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Original article

Microscopic Analysis of Gastrointestinal Tumors: A Retrospective Study from Misurata Medical Center, Libya

Khadija Slik*[1], Wesam Elsaghayer[2,3], Abdalhalim Suaiee[4]

[1]*Department of Surgery, Medical School of Sciences, Libyan Academy for Postgraduate Study, Tripoli, Libya*
[2]*Department of Pathology, Faculty of Medicine, Misurata University, Misurata, Libya*
[3]*Department of Pathology, Misurata Medical Center, Misurata, Libya*
[4]*Department of Statistics, Faculty of Science, Zawia University, Zawia, Libya*
Corresponding Email. *khadojmsli@gmail.com*

Abstract
Microscopic diagnosis of gastrointestinal biopsies remains a challenge in surgical pathology, involving both neoplastic and non-neoplastic changes. This study aims to analyze the prevalence, histopathological features, and grading of gastrointestinal (GIT) tumors in biopsies collected over 12.5 years at Misurata Medical Center, Libya, while assessing demographic patterns and the correlation of Helicobacter pylori infection with gastric malignancies. A total of 753 GIT biopsies were retrospectively analyzed from 1995 to 2007. Clinical data, including age, sex, and microscopic diagnoses, were documented. Biopsies underwent histopathological evaluation using the World Health Organization (WHO) classification. Statistical analyses were performed using SPSS software to explore relationships between neoplastic lesions and demographic factors. Non-neoplastic diseases accounted for 559 cases, which constitute 74.24% of the total cases, while neoplastic lesions were identified in 194 cases (25.76%). with a statistically significant predominance of malignant tumors (68.6%) over benign ones (31.4%, $p<0.001$). A slight male predominance was observed in overall biopsies (52.2%), with the 61-70 age group showing the highest frequency (17.4%). Well-differentiated tumors were more common, correlating with better prognoses. The TNM staging analysis revealed a concerning trend toward late-stage diagnoses, particularly in stomach and colorectal cancers. The investigation into Helicobacter pylori positivity indicated a complex relationship with gastric malignancies, warranting further research. The findings reflect a high burden of GIT malignancies during the study period, with late-stage diagnosis and limited diagnostic resources. These results underscore the need for improved screening programs, early detection efforts, and enhanced diagnostic infrastructure in Libya. The study underscores the importance of understanding the multifactorial influences of Helicobacter pylori in gastric cancer development.
Keywords: Gastrointestinal Tumors, Adenocarcinomas, Histopathology, Helicobacter Pylori.

Introduction

The microscopic evaluation of endoscopic and resectional gastrointestinal (GIT) biopsies poses a significant challenge in routine surgical pathology diagnostics. The main part of the materials consists of non-neoplastic changes, but the tumors constitute a substantial number of cases requiring accurate diagnosis. Furthermore, the management of GIT tumors is particularly complex due to their heterogeneous histopathological patterns and varied clinical outcomes. The benign epithelial tumors are tubular or villous adenomas of the stomach and intestine, and papilloma arise from the squamous epithelium [1]. The stomach and colorectal areas are the most often affected areas of the GIT, with adenocarcinoma being the most prevalent malignant neoplasm. In contrast, squamous cell carcinoma primarily arises in the upper gastrointestinal tract (GIT) and occasionally might be found in the stomach [2, 3]. Gastrointestinal cancers are among the most frequently diagnosed and deadliest malignancies worldwide, contributing to over one-fifth of all cancer cases [4]. In 2022, an estimated 20 million new cancer cases and 9.7 million cancer-related deaths occurred worldwide.

Gastrointestinal malignancies constituted a significant percentage of these cases, with colorectal cancer accounting for 9.6%, stomach cancer for 4.9%, and esophagus cancer 2.6% of all diagnoses, while leading causes of cancer-related mortality included colorectal cancer (9.3%), stomach cancer (6.8%), and esophagus cancer (4.6%). These statistics highlight the global burden of cancer, underscoring the need for comprehensive prevention, early detection, and effective therapeutic strategies [5]. The WHO classification system provides a standardized framework for categorizing these lesions, facilitating consistent research and clinical management. Gastrointestinal stromal tumors (GISTs) are mesenchymal neoplasms of the gastrointestinal tract, accounting for approximately 1 to 2% of all gastrointestinal neoplasms, with the potential for malignancy [6, 7]. Lymphomas originating from mucosa-associated lymphoid tissue (MALT), account for approximately 10% to 15% of all non-Hodgkin lymphomas. These lymphomas are predominantly of B-cell origin, with diffuse large B-cell lymphoma being the most common subtype across all anatomical sites [8].

The development of GIT tumors is influenced by complex interactions among environmental exposures, genetic predisposition, and lifestyle factors. Studies indicate that modifiable risk factors, including alcohol and tobacco use, infections, nutritional deficiencies, and obesity, contribute to more than 50% of all gastrointestinal malignancies [9]. The consumption of red and processed meat has been associated with an

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increased risk of colorectal and gastric cancer, attributed to carcinogenic compounds such as N-nitroso compounds, heterocyclic aromatic amines, and polycyclic aromatic hydrocarbons. Furthermore, the high salt content in processed meat, along with tobacco use and inadequate intake of antioxidant-rich fruits and vegetables, further contributes to the risk of gastric cancer [10]. The normal deterioration in digestive function that comes with ageing is frequently connected to the nearly 40% of those over 60 who suffer from gastrointestinal problems.

An increased incidence of infections, notably Helicobacter pylori (H. pylori), atrophic changes in the stomach mucosa, and decreased activity of digestive enzymes are the hallmarks of upper gastrointestinal problems, which are more common in older people [11]. H. pylori infection is the most important risk factor among the several factors that are known to influence the occurrence of stomach cancer [10]. In 1994, the World Health Organization and the International Agency for Research on Cancer classified H. pylori as a definitive carcinogen based on substantial epidemiological and histological evidence [12]. Nearly 50% of people worldwide are infected with H. pylori, which causes chronic inflammation of the stomach mucosa. Of these, 5–15% develop into duodenal and stomach ulcers, and less than 1% develop gastric cancer [10]. Persistent non-atrophic gastritis, primarily associated with H. pylori infection, represents a chronic inflammatory state of the gastric mucosa. This condition has been implicated in the sequential progression toward gastric carcinogenesis through a well-established cascade, which includes intestinal metaplasia, dysplasia, and ultimately, gastric cancer [13]. Although major gastrointestinal (GI) cancers share common risk factors, their etiologies and epidemiological patterns vary considerably due to geographic, social, and familial differences in the prevalence of benign and malignant neoplastic proliferations. Given these variations, periodic analysis of data from diverse populations and regions is essential for understanding disease patterns and improving preventive strategies. This study aims to analyze gastrointestinal biopsies collected over 12.5 years at Misurata Medical Center, Libya, focusing on the prevalence, histopathological features, and grading of GIT tumors. The findings aim to contribute to multiple efforts in improving diagnostic accuracy and treatment outcomes through a multidisciplinary approach.

Methods

This retrospective study analyzed 45,313 biopsies reported in the Surgical Pathology Department of Misurata Medical Center, Misurata, Libya, over 12.5 years (1995–2007). Among these, 753 gastrointestinal (GIT) biopsies were selected for detailed examination. Each biopsy was documented with the following information: registration number, patient name, age, nationality, clinical data, and microscopic diagnosis. Formalin-fixed surgical specimens underwent gross examination, with representative sections selected based on the nature of each case.

Tissue samples were processed using standard histological techniques, embedded in paraffin, and sectioned at a thickness of 5–7 micrometers. The sections were stained with Hematoxylin and Eosin (H&E) and examined microscopically. Diagnoses were made following the World Health Organization (WHO) histopathological classification of gastrointestinal tumors. Neoplastic proliferations were identified in 194 cases (25.19%). Of these, 61 cases (7.96%) were benign tumors, with tubular adenoma being the most common, while 133 cases (17.36%) were malignant, predominantly adenocarcinomas. Appendectomy specimens were excluded from this analysis. A summary of the materials studied and their histopathological diagnoses is presented in Table 1.

Statistical analysis was performed using IBM SPSS Statistics version 27. Descriptive statistics, including frequencies and percentages, were used to summarize demographic variables and tumor characteristics. Associations between categorical variables—such as tumor type (benign vs. malignant), gender distribution, age groups, histological subtypes by anatomical site, and tumor staging by location—were evaluated using the chi-square test. A p-value <0.05 was considered statistically significant, and p <0.001 was interpreted as highly significant.

Results

Among the 753 gastrointestinal tract (GIT) biopsies analyzed in this 12.5-year retrospective study at Misurata Medical Center, Libya, non-neoplastic lesions constituted the majority, with 559 cases (74.24%), while neoplastic lesions were identified in 194 cases (25.76%) (Table 1). Of the neoplastic cases, malignant tumors predominated, accounting for 133 cases (68.6%), compared to 61 benign tumors (31.4%). This distribution showed a statistically significant difference ($x^2 = 26.722$, $p < .001$), indicating that malignant GIT tumors occur at a significantly higher rate than benign tumors in this population.

Table 1. Total GIT biopsies (753) with Prevalence of each disease.

Type	Count	%	Chi square	P value
Non-neoplastic Diseases	559	74.24	26.722	< 0.001
Benign	61	31.4		
Malignant	133	68.6		
Total Neoplasms	194	100.0		

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Table 2 summarizes the age and sex distribution of 753 gastrointestinal (GIT) biopsies diagnosed microscopically. The sample included 393 males (52.2%) and 360 females (47.8%), with a slight male predominance (male-to-female ratio: 1.09:1). The highest biopsy frequency occurred in the 61–70 age group (n = 131, 17.4%), followed by 21–30 years (n = 120, 15.9%). The lowest rates were in the 0–10 years (4.6%) and >80 years (2.1%) age groups. Males outnumbered females in most age categories, notably in the 61–70 (10.4% vs. 7.0%) and 71–80 (5.8% vs. 3.3%) groups. However, females were more represented in some younger groups, particularly 31–40 years (8.2% vs. 7.2%).

Table 2. Age and Sex distribution of all microscopically diagnosed GIT biopsies (753).

Age		0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	>80	Total
Female	N	19	36	57	62	51	54	53	25	3	360
	%	2.5	4.8	7.6	8.2	6.8	7.2	7.0	3.3	0.4	47.8
Male	N	16	26	63	54	46	53	78	44	13	393
	%	2.1	3.5	8.4	7.2	6.1	7.0	10.4	5.8	1.7	52.2
Total		35	62	120	116	97	107	131	69	16	753

Table 3 shows the gender distribution of 194 diagnosed gastrointestinal (GIT) tumors. Malignant tumors predominated (68.6%), with benign tumors accounting for 31.4%. Males had a slightly higher proportion of both benign (17.0%) and malignant (37.1%) tumors than females (14.4% and 31.4%, respectively). However, this difference was not statistically significant ($x^2 = 0.001$, $p = .996$), indicating that gender was not a significant factor in the benign or malignant nature of GIT tumors in this cohort.

Table 3. Distribution of Benign and Malignant Gastrointestinal Tumors by Gender

Gender	Type of tumor				Chi square	P value
	Benign Tumors		Malignant tumors			
	Count	%	Count	%		
Female	28	14.4	61	31.4	0.001	0.996
Male	33	17.0	72	37.1		
Total	61	31.4	133	68.6		

Table 4 presents the age and sex distribution of benign tumors among 61 patients. Males accounted for a slightly higher proportion (53.3%, $n = 33$) than females (46.7%, $n = 28$), with a male-to-female ratio of 1.18:1. However, this difference was not statistically significant ($x^2 = 0.267$, $p = 0.606$). Benign tumors were observed across a wide age range, with the highest frequency in the 61–70 age group (n = 12, 19.7%), followed by equal frequencies in the 0–10 and 11–20 age groups (n = 10, 16.4% each). No cases were reported in patients over 80 years of age. The age distribution was also not statistically significant ($x^2 = 10.133$, $p = 0.181$), indicating no significant variation across age groups.

Table 4. Age and Sex distribution of benign tumours.

Age		0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	>80	Total	Chi square	P value
Female	N	5	4	2	6	2	2	3	4	0	28	0.267	0.606
	%	8.3	6.7	3.3	10.0	3.3	3.3	5.0	6.7	0.0	46.7		
Male	N	5	6	6	1	2	0	9	3	0	33		
	%	8.3	10.0	10.0	1.7	3.3	0.0	15.0	5.0	0.0	53.3		
Total		10	10	8	7	4	2	12	7	0	61		
Chi square =10.133, P-value = 0.181													

Table 5 shows the distribution of benign gastrointestinal (GIT) tumors by histological type and site in 61 cases. The rectum was the most commonly affected site (37.7%), followed by the colon (21.3%) and anal region (18.0%). The appendix and mesentery were the least affected (1.6% each). Tubular adenomas were the most common histological type, predominantly found in the rectum ($n = 23$) and colon ($n = 12$), indicating a lower GIT predilection. Other types included squamous cell papillomas, villous adenomas, and capillary hemangiomas. A significant association was found between tumor type and site ($x^2 = 65.738$, $p < .001$), suggesting specific histological types preferentially affect certain anatomical locations.

Table 5. Number and Percentage of Benign Tumors by Histological Type and Site Location,

Site	Benign tumor types in 61 cases	Count	%	Chi square	P value
Oral cavity	(Squamous cell papilloma, Capillary hemangioma)	2	3.3	65.738	< 0.001
Tongue	(2 Squamous cell papillomas, Capillary hemangioma)	3	4.9		
Stomach	(2 Tubular adenomas, Villous adenoma)	3	4.9		

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Small intestine	(2 Tubular adenomas, Villous adenoma, Capillary hemangioma).	4	6.6		
Colon	(12 Tubular adenomas, Villous adenoma).	13	21.3		
Rectum	Tubular adenomas	23	37.7		
Anal	(8Tubular adenomas, 3 Squamous cell papillomas).	11	18.0		
Appendix	Villous adenoma	1	1.6		
Mesenteric	Cavernous lymphangioma	1	1.6		

Table 6 presents the age and sex distribution of malignant gastrointestinal (GIT) tumors among 133 patients. Males comprised a slightly higher proportion (54.1%, n = 72) than females (45.9%, n = 61), with a male-to-female ratio of 1.17:1. This difference was not statistically significant (x^2 = 0.910, p = 0.340). In contrast, age distribution showed a highly significant association with malignancy occurrence (x^2 = 80.632, p < 0.001). The highest frequencies were in the 61–70 (n = 35, 26.3%), 71–80 (n = 29, 21.8%), and 51–60 (n = 23, 17.3%) age groups, with over 65% of cases occurring in individuals over 50. Sex-specific trends included higher prevalence in females aged 41–50 (9.8% vs. 3.8% in males) and in males aged 61–70 (16.5% vs. 9.8% in females). Malignant tumors were rare in patients under 20 (3.0%) and over 80 (2.3%), underscoring their predominance in older adults.

Table 6. Age and Sex distribution of malignant tumors.

Age		**0-10**	**11-20**	**21-30**	**31-40**	**41-50**	**51-60**	**61-70**	**71-80**	**>80**	**Total**	**Chi square**	**P value**
Female	N	1	2	4	4	13	10	13	13	1	61	0.910	0.340
	%	0.8	1.5	3.0	3.0	9.8	7.5	9.8	9.8	0.8	45.9		
Male	N	1	0	7	6	5	13	22	16	2	72		
	%	0.8	0.0	5.3	4.5	3.8	9.8	16.5	12.0	1.5	54.1		
Total		2	2	11	10	18	23	35	29	3	133		
Chi square =80.632, P-value = < 0.001													

Table 7 summarizes the distribution of malignant gastrointestinal (GIT) tumors by organ and histological type in 133 cases. The colon (33.1%) and rectum (30.1%) were the most affected sites, together accounting for 63.2% of cases, with adenocarcinoma being the dominant histological type. This underscores the high burden of colorectal cancer in the study population. The stomach was the third most common site (12.8%), showing a mix of adenocarcinoma, lymphoma, undifferentiated carcinoma, and leiomyosarcoma. Less frequently involved sites included the appendix (7.5%), small intestine (3.8%), and esophagus (3.8%), while the oral cavity, tongue, and mesentery had the lowest incidence (≤2.3%). A significant association was found between tumor type and site (x^2 = 168.729, p < .001), indicating strong site-specific patterns—particularly adenocarcinoma in the lower GIT and squamous cell carcinoma in the esophagus and oral cavity. These findings highlight the anatomical variability of GIT malignancies and support the need for site-specific diagnostic and treatment strategies.

Table 7. Total number of GIT Malignant tumors organ localization- 133 cases.

Site	**Malignant tumor types in 133 cases**	**Count**	**%**	**Chi square**	**P value**
Oral Cavity	Squamous Cell Carcinoma, Anaplastic Tumor	3	2.3	168.729	< 0.001
Tongue	Squamous Cell Carcinoma	2	1.5		
Esophagus	Squamous Cell Carcinoma, Adenocarcinoma	5	3.8		
Stomach	Adenocarcinoma, Lymphomas, Undifferentiated Carcinoma, Leiomyosarcoma	17	12.8		
Small Intestine	Lymphomas, Carcinoid Tumor	5	3.8		
Colon	Adenocarcinoma	44	33.1		
Rectum	Adenocarcinoma	40	30.1		
Anal	Adenocarcinoma, Squamous Cell Carcinoma	4	3.0		
Appendix	Carcinoid, Carcinomas	10	7.5		
Mesenteric	Adenocarcinoma	3	2.3		

Figure 6 shows the longitudinal trend distribution of stomach and colorectal cancer cases, with a peak in 1998–1999 and minor increases in 2002, 2005, and 2006. A gradual decline, particularly in stomach

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adenocarcinoma, was observed over time. Colorectal cancer remained more prevalent, consistent with global patterns. Overall, gastrointestinal malignancies were most common in the colon and rectum, which together accounted for approximately two-thirds of cases. These trends reflect both environmental and genetic influences and highlight the changing epidemiology of GIT cancers.

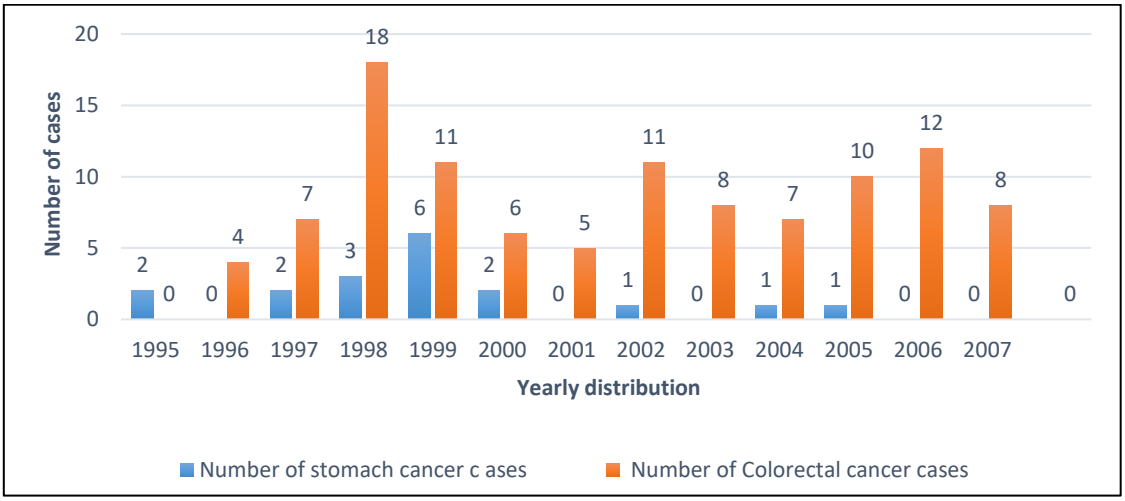

Figure 6. Stomach and colorectal cancer distribution over the years.

Figure 7 shows a significant correlation between tumor differentiation and frequency in malignant gastrointestinal (GIT) tumors. The majority were well-differentiated, followed by moderately differentiated tumors, with fewer poorly differentiated cases. Well-differentiated carcinomas had the highest incidence, while poorly differentiated tumors were associated with more aggressive behavior and poorer prognoses. Two cases were undifferentiated, and 29 had indeterminate differentiation. These findings highlight the importance of histopathological assessment in understanding tumor behavior and guiding treatment strategies. The predominance of well and moderately differentiated tumors (67.67%) aligns with prior studies, underscoring the need for further research on clinical outcomes by differentiation level.

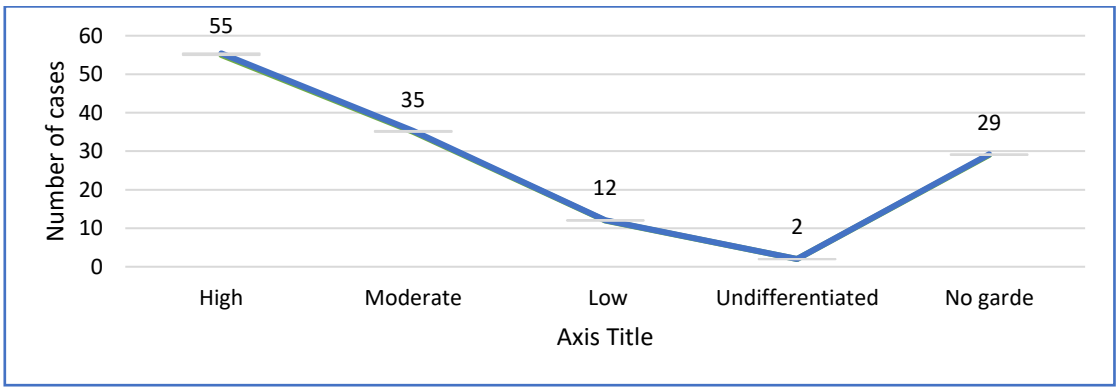

Figure 7. Levels of differentiation of the Malignant GIT tumors.

Table 8 presents the distribution of gastrointestinal (GIT) tumors by stage across different tumor sites. A total of 24 cases were staged, including tumors from the stomach (n = 6), colorectal region (n = 13), and appendix (n = 5). Most cases were diagnosed at Stage II (58.3%, *n* = 14), followed by Stage III (29.2%, *n* = 7), with fewer at Stage I (8.3%, *n* = 2) and Stage IV (4.2%, *n* = 1). Stage II tumors were most common in the colorectal region (61.5%, *n* = 8), indicating many malignancies were identified at an intermediate stage. A chi-square test ($x^2 = 4.750$, $p = .093$) showed no significant variation in staging across tumor sites. These results highlight the need for improved early detection, as only 8.3% of cases were diagnosed at Stage I, where outcomes are more favorable. Future research should investigate factors contributing to late-stage diagnoses to enhance early cancer detection.

Table 8. Distribution of GIT tumors according to stage.

Site of the tumor	Count	Stage: I	II	III	IV	Chi square	P value
Stomach	6	1	1	4	0		
Colorectal	13	1	8	3	1	4.750	0.093
Appendix	5	0	5	0	0		
Total	24	2	14	7	1		

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Table 9 presents an analysis of metastatic patterns in gastrointestinal (GIT) tumors. Four cases with distinct primary origins and metastatic sites were identified: a pancreatic adenocarcinoma metastasized to the omentum, a colon adenocarcinoma found in peritoneal fluid, and two metastatic tumors from prostate cancer (adenocarcinoma and papillary carcinoma) in the rectum. These findings highlight the aggressive nature of pancreatic cancer, the abdominal spread of colorectal cancer, and the rectal involvement in advanced prostate cancer. Enhanced monitoring of metastatic spread is crucial for informing treatment strategies and improving clinical outcomes.

Table 9. Metastatic tumors.

Metastatic tumors		
1	To the Omentum from Pancreas	Adenocarcinoma
2	To the peritoneal fluid from the colon	Adenocarcinoma H.D
3	To rectum from the prostate	Aden papillary carcinoma
4	To rectum from the prostate	Adenocarcinoma

Figure 8 shows the association between Helicobacter pylori (H. pylori) positivity and gastric malignancies across age groups. H. pylori positivity increased with age, peaking at 41 cases in the 61–70 age group. Stomach carcinoma first appeared in the 31–40 age group and peaked at six cases in the 51–60 age group. While older age groups had higher H. pylori prevalence, the correlation with malignancy was inconsistent. For instance, the 41–50 age group had 31 H. pylori-positive cases but only four carcinoma cases. The highest malignancy incidence was observed in the 51–60 age group, but other age groups with high H. pylori prevalence did not show a proportional increase in malignancies.

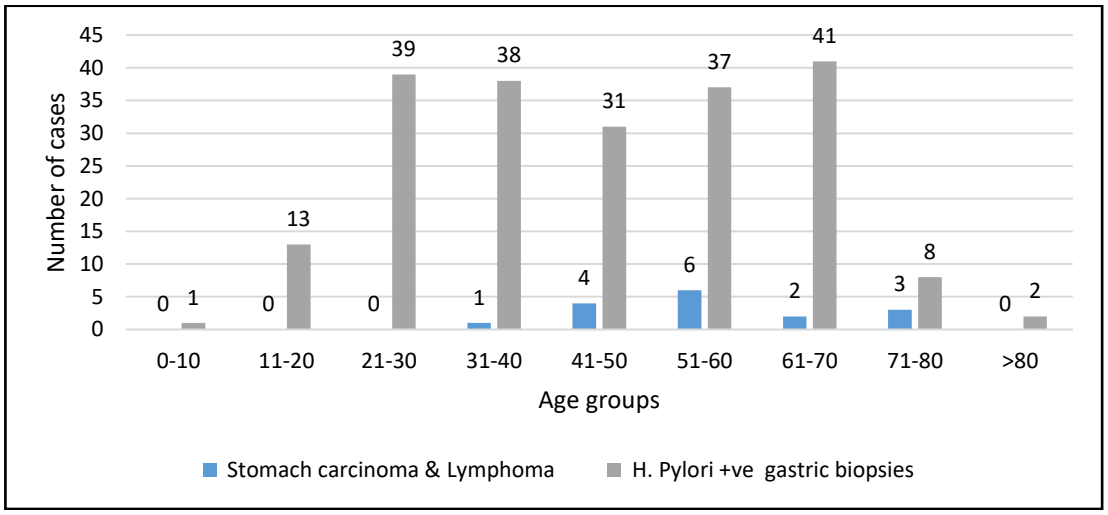

Figure 8. Comparison of Stomach carcinoma, Lymphomas & Helicobacter pylori +ve cases by age.

Discussion

This retrospective study covering the period from 1995 to 2007 offers critical insights into the histopathological trends of gastrointestinal (GIT) tumors at Misurata Medical Center, Libya. During this time, the burden of GIT malignancies was increasingly recognized worldwide, particularly in transitioning countries where lifestyle and dietary changes were taking place. Our data, reflecting local patterns over this 12.5-year period, provide a valuable historical baseline to understand the shifting epidemiology of gastrointestinal tumors both locally and globally.

The study found that malignant tumors accounted for 68.6% of neoplastic GIT lesions, with adenocarcinomas, especially in the colon, rectum, and stomach, being the most prevalent histological types. This pattern aligns with global data from the late 1990s and early 2000s, which identified colorectal and gastric cancers as leading contributors to cancer incidence and mortality. Notably, the highest tumor frequencies occurred in older adults (≥50 years), reflecting well-established age-related risk patterns. That is why in the United States in 2001, over 31% of individuals aged 50 years and older reported undergoing fecal occult blood testing (FOBT) within the previous two years, and approximately 37% had received a sigmoidoscopy or colonoscopy within the past five years, highlighting the role of age as a key factor in colorectal cancer screening uptake [14].

Between 1995 and 2007, Libya, like many developing countries, faced limited access to colorectal cancer screening programs, such as fecal occult blood testing (FOBT) and endoscopy. This likely contributed to the high rate of late-stage diagnoses in our cohort, with the majority presenting at Stage II and III, and only 8.3% detected at Stage I. And this continued in the United States, despite overall declines in colorectal cancer (CRC) rates, diagnoses at advanced stages remain prevalent. Research indicates that progress could be expedited by understanding the rising incidence in individuals born after 1950 and improving access to

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screening and treatment across all populations [15]. A 2009 study conducted in Iran reported that gastric (GC) and colorectal cancers (CRC) were among the most prevalent malignancies, with late-stage diagnoses significantly compromising survival outcomes. The findings highlight the need for early detection and improved screening strategies [16]. Additionally, the predominance of well- and moderately differentiated tumors in our cohort (over 67%) suggests that despite the advanced stages, many tumors still retained some tissue organization, implying a potential for earlier intervention that was missed due to the underutilization of diagnostic resources during this period.

The patterns observed in our study—characterized by a historical predominance of colorectal and stomach cancers with a gradual decline in stomach adenocarcinoma—are largely consistent with current global trends. The increasing global burden of colorectal cancer, as highlighted in GLOBOCAN 2022 [17] aligns with our findings of its dominant role among gastrointestinal malignancies. However, while our data showed a historical peak and subsequent decline in incidence, particularly for gastric cancer, the global trend reflects a continued rise in colorectal cancer incidence, especially in high- and middle-income countries. This suggests that while the general distribution of GIT cancers remains comparable, the ongoing global rise in colorectal cancer incidence marks a divergence from the declining trend observed in our local data, highlighting the importance of region-specific risk factors, screening practices, and healthcare infrastructure. Therefore, our study provides a valuable baseline for understanding past trends in gastrointestinal malignancies. To determine whether these patterns have persisted or shifted in line with current global trends, it is essential to examine a new cohort using recent data. Such comparative analysis would help clarify the evolving epidemiology and guide future prevention and screening strategies.

In this study, we examined the anatomical and histological patterns of gastrointestinal (GIT) tumors, with a particular focus on adenomas, which play a critical role in the progression to colorectal cancer (CRC). Our findings align with previous reports, such as the 25%-40% prevalence of adenomas in screened adults, with tubular adenomas being the most common benign tumors in the rectum and colon. While squamous cell papillomas and villous adenomas were less frequent, the predominance of tubular adenomas in these locations emphasizes their significance in the progression from benign to malignant lesions. The malignant tumors observed in the colon and rectum were predominantly adenocarcinomas, confirming the well-established link between adenomatous polyps and CRC development. This correlation highlights the importance of tumor type and location in influencing tumor biology and progression. Specifically, the progression from polyps to carcinoma, particularly in the colon, is a well-documented pathway in CRC development, as initially described by Shinya and Wolff (1979) [18], and later reaffirmed by studies such as that of Short et al. (2015), that **t**he risk of malignancy in adenomas was found to be significantly associated with the histological subtype, size, and grade of dysplasia. Tubular adenomas, which represent about 80% of all adenomas, were shown to have a malignancy rate of 4.8% at diagnosis. However, tubulovillous and villous adenomas, though less common, demonstrated much higher malignancy rates—19.0% and 38.4%, respectively. These findings are consistent with the literature, which suggests that larger adenomas and those exhibiting high-grade dysplasia are more likely to undergo malignant transformation [19]. Recent studies, including a 2023 report, have further validated the role of adenomas in CRC development. It was found that approximately 17% of cancers detected in CRC screening programs originated from polyps. Additionally, premalignant and malignant changes were more frequently observed in male patients, conventional colorectal tubular adenomas (TAs), and polyps larger than 10 mm. These observations underscore the importance of early detection and surveillance in mitigating CRC risk [20].

In light of these findings, we advocate for the implementation of structured surveillance programs to detect and remove colorectal polyps through colonoscopy. Such programs, focused on histological evaluation, polyp size, and grade of dysplasia, have proven effective in reducing CRC incidence and improving patient outcomes, as emphasized by Koyuncuer and Zengin (2023). Overall, our study reinforces the central role of adenomas, particularly tubular and villous types, in the development of CRC and highlights the need for proactive screening and surveillance strategies to combat this major public health concern.

Sex-biased molecular markers have been identified across various tumor types, with growing evidence suggesting the presence of sexual dimorphism in cancer biology [21]. And Malignancy differences by sex are widely established. impacting the occurrence, course, responsiveness, and results of cancer therapy. Male and female tumour growth differs are due to biological variables, such as genetic, hormonal, and immune system variances [22]. Males are more likely than females to get gastrointestinal malignancies, although this finding cannot be explained by a specific risk behavior. The finding could have been caused by variations in p53 signalling and immunological response [23]. Our study showed that the demographic patterns observed in gastrointestinal (GIT) tumors from 1995 to 2007, notably the slight male predominance with males representing 52.2% of total biopsies, align with trends observed in many studies and continued until recently. For instance, Colorectal cancer (CRC) accounts for approximately 10% of all cancers worldwide, ranking third in men and second in women. Incidence is higher in males (male-to-female ratio 1.4) and varies up to tenfold across regions [24]. Moreover, a global analysis covering data from 2003 to 2012 found a consistent male predominance in esophageal and gastric cancers worldwide; the male-to-female age-standardized incidence rate ratios were 6.7:1 for esophageal adenocarcinoma, 3.3:1 for esophageal squamous cell carcinoma, 4.0:1 for gastric cardia cancer, and 2.1:1 for gastric non-cardia cancer [25].

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Similarly, a study focusing on gastric cancer clinical characteristics reported that 65% of the patients were male, indicating a persistent male predominance in recent years [26]. These findings suggest that the male predominance observed in GIT tumors during the 1995–2007 period continues to be evident in more recent studies, although the degree of predominance may vary depending on the specific type of GIT cancer and the population studied.

Age remains a key factor in GIT tumor incidence, with the 61–70 age group showing the highest frequency during both the 1995–2007 period and in more recent data. A population-based study in Georgia reported similar trends, noting that digestive organ cancer rates aligned with global patterns, though stomach cancer was more prevalent and colorectal cancer less so. The average age at diagnosis was 65.1 years, with peak incidence in the 50–69 age group. Males were more commonly affected, and colorectal and stomach cancers were the most frequently diagnosed in both sexes [27]. Notably, CRC rates are also rising in individuals under 50, with the U.S. reporting annual increases of 1.0%–2.4% for colon and 3.2% for rectal cancer [28]. However, more recent studies have indicated a trend toward earlier onset of certain GIT malignancies, particularly in younger populations, possibly due to environmental factors and changes in lifestyle, a cohort analysis of over one million cases from 1980 to 2018 reported a rising incidence of stomach cancer among individuals under 40 in several countries, including Sweden, the UK, and Ecuador [29].

The emerging trend of early-onset disease has been linked to changes in gut microbiota, obesity, sedentary lifestyles, and high consumption of processed foods—factors that were less prominent in Libya during the study period but are increasingly relevant today. Furthermore, advancements in diagnostic tools, such as immunohistochemistry, molecular profiling, and next-generation sequencing, have become integral to modern GIT cancer diagnosis and treatment. These tools were largely unavailable in Libya during the study period, limiting the ability to subclassify tumors beyond basic histopathological differentiation. For example, biomarkers such as KRAS, BRAF, and mismatch repair (MMR) status are now routinely evaluated in colorectal cancer to guide treatment at a level of precision not possible during the 1995–2007 timeframe. These findings underscore the need to integrate preventive strategies into clinical guidelines and public health policies, with particular focus on younger populations. this shift highlights the need for improved screening and early detection strategies, especially for high-risk groups. Furthermore, while Helicobacter pylori infection was strongly associated with gastric malignancies in the earlier years [12], recent studies have shown a decline in H. pylori prevalence in some populations due to improved sanitation and antibiotic treatments, which may have impacted the incidence of gastric cancer. In summary, while the overall patterns of male predominance and aging-related tumor prevalence have persisted from 1995–2007 to the present, the evolving epidemiology of colorectal cancer and the changing role of Helicobacter pylori infection suggest that ongoing monitoring and adaptation of diagnostic and treatment strategies are essential to address the shifting trends in GIT tumor demographics.

Our study documented a high prevalence of H. pylori infection, particularly among older adults, and explored its association with gastric malignancies. Although a clear linear correlation was not observed, H. pylori remained an important risk factor. Data from a Hong Kong public hospital database suggest that H. pylori eradication is associated with a lower long-term risk of gastric cancer, particularly among older adults [30]. Globally, since the early 2000s, test-and-treat strategies and national screening programs—such as those in Japan and South Korea—have contributed to a significant decline in non-cardia gastric cancer incidence [31]. In contrast, limited routine screening and eradication efforts in Libya during the study period likely contributed to the sustained burden of gastric cancer. Our data showed a peak in H. pylori positivity (41 cases) in the 61–70 age group, while gastric carcinoma peaked earlier, with six cases in the 51–60 age group. The lack of alignment between the highest infection prevalence and malignancy incidence suggests that H. pylori alone may not be a sufficient predictor of cancer risk, and other environmental, genetic, or lifestyle factors may play a role. Other studies showed that the gastric microbiota other than H. pylori may play a role in the last steps of gastric carcinogenesis [32]. The link between Helicobacter pylori infection and gastric cancer remains controversial, influenced by variations in study design, patient demographics, and tumor characteristics. [33]. Future studies in our region, involving updated cohorts and improved diagnostic approaches, may provide further insights into the changing epidemiology of gastric cancer.

Conclusion

This study offers a historical perspective on gastrointestinal (GIT) tumor trends in Libya during 1995–2007, revealing a high burden of malignant tumors, particularly in older adults, with late-stage presentations and limited diagnostic precision. The findings highlight persistent male predominance and age-related risk factors, especially for colorectal and gastric cancers. Adenomas, particularly tubular and villous types, are central to colorectal cancer progression, emphasizing the need for early detection and screening. While Helicobacter pylori remained a key risk factor for gastric cancer, other genetic and environmental factors also contribute to its development. When compared to current global patterns, it becomes evident that significant progress has been made elsewhere in early detection, precision diagnostics, and public health initiatives. Bridging this gap will require coordinated efforts in policy, education, and health infrastructure to align regional cancer care with global standards. Improved screening, early detection, and modern

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diagnostic tools are essential to guide prevention and treatment strategies, and further research is necessary to refine the understanding of GIT tumor patterns and inform clinical practice.

Conflicts of Interest

There are no financial, personal, or professional conflicts of interest to declare.

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