

# Risk Factors Associated with Adenomas or Serrated Polyps in Patients who Underwent Screening Colonoscopy

Grazia Maria Cariglia<sup>1</sup>, Chiara Marzano<sup>2</sup>, Angelo Zullo<sup>3</sup>, Vincenzo De Francesco<sup>4</sup>, Paolo Fedeli<sup>5</sup>, Lorenzo Ridola<sup>1</sup>, Angelo Dezi<sup>2</sup>

1) Department of Medical and Surgical Sciences and Biotechnologies, Sapienza University, Rome;  
2) Gastroenterology Unit, San Filippo Neri Hospital, Rome;  
3) Gastroenterology Unit, Nuovo Regina Margherita Hospital, Rome;  
4) Gastroenterology and Endoscopy Unit, Department of Medical and Surgical Sciences, Riuniti Hospital, University of Foggia, Foggia;  
5) Gastroenterology Unit, Santo Spirito Hospital, Rome, Italy

## ABSTRACT

**Background & Aims:** Colorectal polyps, including adenomas and serrated adenomas, are recognized as premalignant lesions responsible of a significant proportion of colorectal cancer, via the traditional adenoma-carcinoma sequence and the serrated neoplasia pathway. This study aimed to search for potential risk factors of these lesions.

**Methods:** Demographic and clinical characteristics of consecutive subjects with positive fecal immunological test who underwent colonoscopy, as a part of regional screening program (first round), were collected. In detail, age, gender, current smoking habit, presence of blood hypertension, diabetes, hyperlipaemia, and diverticulosis were considered as potential risk factors. Data were analysed at both univariate and multivariate analysis.

**Results:** Data of 1,499 (707 males; mean age:  $62.2 \pm 7.1$  years) subjects were collected. At least an adenomas or serrated polyp were detected in 533 (35.5%) and 47 (3.1%) subjects, respectively. At multivariable logistic regression analysis, smoking habit (OR=1.6, 95%CI: 1.3-2.1), diverticulosis (OR=1.5, 95%CI: 1.01-1.6), male gender (OR=1.4, 95%CI: 1.1-1.9), and age (OR=1.02, 95%CI: 1.01-1.04) were significant risk factors for adenomas, whilst smoking was the lone independent risk factor for serrated lesions (OR=2.3; 95%CI: 1.2-4.5).

**Conclusions:** In our study population, adenomas were associated with male gender, age, smoking and diverticula, whilst serrated polyp only with smoking habit. Other considered factors were not associated. Smoking avoiding or cessation could impact colon polyp development.

**Key words:** adenomas – serrated polyps – colonoscopy – risk factors – screening.

**Abbreviations:** BMI: body mass index; CCR: colorectal cancer; CI: confidence interval; FAP: familial adenomatous polyposis; OR: odds ratio; SSL: sessile serrated lesions; TSA: traditional serrated adenomas.

## Address for correspondence:

Dr. Angelo Zullo  
Gastroenterologia  
PTP Nuovo Regina  
Margherita,  
Via Emilio Morosini, 30  
00153 Roma, Italy  
[angelozullo66@yahoo.it](mailto:angelozullo66@yahoo.it)

## INTRODUCTION

Colorectal cancer (CRC) is the third most prevalent cancer in the world, developing mostly sporadic or in rare genetic syndromes, like familial adenomatous polyposis (FAP) or Lynch syndrome [1]. The main pathway, traditionally considered responsible for sporadic CRC, is the adenoma-carcinoma sequence [2]. More recently, another tumorigenesis has emerged, namely the serrated neoplasia pathway, responsible for approximately 20-35% of all CRC cases [3-6]. Both pathways

are based on the development of polyps, which are adenomas and sessile serrated lesions (SSL) / traditional serrated adenomas (TSA), respectively [7]. Serrated polyps are more difficult to recognize due to their flat morphology, their cloudy aspects and their indistinct borders, accounting for only 4-9% of polyps detected during colonoscopies [8, 9]. Some studies have demonstrated that adenomas and SSL share similar modifiable and non-modifiable risk factors, but certain risk factors differ or have a stronger or weaker association with one group than the other [10, 11]. Adenomas seem to be more frequent in men than in woman, and their prevalence increases in general with age [12, 13]. Conversely, the association for serrated polyps with age and gender was reported to be weaker [14, 15]. Studies on the others potential risks factors, such as smoking, diabetes, diverticulosis, and body mass index (BMI) provided quite conflicting results [16-20]. Moreover, in some studies, SSL/TSA (pre-malignant lesions) and hyperplastic polyps (benign lesions) were collectively considered [21,

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22], whilst these lesions are now considered as separated entities according to updated WHO classification of digestive malignancies [23]. In addition, risk factors for SSL-TSA lesions were scantily investigated [24]. Since the identification of risk factors could have an impact on the incidence [25], we performed this study to search for modifiable and non-modifiable factors associated to these two types of polyps in subjects who underwent high-quality colonoscopy in an organized colorectal screening program.

## METHODS

Data of consecutive 50–74 aged subjects with positive fecal immunological test (cut-off: 100 ng/ml) who underwent colonoscopy a single endoscopic unit, as a part of regional screening program (first round), were considered. In detail, a pre-endoscopic questionnaire was used to collect age, gender, current smoking habit, presence of blood hypertension, diabetes, and hyperlipidemia, whilst presence of diverticula in colon was registered following colonoscopy. All endoscopic examinations were performed under deep sedation with propofol i.v. administered by an anesthesiologist. Split bowel cleansing was performed with either high- or low-volume PEG solution, according to subject preference and all examinations were scheduled in a morning dedicated session. For the purpose of the study, incomplete examinations, for any reason, were excluded. Endoscopic and clinical data of subjects observed between 1<sup>st</sup> January 2020 to 30<sup>th</sup> January 2025 were prospectively registered in specifically designed excel database. The prevalence of adenomas and serrated polyp (with or without dysplasia) was quoted, whilst hyperplastic polyps were not considered. Diverticulosis was categorized as present (at least one or more diverticula present through the colon, regardless of the site, extent and severity), or absent.

### Statistical Analysis

Frequencies, percentages, means values with standard deviations, and 95% confidence intervals (CI) were calculated for all observations. The univariate analysis by using the Chi-squared test and T-test, as appropriate. A multiple logistic regression was used to assess the relationship between adenomas, serrated polyp and the considered risk factors. Odds ratio (OR) and 95%CI were calculated. A *p* level less than 0.05 was considered significant.

## RESULTS

### Descriptive Analysis

We analyzed data of 1,499 subjects who underwent total colonoscopy, including 707 males and 792 females, with a mean age of 62.2±7.1 years (range: 50–74), and a mean BMI of 26.7±4.5. Overall, at least 1 polyp (more than one polyp could be present in same subject) was detected in 690 cases, including adenomas (533; 35.6%), serrated polyp (47; 3.1%) or hyperplastic (188). A total of 555 subjects had at least one adenoma or serrated polyp. Therefore, the polyp detection rate (PDR) and the adenoma detection rate (ADR) were 46% and 37%, respectively. Diverticula were found in 536 (35.7%) subjects, 611 (40.7%) disclosed smoking habit, blood hypertension was present in 599 (39.9%), hyperlipidemia in 290 (19.3%), and diabetes in 102 (6.8%) cases.

### Univariate Analysis

At univariate analysis, subjects with a polyp (adenomas or serrated) were more frequently males (53.7%; 95%CI: 49.5–57.8) than those without (41.1%; 95%CI: 38.1–44.2), smokers (49.2%; 95%CI: 45–53.3 vs 34%; 95%CI: 31–36.9), with hypertension smokers (44.7%; 95%CI: 40.5–48.8 vs 35.3%; 95%CI: 32.3–38.3), and with diverticula (38.9%; 95%CI: 34.9–43 vs 32.1%; 95%CI: 29.3–35.1), and have more frequently hyperlipidemia (21.6%; 95%CI: 18.4–25.2 vs 17.1% 95%CI: 14.9–19.6) (Table I). No statistically significant association was observed with the other considered variables. As shown in the Table II, the association with male gender, smoking habit,

**Table I.** Association between polyps (adenomas and/or serrated) with the considered variables

|                 | Polyps    |          | p       |
|-----------------|-----------|----------|---------|
|                 | Yes = 555 | No = 994 |         |
| Male            | 298       | 409      | <0.0001 |
| Age             | 63.2±7.2  | 61.7±6.9 | 0.1     |
| Body mass index | 26.6±3.9  | 26.8±4.8 | 0.9     |
| Smoking         | 273       | 338      | <0.0001 |
| Hypertension    | 248       | 351      | 0.003   |
| Hyperlipidemia  | 120       | 170      | 0.03    |
| Diabetes        | 40        | 62       | 0.6     |
| Diverticula     | 216       | 319      | 0.046   |

**Table II.** Association between adenomas or serrated polyps subgroup with the considered variables

| Factor          | Adenomas  |          | p       | Serrated polyps |           | p    |
|-----------------|-----------|----------|---------|-----------------|-----------|------|
|                 | Yes = 533 | No = 966 |         | Yes = 47        | No = 1452 |      |
| Male            | 286       | 421      | <0.0001 | 21              | 686       | 0.7  |
| Age             | 63.2±7.1  | 61.7±6.9 | 0.2     | 63.5±7.4        | 62.2±7.1  | 0.3  |
| Body mass index | 26.6±3.9  | 26.8±4.8 | 0.9     | 24.2±2.1        | 26.8±4.6  | 0.9  |
| Smoking         | 259       | 352      | <0.0001 | 28              | 583       | 0.01 |
| Hypertension    | 239       | 360      | 0.003   | 19              | 580       | 0.9  |
| Hyperlipidemia  | 117       | 173      | 0.058   | 8               | 282       | 0.6  |
| Diabetes        | 40        | 62       | 0.4     | 1               | 101       | 0.4  |
| Diverticula     | 206       | 329      | 0.08    | 20              | 515       | 0.3  |

and hypertension remained in the subgroup with adenomas, whilst only smoking habit was associated with serrated polyps.

### Multivariate Analysis

At multivariate analysis, the presence of polyps (adenomas or serrated) was significantly associated with male gender (OR=1.5, 95%CI: 1.1-1.9;  $p=0.001$ ), and smoking habit (OR=2.33, 95%CI: 1.2-4.5;  $p=0.012$ ), and tended to be associated with age (OR=1.01, 95%CI: 0.99-1.03;  $p=0.058$ ). In the subgroup with adenomas, a statistically significant association was confirmed with male gender, age, smoking habit, and diverticula, whilst only smoking was associated with serrated polyps (Table III).

**Table III.** Multivariate analysis

| Factor          | Adenomas<br>(N=555) |       | Serrated polyps<br>(N=47) |       |
|-----------------|---------------------|-------|---------------------------|-------|
|                 | OR (95% CI)         | p     | OR (95% CI)               | p     |
| Male gender     | 1.4 (1.1-1.9)       | 0.001 | –                         | 0.5   |
| Age             | 1.02 (1.01-1.04)    | 0.02  | –                         | 0.6   |
| Body Mass Index | –                   | 0.2   | –                         | 0.8   |
| Smoking         | 1.6 (1.3-2.1)       | 0.001 | 2.3 (1.2-4.5)             | 0.012 |
| Hypertension    | –                   | 0.1   | –                         | 0.6   |
| Hyperlipidemia  | –                   | 0.9   | –                         | 0.6   |
| Diabetes        | –                   | 0.5   | –                         | 0.3   |
| Diverticula     | 1.5 (1.01-1.6)      | 0.05  | –                         | 0.4   |

## DISCUSSION

Different risk factors were associated with an increased development of precancerous and neoplastic lesions in the colon, including some not modifiable (gender, age, and diverticulosis) and modifiable (smoking habit, BMI, hypertension, and hyperlipidemia) factors [11, 16, 20, 26, 27]. Concerning gender, a lower prevalence of adenomas was reported in females as compared to males [28-30], most likely due to a protective role for estrogens and progestins [31]. While is an independent risk factor for adenomas [32, 33], the role of age – as well as gender – for serrated polyps development is more uncertain, with some studies indicating that the prevalence increased only slightly with age [14, 22], and that the sessile serrated polyps occur more frequently in females as compared to males [34]. Different studies assessed the possible connection between polyp development in the colon and diverticulosis, showing controversial results [35-40].

The present study, where the prevalence of both adenomas (35.6%) and serrated polyps (3.1%) was similar to values reported in other studies on screening colonoscopy [38-40], further assessed the role of these factors. Our data confirmed a significant association, at both univariate and multivariate analyses, between either male gender or age with adenomas, whilst these associations did not emerge for serrated polyps. Regarding the role of diverticulosis, the multivariate analysis computed an increased risk (OR=1.5; 95%CI: 1.01-1.6) of adenomas, but not serrated polyps, in subjects with diverticula. This result is in agreement with data of a study [35], but not

another [40] performed in a very similar setting, and with data of a recent meta-analysis [41].

Cigarette smoking is a known risk factor associated with colorectal polyps and CRC onset [42, 43]. Indeed, tobacco contains a lot of carcinogens that can create genetic mutations, predisposing to polyp formation. In some studies [42, 44], smoking was more strongly associated with serrated than adenomatous polyps. Indeed, CRC arising from serrated lesions contain genetic alterations typically associated with cigarette smoking, such as microsatellite instability and BRAF/KRAS mutations [26]. The multivariate analysis of our data find that smoking significantly increases the risk for both adenomas (OR=1.6; 95%CI: 1.3-2.1) and, more markedly, serrated polyps (OR=2.3; 95%CI: 1.2-4.5). Therefore, smoking cessation could be important in reducing the risk of CRC, including the interval ones correlated to serrated lesions.

A systematic review showed that BMI values were significantly associated with increased risk (RR=1.40; 95%CI: 1.22-1.61) of serrated polyps [20]. In our study, study BMI was not associated with serrated lesions and/or adenomas formation neither at univariate nor at multivariate analyses. As far as hypertension, hyperlipidemia and diabetes is concerned, a previous study found that hypertension was one of the strongest predictors of adenomas, but not of serrated lesions [45]. Moreover, experimental data showed that hypertension could induce oxidative stress and exacerbation of inflammation in the colonic mucosa, producing aberrant crypt foci in colonic mucosa, and angiotensin-converting enzyme inhibitor administration significantly reduced the total number and size of aberrant crypt foci [46, 47]. In the present study, hypertension, hyperlipidemia and diabetes were not associated with adenomas or serrated polyps at multivariate analysis.

Our analysis has some strengths and limitations. Among strengths, we used the more updated WHO definitions of colorectal polyps, separately considering adenomas and serrated polyps, and excluding hyperplastic polyps from analysis. Moreover, the study was performed in a screening setting where high-quality colonoscopy was performed. Among limitations, we did not collect data on other potential risk factors for colorectal polyps, such as alcohol and red meat consumption. Lastly, the sample of subjects with serrated lesions is rather small.

## CONCLUSIONS

Among the considered risk factors, our data found that adenomas were associated with male gender, age and diverticula, whilst serrated polyp only with smoking habit. At least in theory, avoiding or cessation of smoking habit could impact colon polyp development.

**Conflicts of interest:** None to declare.

**Authors' contribution:** G.M.C. conceived the study and the methodology. C.M., P.F. and A.D. collected data. A.Z. and V.D.F. analyzed the data and drafted the manuscript. L.R. critically revised the manuscript. All the authors read and approved the final version.

## REFERENCES

- Rex DK. Colorectal cancer prevention 2000: screening recommendations of the American College of Gastroenterology. *Am J Gastroenterol*. 2000;95(4):868-77. doi:10.1111/j.1572-0241.2000.02059.x
- Nguyen LH, Goel A, Chung DC. Pathways of colorectal carcinogenesis. *Gastroenterology*. 2020;158(2):291-302. doi: 10.1053/j.gastro.2019.08.059
- Szylberg L, Janiczek M, Popiel A, Marszałek A. Serrated polyps and their alternative pathway to colorectal cancer: a systematic review. *Gastroenterol Res Pract*. 2015;2015:641247. doi: 10.1155/2015/573814
- Rex DK, Ahnen DJ, Baron JA, Batts KP, Burke CA, Burt RW, et al. Serrated lesions of the colorectum: Review and recommendations from an expert panel. *Am J Gastroenterol*. 2012;107(9):1315-29. <https://doi.org/10.1038/ajg.2012.161>
- Crockett SD. Sessile serrated polyps and colorectal cancer. *JAMA*. 2017;317(10):975. doi: 10.1001/jama.2017.0538
- Snover DC. Update on the serrated pathway to colorectal carcinoma. *Hum Pathol*. 2011;42(1):1-10. doi: 10.1016/j.humpath.2010.06.002
- Jass JR. Gastrointestinal polyposis: clinical, pathological and molecular features. *Gastroenterol Clin North Am*. 2007;36(4):927-46. doi: 10.1016/j.gtc.2007.08.009
- Murakami T, Kurosawa T, Fukushima H, Shibuya T, Yao T, Nagahara A. Sessile serrated lesions: clinicopathological characteristics, endoscopic diagnosis, and management. *Dig Endosc*. 2022;34(7):1096-109. doi: 10.1111/den.14273
- Ijspeert JEG, Bevan R, Senore C, Kaminski MF, Kuipers EJ, Mroz A, et al. Detection rate of serrated polyps and serrated polyposis syndrome in colorectal cancer screening cohorts: a European overview. *Gut*. 2017;66(7):1225-32. doi: 10.1136/gutjnl-2015-310784
- Oines M, Helsingen LM, Brethauer M, Emilsson L. Epidemiology and risk factors of colorectal polyps. *Best Pract Res Clin Gastroenterol*. 2017;31(4):419-24. doi: 10.1016/j.bpg.2017.06.004
- He X, Wu K, Ogino S, Giovannucci EL, Chan AT, Song M. Association between risk factors for colorectal cancer and risk of serrated polyps and conventional adenomas. *Gastroenterology*. 2018;155(2):355-73. doi: 10.1053/j.gastro.2018.04.019
- Vilkoite I, Tolmanis I, Abu Meri H, Polaka I, Mezmale L, Lejnieks A. Age-based comparative analysis of colorectal cancer colonoscopy screening findings. *Medicina (Kaunas)*. 2023;59(10):2017. doi: 10.3390/medicina59112017
- McCashland TM, Brand R, Lyden E, de Garmo P; CORI Research Project. Gender differences in colorectal polyps and tumors. *Am J Gastroenterol*. 2001;96(3):882-6. doi: 10.1111/j.1572-0241.2001.3638\_a.x
- Kahi CJ, Li X, Eckert GJ, Rex DK. High colonoscopic prevalence of proximal colon serrated polyps in average-risk men and women. *Gastrointest Endosc*. 2012;75(3):515-20. doi: 10.1016/j.gie.2011.08.021
- Lall V, Ismail AGM, Ayonrinde OT. Disparate age and sex distribution of sessile serrated lesions and conventional adenomas in an outpatient colonoscopy population—implications for colorectal cancer screening? *Int J Colorectal Dis*. 2022;37(8):1569-79. doi: 10.1007/s00384-022-04191-x
- Anderson JC, Rangasamy P, Rustagi T, Myers M, Sanders M, Vaziri H, et al. Risk factors for sessile serrated adenomas. *J Clin Gastroenterol*. 2011;45(8):694-9. doi: 10.1097/MCG.0b013e318207f3cf
- Haque T, Greene KG, Crockett SD. Serrated neoplasia of the colon: what do we really know? *Curr Gastroenterol Rep*. 2014;16(9):380. doi: 10.1007/s11894-014-0380-6
- Molla MD, Symonds EL, Winter JM, Cock C, Wassie MM. Metabolic factors are associated with a higher risk of conventional adenoma in males during surveillance colonoscopy: findings from a South Australian cohort. *Sci Rep*. 2025;16(1):1532. doi: 10.1038/s41598-025-31239-z.
- Lui RN, Kyaw MH, Lam TYT, Ching JYL, Chan VCW, Wong MCS, et al. Prevalence and risk factors for sessile serrated lesions in an average risk colorectal cancer screening population. *J Gastroenterol Hepatol*. 2021;36(6):1656-62. doi: 10.1111/jgh.15368
- Bailie L, Loughrey MB, Coleman HG. Lifestyle risk factors for serrated colorectal polyps: a systematic review and meta-analysis. *Gastroenterology*. 2017;152(1):92-104.e14. doi: 10.1053/j.gastro.2016.09.003
- Erhardt JG, Kreichgauer HP, Meisner C, Bode JC, Bode C. Alcohol, cigarette smoking, dietary factors and the risk of colorectal adenomas and hyperplastic polyps – a case control study. *Eur J Nutr*. 2002;41(1):35-43. doi: 10.1007/s003940200004
- Wallace K, Grau MV, Ahnen D, Snover DC, Robertson DJ, Mahnke D, et al. The association of lifestyle and dietary factors with the risk for serrated polyps of the colorectum. *Cancer Epidemiol Biomarkers Prev*. 2009;18(8):2310-7. doi: 10.1158/1055-9965.EPI-09-0211
- Nagtegaal ID, Odze RD, Klimstra D, Paradis V, Rugge M, Schirmacher P, et al. The 2019 WHO classification of tumours of the digestive system. *Histopathology*. 2020;76(2):182-8. doi: 10.1111/his.13975
- anaka Y, Eizuka M, Uesugi N, Kawasaki K, Yamano H, Suzuki H, et al. Traditional serrated adenoma has two distinct genetic pathways for molecular tumorigenesis with potential neoplastic progression. *J Gastroenterol*. 2020;55(9):846-57. doi: 10.1007/s00535-020-01697-5
- Morimoto LM, Newcomb PA, Ulrich CM, Bostick RM, Lais CJ, Potter JD. Risk factors for hyperplastic and adenomatous polyps: evidence for malignant potential? *Cancer Epidemiol Biomarkers Prev*. 2002;11(10):1012-8. <https://pubmed.ncbi.nlm.nih.gov/12376501/>
- Burnett-Hartman AN, Passarelli MN, Adams SV, Upton MP, Zhu LC, Potter JD, et al. Differences in epidemiologic risk factors for colorectal adenomas and serrated polyps by lesion severity and anatomical site. *Am J Epidemiol*. 2013;177(7):625-37. doi: 10.1093/aje/kws282
- Davenport JR, Su T, Zhao Z, Coleman HG, Smalley WE, Ness RM, et al. Modifiable lifestyle factors associated with risk of sessile serrated polyps, conventional adenomas and hyperplastic polyps. *Gut*. 2018;67(3):456-65. doi: 10.1136/gutjnl-2016-312893
- Pox CP, Altenhofen L, Brenner H, Theilmeyer A, von Stillfried D, Schmiegel W. Efficacy of a nationwide screening colonoscopy program for colorectal cancer. *Gastroenterology*. 2012;142(7):1460-67.e2. doi: 10.1053/j.gastro.2012.03.022
- Regula J, Rupinski M, Kraszewska E, Polkowski M, Pachlewski J, Orłowska J, et al. Colonoscopy in colorectal-cancer screening for detection of advanced neoplasia. *N Engl J Med*. 2006;355(18):1863-72. doi: 10.1056/NEJMoa054967
- Lieberman DA. Prevalence of colon polyps detected by colonoscopy screening in asymptomatic black and white patients. *JAMA*. 2008;300(12):1417. doi: 10.1001/jama.300.12.1417
- McMichael AJ, Potter JD. Reproduction, endogenous and exogenous sex hormones, and colon cancer: a review and hypothesis. *J Natl Cancer Inst*. 1980;65(6):1201-7. <https://pubmed.ncbi.nlm.nih.gov/7001123/>
- Heitman SJ, Ronsley PE, Hilsden RJ, Manns BJ, Rostom A, Hemmelgarn BR. Prevalence of adenomas and colorectal cancer in average risk individuals: a systematic review and meta-analysis. *Clin Gastroenterol Hepatol*. 2009;7(12):1272-8. doi: 10.1016/j.cgh.2009.05.032

33. Corley DA, Jensen CD, Marks AR, Zhao WK, de Boer J, Levin TR, et al. Variation of adenoma prevalence by age, sex, race, and colon location in a large population: implications for screening and quality programs. *Clin Gastroenterol Hepatol.* 2013;11(2):172-80. doi: [10.1016/j.cgh.2012.09.010](https://doi.org/10.1016/j.cgh.2012.09.010)
34. Chacko L, Macaron C, Burke CA. Colorectal cancer screening and prevention in women. *Dig Dis Sci.* 2015;60(3):698-710. doi: [10.1007/s10620-014-3452-4](https://doi.org/10.1007/s10620-014-3452-4)
35. Muhammad A, Lamendola O, Daas A, Kumar A, Vidyarthi G. Association between colonic diverticulosis and prevalence of colorectal polyps. *Int J Colorectal Dis.* 2014;29(8):947-51. doi: [10.1007/s00384-014-1908-9](https://doi.org/10.1007/s00384-014-1908-9)
36. Morini S, Zullo A, Hassan C, Tomao S, Campo SM. Diverticulosis and colorectal cancer. *J Clin Gastroenterol.* 2008;42(7):763-70. doi: [10.1097/MCG.0b013e31816200fb](https://doi.org/10.1097/MCG.0b013e31816200fb)
37. Levine I, Rangnekar AS, Tokayer AZ. Low frequency of polyps in colonic regions with diverticulosis. *Int J Colorectal Dis.* 2017;32(12):1597-602. doi: [10.1007/s00384-017-2895-4](https://doi.org/10.1007/s00384-017-2895-4)
38. Ray J, Zidong Z, Yuan J, Quan M, Hachem C. The relationship between colon polyps and colonic diverticulosis: a retrospective review. *Ann Gastroenterol.* 2023;36(4):314-20. doi: [10.20524/aog.2023.0795](https://doi.org/10.20524/aog.2023.0795)
39. Meurs-Szojda MM, Droste JS, Kuik DJ, Mulder CJJ, Felt-Bersma RJF. Diverticulosis and diverticulitis form no risk for polyps and colorectal neoplasia in 4,241 colonoscopies. *Int J Colorectal Dis.* 2008;23(10):979-84. doi: [10.1007/s00384-008-0510-4](https://doi.org/10.1007/s00384-008-0510-4)
40. Fedeli P, Masotti M, Marzano C, Dezi A, Scaccianone G, Martinelli E, et al. Diverticulosis and neoplastic lesions in screening colonoscopy: a large, multicenter study. *Ann Gastroenterol.* 2025;38(1):68-71. doi: [10.20524/aog.2024.0928](https://doi.org/10.20524/aog.2024.0928)
41. Del Forno A, Zullo A, Marmo C, Marmo R, Manta R, De Francesco V, et al. Diverticulosis, adenomas, and cancer in the colon. *J Clin Gastroenterol.* 2024;58(8):764-8. doi: [10.1097/MCG.0000000000002046](https://doi.org/10.1097/MCG.0000000000002046)
42. Botteri E, Iodice S, Raimondi S, Maisonneuve P, Lowenfels AB. Cigarette smoking and adenomatous polyps: a meta-analysis. *Gastroenterology.* 2008;134(2):388-95. doi: [10.1053/j.gastro.2007.11.007](https://doi.org/10.1053/j.gastro.2007.11.007)
43. Giovannucci E. An updated review of the epidemiological evidence that cigarette smoking increases risk of colorectal cancer. *Cancer Epidemiol Biomarkers Prev.* 2001;10(7):725-31. <https://pubmed.ncbi.nlm.nih.gov/11440957/>
44. Liang PS, Chen TY, Giovannucci E. Cigarette smoking and colorectal cancer incidence and mortality: systematic review and meta-analysis. *Int J Cancer.* 2009;124(10):2406-15. doi: [10.1002/ijc.24191](https://doi.org/10.1002/ijc.24191)
45. Fliss-Isakov N, Zelber-Sagi S, Webb M, Halpern Z, Shibolet O, Kariv R. Distinct metabolic profiles are associated with colorectal adenomas and serrated polyps. *Obesity (Silver Spring).* 2017;259(Suppl 2):S72-80. doi: [10.1002/oby.22001](https://doi.org/10.1002/oby.22001)
46. Kochi T, Shimizu M, Ohno T, Baba A, Sumi T, Kubota M, et al. Enhanced development of azoxymethane-induced colonic preneoplastic lesions in hypertensive rats. *Int J Mol Sci.* 2013;14(7):14700-11. doi: [10.3390/ijms140714700](https://doi.org/10.3390/ijms140714700)
47. Ager EI, Neo J, Christophi C. The renin-angiotensin system and malignancy. *Carcinogenesis.* 2008;29(9):1675-84. doi: [10.1093/carcin/bgn171](https://doi.org/10.1093/carcin/bgn171)