

# Anatomical Distribution, Histopathological Characteristics, and Dysplasia Patterns of Colonic Polyps: A Retrospective Cross-Sectional Study from Iraq

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## Abstract

**Background:** Colonic polyps are growths that protrude into the colon or rectum's lumen. Sessile polyps emerge straight from the mucosa, while pedunculated polyps are connected by a fibrovascular stalk, according to the macroscopic classification. Due to their potential for malignant transformation and their function as precursors to the majority of colorectal malignancies, neoplastic polyps—particularly adenomas—hold the highest clinical significance. Screening and monitoring are crucial for early detection and prevention, thus aim of this study was to assess the clinical presentation of different colonic polyps, identify the commonest site, and assess the association of the type and site with colon cancer.

**Methodology:** A cross-sectional retrospective study among patients diagnosed with colonic polyps in Duhok City. The histopathological reports of patients who underwent colonoscopy from different hospitals and centers in the city were analyzed. The study focused on the past 5 years' assessment, 2020–2025, and after data cleaning, 701 cases were collected from the archives. SPSS was used for descriptive statistical analysis. Associations were assessed using the Chi-square test and Fisher's Exact test where appropriate. A  $P < 0.05$  was regarded as statistically significant.

**Results:** Tubular adenoma was the commonest type of pre-neoplastic polyp (83.6%), and hyperplastic polyps were the most common non-pre-neoplastic lesions (47%). The clinical presentation of the polyp, whether male vs. female or presence or absence of symptoms of diarrhea and bleeding per rectum, could not indicate the correlation with the degree of dysplasia ( $P > 0.05$ ). The location of polyps was significantly associated with the age at the time of diagnosis,  $P < 0.001$ ; patients <18 years (44.4%) and those aged 18–44 years (36.0%) were more likely to have polyps in the anorectal region, while those aged 45–62 years (42.3%) and those older than 62 years (47.4%) were more likely to have their polyps scattered.

**Conclusion:** Tubular adenoma of the pre-neoplastic polyps and the hyperplastic polyps of non-pre-neoplastic nature accounted for the most common. Patients <45 years are more likely to have polyps distal to the transverse colon (~60.0%) and more likely to be non-Pre-neoplastic compared with proximal counterparts, which are >50% Pre-neoplastic.

**Keywords:** Colonic polyps, dysplasia, location of colonic polyps, neoplasia

## Introduction

The term “polyp” refers to an abnormal tissue growth protruding from a hollow viscus organ, such as the gastrointestinal, respiratory, and genitourinary tracts. Colonic polyps are protrusions of mucosal tissue from the lumen of the colon.<sup>1</sup> The disease is a significant health concern because polyps can be precursors to cancer, although progression to cancer is usually slow, often requiring a decade. Yet approximately 95% of colorectal cancers arise from polyps.<sup>2–4</sup> Several key risk factors have been identified as associated with colonic polyps, including non-modifiable factors such as advancing age, male gender, positive family history, and genetic predisposition, while modifiable factors include low-fiber diet, high-fat intake, smoking, and alcohol use.<sup>5</sup> Additionally, several other diseases are associated with colonic polyps, including inflammatory bowel disease (ulcerative colitis and Crohn's disease), familial adenomatous polyposis, Peutz–Jeghers syndrome, and Lynch syndrome.<sup>6–8</sup> Therefore, polyps are categorized using several classifications. Most importantly, they are divided by macroscopic examination, based on shape, into either sessile or pedunculated.<sup>9,10</sup>

Histologically, they are either adenomatous polyps, serrated polyps, or non-neoplastic polyps.<sup>1</sup> Adenomatous polyps are subdivided into tubular polyps, which account for >80%; villous polyps, 5–15%; and tubulovillous polyps, 5–15% of adenomatous polyps, while the serrated polyps are either sessile or traditional polyps.<sup>9,11</sup>

Clinically, the majority of the patients are asymptomatic. Among the symptomatic patients, the commonest symptom is rectal bleeding as the commonest presentation in symptomatic individuals; other symptoms include bowel motion changes in the form of constipation and diarrhea, decreased stool caliber, and possibly weight loss in malignant cases.<sup>12</sup> Once the case is suspected to have colonic polyps, the gold standard diagnostic method is via colonoscopy.<sup>13</sup> Additional imaging modalities can be used with aid, which include contrast-enhanced computed tomography (CT) colonography.<sup>14</sup> Once diagnosed, the biopsy is sent for histopathological assessment of the polyp to determine the type and dysplasia, as dysplasia serves as the key marker for cancer detection and follow-up of the polyp.<sup>15,16</sup> Thus, the aim of this study was to assess the clinical presentation of different colonic polyps, identify the commonest site, and assess the association of the type and site with colon cancer.

## Methods

### Study Design and Setting

This retrospective cross-sectional study was conducted in Duhok City, Kurdistan Region, Iraq. The study analyzed histopathological reports of patients diagnosed with colonic polyps following colonoscopy. Records were collected from the pathology laboratory units of several hospitals and diagnostic centers within the city. The study covered a five-year period from January 2020 to January 2025. After cleaning the data and verifying the information, a total of 701 cases were included in the study. The reporting of the study in the article adheres to the guidelines for observational studies as per the STROBE statement.<sup>17</sup>

### Study Population

The population for the study was defined as patients who underwent a colonoscopy procedure with biopsy and histopathological verification of colonic polyps. The data were retrieved from the histopathological archives of the participating laboratories. The research approach for the study was designed according to the Population-Exposure-Comparison-Outcome (PICO) model, as shown in Table 1.

### Variable Definitions

Colonic polyps were classified according to histopathological findings into pre-neoplastic polyps (including tubular adenoma, tubulovillous adenoma, villous adenoma, serrated polyps, and familial adenomatous polyposis-associated lesions) and non-pre-neoplastic polyps (including hyperplastic, inflammatory, juvenile, fibroepithelial, hamartomatous, and other benign polyps). Dysplasia was classified as none, low-grade dysplasia, high-grade dysplasia, and malignant transformation according to histopathological grading. The anatomical location of the polyps was classified as the cecum/ileocecal region, ascending colon, transverse colon, descending colon, sigmoid colon, rectosigmoid region, anorectal region, or scattered locations involving multiple segments according to the colonoscopy report.

Dysplasia was classified as no dysplasia, low-grade dysplasia, high-grade dysplasia, and malignant transformation according to the World Health Organization (WHO) histopathological classification criteria for colorectal epithelial neoplasia as documented in the pathology reports.<sup>18</sup>

### Inclusion and Exclusion Criteria

Patients were considered eligible if they had a confirmed histopathological diagnosis of colorectal polyps, and data were available on the key variables of the study. These variables were patient age, gender, the anatomical location of the polyp, the size of the polyp being  $\leq 5$  mm or  $> 5$  mm, the type of polyp, and the histopathological grade, including the degree of dysplasia. Patients were excluded if the histopathological record showed incomplete data and the biopsy specimen represented colorectal masses not diagnosed as polyps.

### Data Collection

Relevant demographic, clinical, and histopathological data were extracted from pathology records and referral documentation. Variables collected included patient age, gender, clinical presentation (such as abdominal pain, diarrhea, and rectal bleeding), number of polyps detected during colonoscopy, anatomical location of the polyp within the colon, histopathological classification of the polyp, and the degree of dysplasia.

### Ethical Considerations

Ethical approval for this retrospective study was granted by the Research Ethics Committee of the Duhok Directorate General of Health and the University of Duhok College of Medicine (IRB Number: 14012026-1-6) on 14 January 2026. The study involved a retrospective review of archived histopathological and colonoscopy records from the period January 2020 to January 2025. No patients were contacted, recruited, or directly involved during the study process, and no intervention affected patient management. All extracted data were anonymized during data collection, and patient confidentiality was strictly maintained throughout the study.

### Statistical Analysis

For the analysis of the data, the statistical tool used was SPSS version 26 software. Descriptive statistics were carried out on the data and were represented as frequencies and percentages. Associations were determined by the chi-square test, and a *P*-value of less than 0.05 was considered statistically significant. Chi-square test and Fisher exact test were used when necessary to assess the correlation. The data of both tests were placed in the correlation tables accordingly.

Table 1. PICO framework of the study

| Component                   | Description                                                                                                                                                             |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Population (P)              | Patients diagnosed with histopathologically confirmed colonic polyps who underwent colonoscopy in Duhok City between January 2020 and January 2025.                     |
| Exposure / Intervention (I) | Polyp characteristics, including anatomical location, number of polyps, and histopathological type (pre-neoplastic vs. non-pre-neoplastic).                             |
| Comparison (C)              | Comparison between different polyp characteristics (e.g., proximal vs. distal location, solitary vs. multiple polyps, and pre-neoplastic vs. non-pre-neoplastic types). |
| Outcome (O)                 | Presence and degree of dysplasia identified on histopathological examination (no dysplasia, low-grade dysplasia, high-grade dysplasia, or malignant transformation).    |

## Results

### ***Sociodemographic and Clinical Characteristics of the Study Population***

The sociodemographic and clinical characteristics of the participants are presented in Table 2. The largest proportion of patients were aged 45–62 years (39.1%). Male patients were more frequent than females (58.6% vs. 41.4%). Regarding clinical presentation, abdominal pain (21.7%), rectal bleeding (19.0%), and diarrhea (6.1%) were the main reported symptoms. Colonoscopic findings showed that solitary polyps were the most common (64.5%). Histopathological assessment revealed that 89.2% of cases had no dysplasia, while low-grade

dysplasia was observed in 8.8%, high-grade dysplasia in 1.6%, and malignant transformation in 0.4%. Polyps were most frequently observed in multiple scattered locations (39.5%).

### ***Histopathological Types of Colonic Polyps***

Colonic polyps were classified into non-pre-neoplastic and pre-neoplastic types, as illustrated in Figures 1 and 2. Among the non-pre-neoplastic polyps, hyperplastic polyps were the most common (47%), followed by inflammatory polyps (30%), together accounting for 77% of all non-pre-neoplastic lesions. Other types were less frequent. Among the pre-neoplastic polyps, tubular adenoma was the predominant type (83.6%),

Table 2. **Sociodemographic characteristic of the sample**

| Character                         |                           | No  | Percentage (%) |
|-----------------------------------|---------------------------|-----|----------------|
| <b>Age</b>                        | <18                       | 9   | 1.3            |
|                                   | 18–44                     | 222 | 31.7           |
|                                   | 45–62                     | 274 | 39.1           |
|                                   | >62                       | 196 | 28.0           |
| <b>Gender</b>                     | Female                    | 290 | 41.4           |
|                                   | Male                      | 411 | 58.6           |
| <b>Clinical features</b>          |                           |     |                |
| <b>Abdominal pain</b>             | No                        | 549 | 78.3           |
|                                   | Yes                       | 152 | 21.7           |
| <b>Diarrhea</b>                   | No                        | 658 | 93.9           |
|                                   | Yes                       | 43  | 6.1            |
| <b>Bleeding per rectum</b>        | No                        | 568 | 81.0           |
|                                   | Yes                       | 133 | 19.0           |
| <b>Colonoscopy histopathology</b> |                           |     |                |
| <b>Number of polyps</b>           | Solitary                  | 452 | 64.5           |
|                                   | 2–10                      | 150 | 21.4           |
|                                   | 11–99                     | 95  | 13.6           |
|                                   | >100                      | 4   | 0.6            |
| <b>Degree of dysplasia</b>        | No dysplasia              | 625 | 89.2           |
|                                   | low grade                 | 62  | 8.8            |
|                                   | high-grade dysplasia      | 11  | 1.6            |
|                                   | Malignant transformation  | 3   | 0.4            |
| <b>Site of the polyp</b>          | Caecum and ileocecal ring | 17  | 2.4            |
|                                   | Ascending colon           | 35  | 5.0            |
|                                   | Transverse colon          | 16  | 2.3            |
|                                   | Descending Colon          | 23  | 3.3            |
|                                   | Sigmoid                   | 149 | 21.3           |
|                                   | Rectosigmoid area         | 10  | 1.4            |
|                                   | Anorectal region          | 172 | 24.5           |
|                                   | Site of anastomosis       | 2   | 0.3            |
|                                   | Scattered / Colon         | 277 | 39.5           |
|                                   | <b>Total</b>              | 701 | 100.0          |

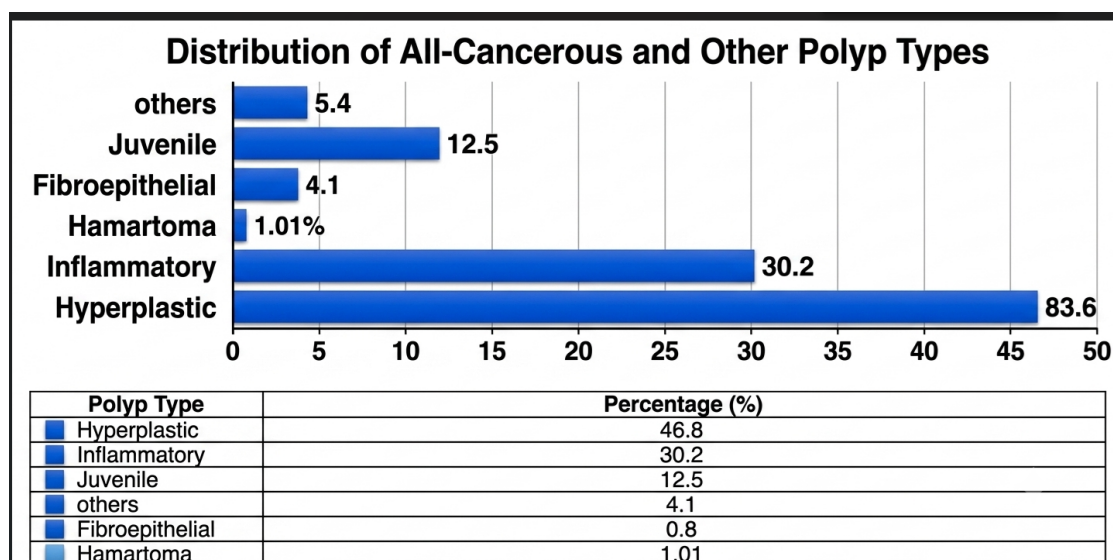


Fig. 1 The prevalence of different types of non-pre-neoplastic polyps.

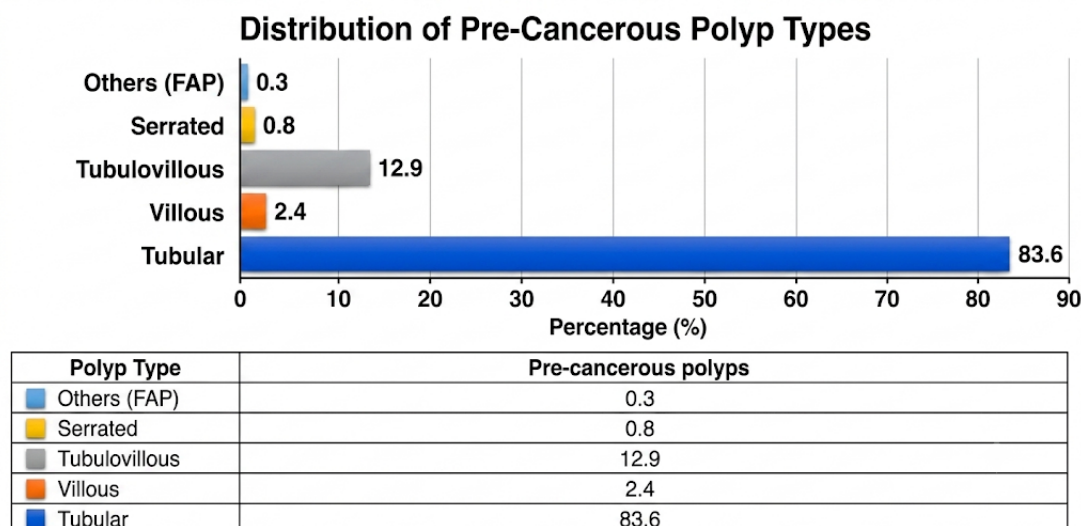


Fig 2. The prevalence of different pre-neoplastic polyps.

followed by tubulovillous adenoma (12.9%), villous adenoma (2.4%), and serrated polyps (0.8%). In addition, familial adenomatous polyposis (FAP)-related lesions accounted for 0.3% of pre-neoplastic polyps.

### Association Between Dysplasia and Clinical Characteristics

Chi-square analysis and Fisher Exact test were performed to evaluate the association between patient characteristics and the degree of dysplasia. No significant association was observed between gender and dysplasia ( $P = 0.082$ ), although females showed slightly higher proportions of high-grade dysplasia (2.8% vs 0.7%) and malignant transformation (0.7% vs 0.2%) compared with males. Similarly, age was not significantly associated with dysplasia ( $P = 0.583$ ).

In contrast, the number of polyps demonstrated a significant association with dysplasia ( $P = 0.027$ ) which may

represent a useful indicator of increased dysplastic potential. Low-grade dysplasia was most frequently observed in solitary polyps (9.5%), compared with 2–10 polyps (8.0%), 11–99 polyps (7.4%), and >100 polyps (0.0%). High-grade dysplasia was more frequent in patients with >100 polyps (25.0%) compared with other groups. Additionally, the frequency of malignant transformation increased with the number of polyps, rising from 0.2% in solitary polyps to 0.7% in patients with 2–10 polyps and 1.1% in those with 11–99 polyps.

No significant associations were identified between dysplasia and the presence of rectal bleeding ( $P = 0.091$ ) or diarrhea ( $P = 0.134$ ). Detailed distributions are presented in Table 3.

### Association Between Polyp Type and Dysplasia

The relationship between the histopathological type of polyps and the presence of dysplasia was assessed (Table 4).

Table 3. Correlation of degree of dysplasia to other factors

| Character           |              | Degree of dysplasia |           |                      |                          |        | P-value |
|---------------------|--------------|---------------------|-----------|----------------------|--------------------------|--------|---------|
|                     |              | No                  | Low grade | High-grade dysplasia | Malignant transformation | Total  |         |
| Gender              | Female       | 259                 | 21        | 8                    | 2                        | 290    | 0.082   |
|                     |              | 89.3%               | 7.2%      | 2.8%                 | 0.7%                     | 100.0% |         |
|                     | Male         | 366                 | 41        | 3                    | 1                        | 411    |         |
|                     |              | 89.1%               | 10.0%     | 0.7%                 | 0.2%                     | 100.0% |         |
| Age                 | <18          | 7                   | 2         | 0                    | 0                        | 9      | 0.583   |
|                     |              | 77.8%               | 22.2%     | 0.0%                 | 0.0%                     | 100.0% |         |
|                     | 18–44        | 200                 | 18        | 4                    | 0                        | 222    |         |
|                     |              | 90.1%               | 8.1%      | 1.8%                 | 0.0%                     | 100.0% |         |
|                     | 45–62        | 247                 | 24        | 2                    | 1                        | 274    |         |
|                     |              | 90.1%               | 8.8%      | 0.7%                 | 0.4%                     | 100.0% |         |
|                     | >62          | 171                 | 18        | 5                    | 2                        | 196    |         |
|                     |              | 87.2%               | 9.2%      | 2.6%                 | 1.0%                     | 100.0% |         |
| Number of Polyps    | Solitary     | 403                 | 43        | 5                    | 1                        | 452    | 0.027   |
|                     |              | 89.2%               | 9.5%      | 1.1%                 | 0.2%                     | 100.0% |         |
|                     | 2–10 Polyps  | 135                 | 12        | 2                    | 1                        | 150    |         |
|                     |              | 90.0%               | 8.0%      | 1.3%                 | 0.7%                     | 100.0% |         |
|                     | 11–99 polyps | 84                  | 7         | 3                    | 1                        | 95     |         |
|                     |              | 88.4%               | 7.4%      | 3.2%                 | 1.1%                     | 100.0% |         |
|                     | >100         | 3                   | 0         | 1                    | 0                        | 4      |         |
|                     |              | 75.0%               | 0.0%      | 25.0%                | 0.0%                     | 100.0% |         |
| Bleeding per rectum | No           | 511                 | 48        | 6                    | 3                        | 568    | 0.091   |
|                     |              | 90.0%               | 8.5%      | 1.1%                 | 0.5%                     | 100.0% |         |
|                     | Yes          | 114                 | 14        | 5                    | 0                        | 133    |         |
|                     |              | 85.7%               | 10.5%     | 3.8%                 | 0.0%                     | 100.0% |         |
| Diarrhea            | No           | 582                 | 62        | 11                   | 3                        | 658    | 0.134   |
|                     |              | 88.4%               | 9.4%      | 1.7%                 | 0.5%                     | 100.0% |         |
|                     | Yes          | 43                  | 0         | 0                    | 0                        | 43     |         |
|                     |              | 100.0%              | 0.0%      | 0.0%                 | 0.0%                     | 100.0% |         |
| Total               |              | 625                 | 62        | 11                   | 3                        | 701    |         |
|                     |              | 89.2%               | 8.8%      | 1.6%                 | 0.4%                     | 100.0% |         |

Table 4. Correlation of dysplasia to the state of polyps

|                 |                           | No dysplasia | Dysplasia | Total  |
|-----------------|---------------------------|--------------|-----------|--------|
| State of polyps | Non-pre-neoplastic polyps | 283          | 12        | 295    |
|                 |                           | 95.9%        | 4.1%      | 100.0% |
|                 | Pre-neoplastic            | 315          | 63        | 378    |
|                 |                           | 83.3%        | 16.7%     | 100.0% |
|                 | Mixed                     | 27           | 1         | 28     |
|                 |                           | 96.4%        | 3.6%      | 100.0% |

P value &lt; 0.001.

Pre-neoplastic polyps, including tubular and villous adenomas, were significantly more likely to exhibit dysplasia compared with non-pre-neoplastic and mixed polyps ( $P < 0.001$ ). Dysplasia was observed in 16.7% of pre-neoplastic polyps, compared with 4.1% of non-pre-neoplastic polyps and 3.6% of mixed-type polyps. So, pre-neoplastic histology suggesting its value as a marker of neoplastic progression.

### Association Between Age and Anatomical Location of Colonic Polyps

The association between age and the anatomical location of colonic polyps was evaluated using the chi-square test and fisher exact test. A statistically significant relationship was observed ( $P < 0.001$ ). In general, patients <18 years, and 18–44 years were more frequently located in the anorectal region, whereas in older age groups 45–62 years and >62 years, polyps were more commonly found in multiple scattered locations within the colon. Detailed distributions of polyp locations across different age groups are presented in Table 5.

Furthermore, polyps in the anorectal area, descending colon, and site of anastomosis are mostly non-pre-neoplastic polyps, 61.0%, 60.9%, and 100.0%, respectively. While polyps in the ascending colon, cecum, ileocecal ring, scattered, sigmoid, and transverse colon are mostly pre-neoplastic (51.4%, 52.9%, 70.0%, 59.2%, 64.4%, and 62.5%, respectively). The association was found significant at  $P < 0.001$ , as seen in Table 6.

### Discussion

The most prevalent pre-neoplastic polyps in the current study were tubular adenoma polyps, while the most prevalent non-pre-neoplastic polyps were hyperplastic polyps. The most frequent observations were solitary polyps with a dispersed distribution, and most polyps lacked dysplasia. Age, gender, rectal bleeding, and diarrhea were shown to be unrelated to the existence of polyps; however, dysplasia was found to be substantially connected with the quantity and kind of polyps. Additionally, it was noted that polyp location differed considerably by age group, with the majority of polyps in the younger population being anorectal and in the older population being dispersed throughout the colon.

Among the presenting symptoms for cases undergoing colonoscopy in this study, abdominal pain, diarrhea, and rectal bleeding were assessed. All of which were non-significantly correlated to polyp dysplasia and possible malignancy. Although patients undergoing colonoscopies frequently experience these symptoms,<sup>19</sup> several studies demonstrated no correlation with these presenting symptoms and the prediction of colonic polyps or colon cancer.<sup>20–22</sup>

The study assessed the association between the number of polyps detected during colonoscopy and the degree of dysplasia. An increase in the number of polyps was associated with a higher likelihood of higher grades of dysplasia. Similarly, in another Romanian study on colonoscopy, patients with more than one polyp had 2.5 times higher risk of dysplasia compared to those with solitary polyps. Additionally,

Table 5. Assessment of the relation of age to the site of colonic polyps

|                                  |                       | <18    | 18–44  | 45–62  | >62    | Total  |
|----------------------------------|-----------------------|--------|--------|--------|--------|--------|
| <b>Anorectal area</b>            | Count                 | 4      | 80     | 55     | 33     | 172    |
|                                  | % within age in years | 44.4%  | 36.0%  | 20.1%  | 16.8%  | 24.5%  |
| <b>Ascending colon</b>           | Count                 | 1      | 2      | 15     | 17     | 35     |
|                                  | % within age in years | 11.1%  | 0.9%   | 5.5%   | 8.7%   | 5.0%   |
| <b>Caecum and ileocecal ring</b> | Count                 | 0      | 5      | 9      | 3      | 17     |
|                                  | % within age in years | 0.0%   | 2.3%   | 3.3%   | 1.5%   | 2.4%   |
| <b>Descending colon</b>          | Count                 | 0      | 8      | 11     | 4      | 23     |
|                                  | % within age in years | 0.0%   | 3.6%   | 4.0%   | 2.0%   | 3.3%   |
| <b>Rectosigmoid area</b>         | Count                 | 1      | 4      | 2      | 3      | 10     |
|                                  | % within age in years | 11.1%  | 1.8%   | 0.7%   | 1.5%   | 1.4%   |
| <b>Scattered</b>                 | Count                 | 3      | 65     | 116    | 93     | 277    |
|                                  | % within age in years | 33.3%  | 29.3%  | 42.3%  | 47.4%  | 39.5%  |
| <b>Sigmoid</b>                   | Count                 | 0      | 50     | 60     | 39     | 149    |
|                                  | % within age in years | 0.0%   | 22.5%  | 21.9%  | 19.9%  | 21.3%  |
| <b>Site of anastomosis</b>       | Count                 | 0      | 1      | 0      | 1      | 2      |
|                                  | % within age in years | 0.0%   | 0.5%   | 0.0%   | 0.5%   | 0.3%   |
| <b>Transverse colon</b>          | Count                 | 0      | 7      | 6      | 3      | 16     |
|                                  | % within age in years | 0.0%   | 3.2%   | 2.2%   | 1.5%   | 2.3%   |
| <b>Total</b>                     | Count                 | 9      | 222    | 274    | 196    | 701    |
|                                  | % within age in years | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

$P < 0.001$ .

Table 6. The relation of types of polyps to the site of colonic polyps

|                                  |                                | Mixed | Non-pre-neoplastic polyps | Pre-neoplastic | Total  |
|----------------------------------|--------------------------------|-------|---------------------------|----------------|--------|
| <b>Anorectal area</b>            | Count                          | 2     | 105                       | 65             | 172    |
|                                  | % within the site of the polyp | 1.2%  | 61.0%                     | 37.8%          | 100.0% |
| <b>Ascending colon</b>           | Count                          | 1     | 16                        | 18             | 35     |
|                                  | % within the site of the polyp | 2.9%  | 45.7%                     | 51.4%          | 100.0% |
| <b>Caecum and ileocecal ring</b> | Count                          | 0     | 8                         | 9              | 17     |
|                                  | % within the site of the polyp | 0.0%  | 47.1%                     | 52.9%          | 100.0% |
| <b>Descending colon</b>          | Count                          | 0     | 14                        | 9              | 23     |
|                                  | % within the site of the polyp | 0.0%  | 60.9%                     | 39.1%          | 100.0% |
| <b>Rectosigmoid area</b>         | Count                          | 0     | 3                         | 7              | 10     |
|                                  | % within the site of the polyp | 0.0%  | 30.0%                     | 70.0%          | 100.0% |
| <b>Scattered</b>                 | Count                          | 23    | 90                        | 164            | 277    |
|                                  | % within the site of the polyp | 8.3%  | 32.5%                     | 59.2%          | 100.0% |
| <b>Sigmoid</b>                   | Count                          | 2     | 51                        | 96             | 149    |
|                                  | % within the site of the polyp | 1.3%  | 34.2%                     | 64.4%          | 100.0% |
| <b>Site of anastomosis</b>       | Count                          | 0     | 2                         | 0              | 2      |
|                                  | % within the site of the polyp | 0.0%  | 100.0%                    | 0.0%           | 100.0% |
| <b>Transverse colon</b>          | Count                          | 0     | 6                         | 10             | 16     |
|                                  | % within the site of the polyp | 0.0%  | 37.5%                     | 62.5%          | 100.0% |
| <b>Total</b>                     | Count                          | 28    | 295                       | 378            | 701    |
|                                  | % within the site of the polyp | 4.0%  | 42.1%                     | 53.9%          | 100.0% |

Hu et al. from China found similar results.<sup>23</sup> Thus, the more polyps, the greater the risk of dysplastic changes. This could be due to several factors, which include: a field defect (field cancerization), as patients with a high number of pre-neoplastic polyps are likely to have. The entire lining of the colon may be affected by the same metabolic, genetic, and lifestyle-related conditions, essentially creating a “field defect.” This means the surrounding healthy-appearing tissue is already primed to develop abnormalities. Another factor is a genetic probability: each individual polyp represents a localized growth of mutated cells. The more abnormal growths present, the higher the statistical probability that at least one of these cell populations will undergo further harmful genetic mutations (such as changes in the APC or p53 genes).

Furthermore, patients with mixed polyps (pre-neoplastic and non-pre-neoplastic) were less likely to show dysplasia than patients with only pre-neoplastic or only non-pre-neoplastic polyps. The findings suggest that polyp burden may serve as an indicator of dysplastic potential. Patients presenting with multiple polyps had a higher frequency of advanced dysplasia than those with solitary lesions. Likewise, pre-neoplastic histological subtypes were more frequently associated with dysplasia, supporting their role as clinically relevant markers for risk stratification during colonoscopic surveillance. Because of the cross-sectional design, these observations should be interpreted as associations rather than evidence of causality.

As regards the location of polyps, 39.5% of them were seen scattered at different locations. The commonest location for polyps for ages below 18 years and for adults between 18–44 years of age was in the anorectal region, 44.4% and

36.0%, respectively. While in middle age (45–62 years of age) and elderly (above 62 years), they are more likely scattered, at 42.3% and 47.4%, respectively. In large cohorts for patients under the age of 50, the commonest location was seen as the distal colorectum (sigmoid/rectum),<sup>24–26</sup> while in older age groups, the polyps were more likely proximal.<sup>27,28</sup> Similarly, in this study, the site distal to the transverse colon accounts for 55.5% and 63.9% of the polyps in both young groups, respectively. Since distal adenoma increases the risk of synchronous and future proximal advanced neoplasia,<sup>29,30</sup> the presence of polyps, especially adenomas, on sigmoidoscopy should trigger a full colonoscopy protocol.

The location of polyps indicated the possibility of neoplastic predisposition. Polyps from the transverse and proximal colon were more likely to be pre-neoplastic in nature at a frequency of 51.4%–70.0%, while those from the distal colon were more likely to be non-pre-neoplastic (60.9%–61.0%). In the present study, a higher proportion of pre-neoplastic lesions was observed in proximal colonic segments. However, the underlying mechanisms responsible for these differences were not investigated and cannot be determined from the current data. On the other hand, lesions observed within the distal and anorectal regions were more likely to be non-pre-neoplastic. The age-dependent accumulation of genetic and epigenetic mutations may explain the occurrence of numerous and proximal lesions in the older population group. The results obtained in the current study are mostly similar to those in Iraqis as well as other Middle Eastern groups regarding the distribution of colonic polyps in terms of anatomy. An investigation in Iraq by Karbala showed that the rectum (44.9%)

and sigmoid colon (25.1%) were the most frequently involved segments.<sup>31</sup> Moreover, another study conducted among Saudis by Almadi et al. showed that more adenomas were detected in the left colon and rectum, while proximal and multi-segmented adenomas become more prevalent with aging.<sup>32</sup> The aforementioned tendencies are quite similar to the findings of this study, which showed that anorectal and sigmoid sites were more common in younger people but less common in elderly patients who had more proximal and dispersed lesions.

## Clinical Implications

The implications of the study's findings can be considered in terms of their practical value to the process of risk stratification during colonoscopy and histopathological follow-up. While symptoms such as abdominal pain, diarrhea, and rectal bleeding were not significantly associated with dysplasia or polyp burden and distribution, the latter aspects showed greater clinical relevance. For example, the presence of pre-neoplastic polyps or the presence of multiple polyps showed a greater likelihood of showing dysplastic change. There is also a noted tendency among younger patients to present with distal or anorectal polyps more frequently compared with older patients, whose polyp distribution is more scattered.

## Limitations

The study was retrospective in design and based on archived histopathological and colonoscopy records, which may have introduced selection and information bias related to incomplete clinical documentation and variability in reporting practices. Secondly, the study was conducted using data from centers within a single geographic region, which may limit the generalizability of the findings to other populations and healthcare settings. In addition, the cohort may have included both symptomatic patients and individuals undergoing screening colonoscopy. However, the available records did not consistently permit accurate stratification according to the indication for colonoscopy, which may have influenced the observed prevalence, anatomical distribution, and dysplastic characteristics of the polyps. Furthermore, the study design does not allow assessment of temporal progression from benign to dysplastic or malignant lesions because longitudinal follow-up data were unavailable. Another limitation is that molecular and genetic characterization of the polyps was not available. Lastly, although the overall number of cases was relatively large, some subgroups, particularly those with malignant transformation or extensive polyposis, remained limited in size.

## Conclusion

Tubular adenoma was the predominant pre-neoplastic polyp, whereas hyperplastic polyps were the most common

non-pre-neoplastic lesions. Multiple polyps and pre-neoplastic histology were associated with dysplasia and may assist in risk stratification during colonoscopic surveillance. Older age was associated with a more proximal and scattered distribution of polyps. These findings support the incorporation of polyp burden and histopathological subtype into risk stratification and surveillance strategies following colonoscopy.

## Declarations

### *Ethics Approval and Consent to Participate*

Ethical approval for the study was granted by the Research Ethics Committee of the Duhok Directorate General of Health and the University of Duhok College of Medicine (IRB Number: 14012026-1-6). The study was approved on the 14th of January 2026. All the procedures performed in the study were in accordance with the ethical standards of the institutional review committee. The necessary permissions were granted by the authorities. Patient confidentiality is maintained in the study. The data collected were anonymized.

### *Consent for Publication*

Not applicable. The manuscript does not contain any individual person's data in any form (including individual details, images, or videos).

### *Availability of Data and Materials*

The datasets are available from the corresponding author upon reasonable request.

### *Competing Interests*

The authors declare no competing interests.

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### *Authors' Contributions*

Z.M.S. conceptualized the study, collected the data, and drafted the initial manuscript. A.A.M. supervised the study design and critically revised the manuscript for important intellectual content. A.M.A. contributed to the histopathological evaluation and interpretation of pathological findings. Y.H.A. assisted in data analysis and manuscript preparation. All authors reviewed and approved the final version of the manuscript.

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