Declaration of interest

## References

1. Victor LF. Colonoscopy. In: Walker WA, Durie PR, Hamilton JR, Walker-Smith JA, Watkins JB (Eds.). Pediatric gastrointestinal disease: pathophysiology, diagnosis, management. 2nd ed. St. Louis (MO): Mosby, 1996, pp. 1533-41.

2. Park JH. Role of colonoscopy in the diagnosis and treatment of pediatric lower gastrointestinal disorders. Korean J Pediatr. 2010;53(9):824-9.

3. Tringali A, Thomson M, Dumonceau JM, Tavares M, Tabbers MM, Furlano R, Spaander M, Hassan C, Tzvinikos C, Ijsselstijn H, Viala J, Dall'Oglio L, Benninga M, Orel R, Vandenplas Y, Keil R, Romano C, Brownstone E, Hlava Š, Gerner P, Dolak W, Landi R, Huber WD, Everett S, Vecsei A, Aabakken L, Amil-Dias J, Zambelli A. Pediatric gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy (ESGE) and European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) Guideline Executive summary. Endoscopy. 2017;49(1):83-91.

4. Gilger MA, Gold BD. Pediatric endoscopy: new information from the PEDS-CORI project. Curr Gastroenterol Rep. 2005;7(3):234-9.

5. Wu CT, Chen CA, Yang YJ. Characteristics and Diagnostic Yield of Pediatric Colonoscopy in Taiwan. Pediatr Neonatol. 2015;56(5):334-8.

6. Lei P, Gu F, Hong L, Sun Y, Li M, Wang H, Zhong B, Chen M, Cui Y, Zhang S. Pediatric colonoscopy in South China: a 12-year experience in a tertiary center. PLoS One. 2014 23;9(4):e95933.

7. Park JH. Pediatric Colonoscopy: The Changing Patterns and Single Institutional Experience Over a Decade. Clin Endosc. 2018;51(2):137-41.

8. El Mouzan MI, Al-Mofleh IA, Abdullah AM, Al Sanie AM, Al-Rashed RS. Colonoscopy in children. Saudi J Gastroenterol. 2005;11(1):35-9.

9. El-Mouzan MI, Abdullah AM. Yield of colonoscopy in children with rectal bleeding. Saudi Med J. 2004;25(8):998-1001.

10. Pasquarella CS, Kaplan B, Mahajan L, Lamparyk K, Kay M. A Single-center Review of Pediatric Colonoscopy Quality Indicators. J Pediatr Gastroenterol Nutr. 2019;68(5):648-54.

11. Lee WS, Tee CW, Koay ZL, Wong TS, Zahraq F, Foo HW, Ong SY, Wong SY, Ng RT. Quality indicators in pediatric colonoscopy in a low-volume center: Implications for training. World J Gastroenterol. 2018;24(9):1013-21.

12. Haghi Ashtiani MT, Monajemzadeh M, Motamed F, Moradi Tabriz H, Mahjoub F, Karamian H, Najafi Sani M, Khatami GR, Khodadad A, Farahmand F, Fallahi GH. Colorectal polyps: a clinical, endoscopic and pathologic study in Iranian children. Med Princ Pract. 2009;18(1):53-6.

13. Lee BG, Shin SH, Lee YA, Wi JH, Lee YJ, Park JH. Juvenile polyp and colonoscopic polypectomy in childhood. Pediatr Gastroenterol Hepatol Nutr. 2012;15(4):250-5.

14. MacFarland SP, Zelley K, Katona BW, Wilkins BJ, Brodeur GM, Mamula P. Gastrointestinal Polyposis in Pediatric Patients. J Pediatr Gastroenterol Nutr. 2019;69(3):273-80.

15. Erdman SH, Barnard JA. Gastrointestinal polyps and polyposis syndromes in children. Curr Opin Pediatr. 2002;14(5):576-82.

16. Wei C, Dayong W, Liqun J, Xiaoman W, Yu W, Xiaohong Q. Colorectal polyps in children: a retrospective study of clinical features and the value of ultrasonography in their diagnosis. J Pediatr Surg. 2012;47(10):1853-8.

17. Gupta SK, Fitzgerald JF, Croffie JM, Chong SK, Pfefferkorn MC, Davis MM, Faught PR. Experience with juvenile polyps in North American children: the need for pancolonoscopy. Am J Gastroenterol. 2001;96(6):1695-7.

18. Kay M, Eng K, Wyllie R. Colonic polyps and polyposis syndromes in pediatric patients. Curr Opin Pediatr. 2015;27(5):634-41.