

RESEARCH ARTICLE

Implementation of Screening Colonoscopy amongst First-Degree Relatives of Patients with Colorectal Cancer in Turkey: a Cross-Sectional Questionnaire Based Survey

Yesim Adakan¹, Muharrem Taskoparan², Ayhan Hilmi Cekin³, Adil Duman³, Ferda Harmandar³, Vildan Taskin^{3*}, Ustun Yilmaz¹, Bayram Yesil¹

Abstract

Objective: To evaluate the implementation of screening colonoscopy amongst first-degree relatives (FDRs) of patients with colorectal cancer (CRC) in Turkey. **Materials and Methods:** A total of 400 first-degree relatives (mean(SD)age: 42.5(12.7) years, 55.5% were male) of 136 CRC patients were included in this cross-sectional questionnaire based survey. Data on demographic characteristics, relationship to patient and family history for malignancy other than the index case were evaluated in the FDRs of patients as were the data on knowledge about and characteristics related to the implementation of screening colonoscopy using a standardized questionnaire form. **Results:** The mean(SD) age at diagnosis of CRC in the index patients was 60.0(14.0) years, while mean(SD) age of first degree relatives was 42.5(12.7) years. Overall 36.3% of relatives were determined to have knowledge about colonoscopy. Physicians (66.9%) were the major source of information. Screening colonoscopy was recommended to 19.5% (n=78) of patient relatives, while 48.7% (n=38) of individuals participated in colonoscopy procedures, mostly (57.9%) one year after the index diagnosis. Screening colonoscopy revealed normal findings in 25 of 38 (65.8%) cases, while precancerous lesions were detected in 26.3% of screened individuals. In 19.0% of FDRs of patients, there was a detected risk for Lynch syndrome related cancer. **Conclusions:** In conclusion, our findings revealed that less than 20% of FDRs of patients had received a screening colonoscopy recommendation; only 48.7% participated in the procedure with detection of precancerous lesions in 26.3%. Rise of awareness about screening colonoscopy amongst patients with CRC and first degree relatives of patients and motivation of physicians for targeted screening would improve the participation rate in screening colonoscopy by FDRs of patients with CRC in Turkey.

Keywords: Screening colonoscopy - colorectal cancer - first-degree relatives - awareness

Asian Pac J Cancer Prev, 15 (14), 5523-5528

Introduction

Colorectal cancer (CRC) is the second most common cancer following prostate cancer in men and breast cancer in women with worldwide age-standardized incidence rate of 20.1 per 100,000 in men and 14.6 per 100,000 in women depending on the development levels of the countries (Parkin et al., 2002). According to 2007-2008 Cancer Registry Data published by the Ministry of Health in Turkey, CRC was determined to be the third most common cancer in females with prevalence of 7.8% and fourth most common cancer in males with prevalence of 7.5% (Turkish Ministry of Health Public Health Institute, 2008).

Approximately 20% to 25% of cases of CRCs occur in patients with a family history of CRC (Johns and Houlston, 2001), while first-degree relatives (FDRs) are at increased risk of CRC with an associated relative risk

of 2.24 (Butterworth et al., 2006).

The characteristic pathophysiology of CRC that involves a slow, latent progression from the first appearance of an adenomatous polyp to the development of CRC has made colonoscopy an ideal screening tool to fight CRC (Muto et al., 1975; Murakami et al., 1990). Offering early detection and colonoscopic excision of precancerous polyps before they transform to CRC (Murakami et al., 1990; Winawer et al., 1993; Bronner et al., 2013), screening colonoscopy has been associated with a substantial decrease in the incidence (Winawer et al., 1993) and mortality rate (Kahi et al., 2009) of CRC in average-risk individuals and FDRs of CRC cases (Lieberman, 1995).

Accordingly, FDRs (parent, sibling or child) of patients with CRC or adenomatous polyps are advised to have screening colonoscopy according to current guidelines

¹Department of Internal Medicine, Antalya Training and Research Hospital, Antalya, ²Department of Gastroenterology, Ankara Guven Hospital, ³Department of Gastroenterology, Antalya Training and Research Hospital, Antalya, Turkey *For correspondence: ayhancekin@hotmail.com

which state that screening procedures should start at age 40 years or 10 years younger than the earliest diagnosis in their family, whichever comes first (Winawer et al., 2003; Schmiegell et al., 2004).

However, besides lack of a consensus regarding screening guidelines across organizations, poor adherence to recommendations in guidelines concerning screening colonoscopy in high-risk people has been suggested (Sewitch et al., 2007; Ingrand et al., 2009), as well as low participation of FDRs of CRC patients in the procedure that ranges from 30% to 64% (Bleiker et al., 2005; Denis et al., 2007; Ingrand et al., 2009).

Therefore, the present cross-sectional questionnaire based survey was designed to evaluate the implementation of screening colonoscopy amongst the FDRs of patients with CRC in Turkey.

Materials and Methods

Study population

A total of 400 FDRs (mean(SD)age: 42.5(12.7) years, 55.5% were females) of 136 patients diagnosed with stage International Union Against Cancer (UICC) I-III CRC during their admission to Antalya Training and Research Hospital (n=88, 64.7%) and Ankara Guven Hospital (n=48, 35.3%) were included in this cross-sectional questionnaire-survey based on their voluntary participation.

Written informed consent was obtained from each subject following a detailed explanation of the objectives and protocol of the study which was conducted in accordance with the ethical principles stated in the "Declaration of Helsinki" and approved by the institutional ethics committee.

Study parameters

Data on demographic characteristics, localization of CRC and family history for malignancy were collected in patients with CRC based on medical records. Demographic characteristics, relationship to patient and family history for malignancy other than the index case were evaluated in the FDRs of CRC patients with application of a standardized questionnaire form via face to face method. FDRs were also questioned considering screening colonoscopy including collection of data on the knowledge about screening colonoscopy, source of information, rate of recommendation and application of the procedure along with findings in applied cases as well as the risk for Lynch syndrome related cancer.

Additionally, the rates of having knowledge about screening colonoscopy and receiving screening colonoscopy recommendation were compared with respect to hospital type and the risk for Lynch syndrome related cancer as evaluated in accordance with revised Bethesda criteria (Lynch et al., 2007) in the first degree relatives.

Statistical analysis

Statistical analysis was made using STATA version 10.0. Chi-square (χ^2) test or Fischer's exact test were used for the comparison of categorical data. Numerical data were analyzed using Students' t test for variables

with normal distribution, while Mann-Whitney U test was used for non-normally distributed variables. Data were expressed as "mean (standard deviation; SD)", minimum-maximum and percent (%) where appropriate. $p < 0.05$ was considered statistically significant.

Results

Characteristics of patients diagnosed with CRC

The mean(SD) age at diagnosis of CRC in the index patients (n=136, 64.0% were males) was 60.1(14.0) years. Rectum (30.9%) was the most common tumor localization and family history for malignancy was positive in 31.6% for more than one type of malignancy in 12.5% and CRC in 10.3% (Table 1).

Characteristics of FDRs of patients with colon carcinoma

Mean(SD) age of first degree relatives (55.5% were males) was 42.5(12.7) years and 68.5% were children of patients with CRC. Family history for malignancy except for the index case was positive in 16.0% of FDRs for more than one type of malignancy in 2.3% and CRC in 5.3% (Table 2).

Data on screening colonoscopy in FDRs of patients

Overall 36.3% (n=145) of FDRs of patients with CRC were determined to have knowledge about colonoscopy. Physicians (66.9%), mostly from general surgery (46.4%) and gastroenterology (38.1%) disciplines were the major source of information. Screening colonoscopy was recommended to 19.5% (n=78) of patient relatives, by a surgeon in 60.3% and by a gastroenterologist in 32.1%, while 48.7% (n=38) of these individuals participated in colonoscopy procedures, mostly (57.9%) one year after the index diagnosis. Screening colonoscopy revealed normal findings in 25 of 38 (65.8%) cases, while precancerous

Table 1. Characteristics of Patients Diagnosed with Colorectal Cancer (n=136)

		No.	(%)
Gender	Female	49	(36.0)
	Male	87	(64.0)
Age at diagnosis	Mean(SD)	60.1	(14.0)
	Median(min-max)	60.0	(26.0-92.0)
Hospital type	Training and research	88	(64.7)
	Private hospital	48	(35.3)
Localization of colorectal cancer	Rectum	42	(30.9)
	Sigmoid colon	20	(14.7)
	Descending colon	9	(6.6)
	Transverse colon	4	(2.9)
	Ascending colon	14	(10.3)
	Not defined	47	(34.6)
Co-morbid malignancy	None	134	(98.5)
	Testicular carcinoma	1	(0.7)
	Endometrial carcinoma	1	(0.7)
Family history for malignancy	None	93	(68.4)
	More than one type	17	(12.5)
	Colon cancer	14	(10.3)
	Lung cancer	5	(3.7)
	Breast cancer	4	(2.9)
	Ovary cancer	1	(0.7)
	Gastric cancer	1	(0.7)
	Pancreas cancer	1	(0.7)

Table 2. Characteristics of First-Degree Relatives of Patients with Colon Carcinoma (n=400)

		No.	(%)
Gender	Female	178	(44.5)
	Male	222	(55.5)
Age (years)	Mean(SD)	42.5	(12.7)
	Median (min-max)	42.0	(18.0-81.0)
Relationship to patient	Child	274	(68.5)
	Sibling	120	(30.0)
	Parent	6	(1.5)
Family history for malignancy (except for the index case)	None	336	(84.0)
	More than one type	9	(2.3)
	Colon cancer	21	(5.3)
	Lung cancer	8	(2.0)
	Breast cancer	13	(3.3)
	Larynx cancer	4	(1.0)
	Thyroid cancer	4	(1.0)
	Brain cancer	3	(0.8)
Ovary cancer	2	(0.5)	

Table 3. Data on Screening Colonoscopy in First Degree Relatives of Patients

Knowledge about screening colonoscopy	Absent	255	(63.8)
	Present	145	(36.3)
Source of information on screening colonoscopy (n=145)	Physician	97	(66.9)
	TV	12	(8.3)
	Internet	9	(6.2)
	Print media	1	(0.7)
	Other	27	(18.6)
	Specialty of informing physicians (n=97)	Family medicine	1
Internal medicine		7	(7.2)
General surgery		45	(46.4)
Gastroenterology		37	(38.1)
Medical Oncology		7	(7.2)
Screening colonoscopy		Not recommended	322
	Recommended	78	(19.5)
	By a surgeon	47	(60.3)
	By a gastroenterologist	25	(32.1)
	By an internal medicine specialist	3	(3.8)
	By a medical oncologist	3	(3.8)
	Not applied	362	(90.5)
	Applied	38	(9.5)
Findings	1-year after the index diagnosis	22	(57.9)
	2 years after the index diagnosis	4	(10.5)
	3 years after the index diagnosis	3	(7.9)
	5 years after the index diagnosis	1	(2.6)
	Before the index diagnosis	7	(18.4)
	Unknown	1	(2.6)
	Normal	25	(65.8)
	Precancerous lesion	10	(26.3)
Lynch syndrome	Cancer	2	(5.3)
	Inflammatory bowel disease	1	(2.6)
	Absent	324	(81.0)
Present	76	(19.0)	

lesion was detected in 26.3% of screened individuals. In 19.0% of FDRs of patients, there was a detected risk for Lynch syndrome related cancer and further genetic investigation for microsatellite instability was recommended to these individuals (Table 3).

Table 4. Data on Screening Colonoscopy in First Degree Relatives of Patients with Respect to Hospital type and Lynch Syndrome

Hospital type	Screening colonoscopy	
	Informed	Recommended
Training and research hospital (n=261)	67(25.7)	27(10.3)
Private hospital (n=139)	78(56.1)	51(36.7)
p value	<0.001	<0.001
Lynch syndrome		
Present (n=76)	42(55.3)	35(46.1)
Absent (n=324)	103(31.8)	43(13.3)
p value	<0.001	<0.001

*Data were shown as n(%)

Screening colonoscopy in FDRs of patients with respect to hospital type and Lynch syndrome

Significantly higher percentage of FDRs of patients from private than research and training hospitals were determined to have knowledge about screening colonoscopy (51.6 vs 25.7%, $p<0.001$) and to receive a screening colonoscopy recommendation (36.7 vs 10.3%, $p<0.001$) (Table 4).

When compared to individuals without a risk, having a risk for Lynch syndrome related cancer was associated with higher likelihood of having knowledge about screening colonoscopy (55.3 vs 31.8%, $p<0.001$) and receiving a screening colonoscopy recommendation (46.1 vs 13.3%, $p<0.001$) among FDRs of patients with CRC (Table 4).

Discussion

This cross-sectional questionnaire based survey on the implementation of screening colonoscopy amongst FDRs of patients with CRC in Turkey revealed that 19.5% of FDRs of patients had received a screening colonoscopy recommendation, while only 48.7% of them had participated in the recommended colonoscopy procedures, mostly (57.9%) one year after the diagnosis of index case. Screening colonoscopy revealed normal findings in 65.8%, while a precancerous lesion was detected in 26.3% of screened FDRs of CRC patients.

Despite the evidence supporting reductions in morbidity and mortality related to CRC in average-risk individuals who aged ≥ 50 years (Nadel et al., 2002; Levenson, 2003; Sewitch et al., 2007), underutilization of CRC screening has been consistently reported in several studies, at rates ranging from 18% to 34% (Bronner et al., 2013). Along with poor adherence to recommendations in guidelines on screening colonoscopy in high-risk people (Ingrand et al., 2009), it has also been suggested that FDRs of CRC patients are likely to disregard recommendations with participation rates ranging from 30% to 64% (Bleiker et al., 2005; Denis et al., 2007; Ingrand et al., 2009).

Accordingly, in our study population, less than 20% of FDRs of CRC patients were determined to receive screening colonoscopy recommendation and less than 50% to participate in screening procedure which is in agreement with the statement that the screening process has only been performed in a minority of people, with a documented elevated risk for CRC (Ruthotto et al., 2007).

The low rates of offering colorectal cancer screening to FDRs of CRC patients in the present study seems notable given the consistently reported failure of patients to follow the health care provider's advice leading remarkably low uptake rates even if the high proportion of patients have been advised appropriately (Yusoff et al., 2012).

In a past study on FDRs of patients with CRC, it was reported that screening colonoscopies were performed only in 32% of parents (60.1% before the index case, 39.9% after the index case) and in 39% of siblings (31.7% before the index case, 68.3% after the index case) (Ruthotto et al., 2007). Data from a past study conducted with 1534 FDRs (1381 siblings and 153 parents) of 406 patients with CRC in Turkey revealed that the frequency of screening colonoscopy in parents and siblings of the index patients was 9% and 20% after the diagnosis of CRC in the index patient, respectively, while 38% of the patients was aware of the increased risk for their FDRs (Kilickap et al., 2012).

In our study population, 68.5% of individuals were children of CRC patients, while 30.0% were their siblings. Compliance rate to procedure in our study was slightly higher to include 48.7% of cases eligible for colonoscopy, with application of screening colonoscopy more commonly after (78.9%; after one year in 57.9%) than before (18.4%) the index diagnosis.

A recent family cancer event was indicated as the most common motivator for a FDR to visit a general practitioner (Al-Habsi et al., 2008; Lim et al., 2011), while an increase in the likelihood of having a discussion about family history with a health professional was documented in parallel to the increase in the perceived risk (Honda and Neugut, 2004). Accordingly, higher likelihood of having knowledge about screening colonoscopy and receiving a screening colonoscopy recommendation among FDRs of CRC patients registered at private than research and training hospitals and also among FDRs with than without a risk for Lynch syndrome related cancer in our study population seems to emphasize the pivotal role of a more favorable patient-physician communication as well as the presence and awareness of high risk status in FDRs in better adherence to international guidelines on screening colonoscopy for FDRs of CRC patients.

Detecting precancerous polyps has been associated with a significant reduction in mortality given that the most important part of colorectal neoplasia is derived from polyps (Rex et al., 2000). In this respect, our finding related to identification of a precancerous lesion in 26.3% FDRs who were screened as recommended seems consistent with the well-known increased risk of developing CRC and the range of (6.7-13.3%) of advanced colorectal neoplasia in FDRs of patients with CRC (Ruthotto et al., 2007; Sewitch et al., 2007; Armelo et al., 2011).

While reaching out to FDRs to be able inform them about their level of risk and the corresponding screening recommendations is an integral part of the medical protocol, there is no standardized systematic mechanism for providing information about the risk for family members of the index case (Bronner et al., 2013; Cameron et al., 2013). Notably, in a past study on physician views on screening colonoscopy in FDRs of CRC patients,

participated general practitioners were reported to identify that someone other than themselves was better placed to give the information, while gastroenterologist and surgeons preferred the transfer of educational information materials by index patients themselves to their relatives and the latter to their general practitioners (Ingrand et al., 2009).

In this regard, it should be emphasized that consistent with the statement that doctor endorsement is a key factor in promoting screening participation (Lim et al., 2011; Cameron et al., 2013), physicians were the major source of information (66.9%) identified by FDRs of CRC patients in our study population, while general surgeons (46.4%) and gastroenterologists (38.1%) were the principal information providers rather than the family medicine specialists (1.0%).

Unfortunately, it has been documented that ranging from 30% to 69% according to studies, most of the physicians were not aware of the low rates of participation in colonoscopy screening (Longacre et al., 2006; Ingrand et al., 2009) and they were convinced that the great majority of FDRs get themselves screened (Ingrand et al., 2009). Based on the statement that being asked by a health professional about their family history of CRC was a significant predictor of being screened in accordance to guidelines among FDRs (Courtney et al., 2013), it seems necessary to raise awareness of physicians involved in the care of CRC patients about the actual compliance rate of FDRs for screening colonoscopy besides their predominant role as physicians in motivating their patients to participate in screening through their advice and recommendations (Ingrand et al., 2009).

Lack of symptoms related to colon disease has been indicated amongst the most common reasons for low screening colonoscopy rates (Chong et al., 2013), while data from a multicentre questionnaire study in the Asia Pacific regions revealed lesser likelihood of undergoing colonoscopy screening if patients were well and perceived low risk (Koo et al., 2012).

Notably, consistent with the clear evidence for suboptimal adherence to colonoscopy screening among FDRs of CRC patients, an acknowledged high-risk population (Bronner et al., 2013), participation to screening colonoscopy was noted only in 48.7% of FDRs who received a screening colonoscopy recommendation in the present study. Hence, aside from physician's proper adherence to guidelines in terms of recommending screening colonoscopy, patient adherence to participate colonoscopy seems also considerably important in early detection of CRC among FDRs of an index case.

Supporting the demonstration of factors such as knowledge about CRC, a positive attitude toward screening, and physician recommendation amongst the possible predictors for CRC-screening participation in published studies (Ioannou et al., 2003; Ruthotto et al., 2007; Bronner et al., 2013), only 36.3% of FDRs in our study population identified that they had knowledge about screening colonoscopy. Besides, participation in screening colonoscopy after diagnosis in the index patients was reported to be significantly higher in those families where the index patients knew about the increased risk for CRC

in their families (Ruthotto et al., 2007).

In a past study concerning the risk factors and the health beliefs of Turkish people aged over 50 years regarding colorectal cancer screening, participation rates to colorectal cancer screening programs were reported to be low (11.3%) mostly due to lack of knowledge (81.3%) which was considered as the most important barrier for involvement in CRC screening programs (Tastan et al., 2013).

In a past study concerning the physician cognition to follow CRC screening guidelines in relation to main barriers in the clinical practice, overall poor cognition of CRC screening guidelines for high-risk populations was reported across all practitioners, even among gastroenterologists and oncologists despite their substantial role in the management of CRC (Chen et al., 2013).

Accordingly, by supporting establishment of family cancer registries (Vasen, 2008) along with implementation of training programs for raising awareness among physicians about adherence to guidelines on screening colonoscopy and CRC patients and their FDRs about the risk for CRC could translate into an increase in adherence rates to screening colonoscopy (Lieberman et al., 1995; Bronner et al., 2013).

Certain limitations to this study should be considered. First, the cross-sectional design limits causal inferences. Second, small sample size and potential for self-selection bias are inherent in qualitative methods and should be considered before generalizing the application of our findings in daily practice.

In conclusion, the findings from this cross-sectional questionnaire based survey on the implementation of screening colonoscopy amongst FDRs of patients with CRC in Turkey revealed less than 20% of FDRs of patients had received a screening colonoscopy recommendation, only 46.7% participated in the procedure with detection of precancerous lesion in 26.3%. Emphasizing the integral role of patient-physician communication and awareness of high-risk status in implementation of screening colonoscopy, FDRs of CRC patients from a private than a training-research hospital along with FDRs with than without a risk for Lynch syndrome related cancer were more likely to have knowledge about screening colonoscopy and to receive a screening colonoscopy recommendation. Our findings seem to indicate that rise of awareness about screening colonoscopy amongst patients with CRC and their FDRs and motivation of physicians for targeted screening would improve the participation rate in screening colonoscopy by FDRs of patients with CRC.

References

Al-Habsi H, Lim JN, Chu CE, Hewison J (2008). Factors influencing the referrals in primary care of asymptomatic patients with a family history of cancer. *Genet Med*, **10**, 751-7.

Armelaio F, Paternolli C, Franceschini G, et al (2011). Colonoscopic findings in first-degree relatives of patients with colorectal cancer: a population-based screening program. *Gastrointest Endosc*, **73**, 527-34.

Bleiker EM, Menko FH, Taal BG, et al (2005). Screening behavior of individuals at high risk for colorectal cancer. *Gastroenterology*, **128**, 280-7.

Bronner K, Mesters I, Weiss-Meilik A, et al (2013). Determinants of adherence to screening by colonoscopy in individuals with a family history of colorectal cancer. *Patient Educ Couns*, **93**, 272-81.

Butterworth AS, Higgins JP, Pharoah P (2006). Relative and absolute risk of colorectal cancer for individuals with a family history: a meta-analysis. *Eur J Cancer*, **42**, 216-27.

Cameron E, Rose S, Carey M (2013). Assessment of family history of colorectal cancer in primary care: perceptions of first degree relatives of people with colorectal cancer". *Patient Educ Couns*, in press. <http://dx.doi.org/10.1016/j.pec.2013.11.014>

Chen YS, Xu SX, Ding YB, et al (2013). Colorectal cancer screening in high-risk populations: a survey of cognition among medical professionals in Jiangsu, China. *Asian Pac J Cancer Prev*, **14**, 6487-91.

Chong VH, Bakar S, Sia R, et al (2013). Colorectal cancer screening among government servants in Brunei Darussalam. *Asian Pac J Cancer Prev*, **14**, 7657-61.

Courtney RJ, Paul CL, Carey ML, et al (2013). A population-based cross-sectional study of colorectal cancer screening practices of first-degree relatives of colorectal cancer patients. *BMC Cancer*, **13**, 13.

Denis B, Schon G, Ruetsch M, et al (2007). Cancer screening by primary care physicians: a chart audit. *Presse Med*, **36**, 217-23.

Honda K, Neugut AI (2004). Associations between perceived cancer risk and established risk factors in a national community sample. *Cancer Detect Prev*, **28**, 1-7.

Ingrand I, Dujonquoy S, Beauchant M, et al (2009). General practitioner and specialist views on colonoscopic screening of first-degree relatives of colorectal cancer patients. *Cancer Epidemiol*, **33**, 223-30.

Ioannou GN, Chapko MK, Dominitz JA (2003). Predictors of colorectal cancer screening participation in the United States. *Am J Gastroenterol*, **98**, 2082-91.

Johns LE, Houlston RS (2001). A systematic review and meta-analysis of familial colorectal cancer risk. *Am J Gastroenterol*, **96**, 2992-3003.

Kahi CJ, Imperiale TF, Juliar BE, et al (2009). Effect of screening colonoscopy on colorectal cancer incidence and mortality. *Clin Gastroenterol Hepatol*, **71**, 770-5.

Kilickap S, Arslan C, Rama D, Yalcin S (2012). Screening colonoscopy participation in Turkish colorectal cancer patients and their first degree relatives. *Asian Pac J Cancer Prev*, **13**, 2829-32.

Koo JH, Leong RW, Ching J, et al (2012). Asia pacific working group in colorectal cancer knowledge of, attitudes toward, and barriers to participation of colorectal cancer screening tests in the Asia-Pacific region: a multicenter study. *Gastrointest Endosc*, **76**, 126-35

Levenson D (2003). CDC says colorectal cancer screening rates remain low. *Rep Med Guidel Outcomes Res*, **14**, 10-2.

Lieberman DA (1995). Cost-effectiveness model for colon cancer screening. *Gastroenterology*, **109**, 1781-90.

Lim JN, Hewison J, Chu CE, Al-Habsi H (2011). Factors influencing consultation to discuss family history of cancer by asymptomatic patients in primary care. *J Community Genet*, **2**, 19-26.

Longacre AV, Cramer LD, Gross CP (2006). Screening colonoscopy use among individuals at higher colorectal cancer risk. *J Clin Gastroenterol*, **40**, 490-6.

Lynch HT, Lynch JF, Lynch PM (2007). Towards a consensus in molecular diagnosis of hereditary non-polyposis colorectal

- cancer (Lynch Syndrome). *J Natl Cancer Inst*, **99**, 261-3.
- Turkish Ministry of Health Public Health Institute (2008). Evaluation reports by the cancer control directorate general of the turkish public health institute: colorectal cancer screening. <http://www.kanser.gov.tr/Dosya/Bilgi-Dokumanlari/raporlar/kolorektal.pdf> (in Turkish)
- Murakami R, Tsukuma H, Kanamori S, et al (1990). Natural history of colorectal polyps and the effect of polypectomy on occurrence of subsequent cancer. *Int J Cancer*, **46**, 159-64.
- Muto T, Bussey HJ, Morson BC (1975). The evolution of cancer of the colon and rectum. *Cancer*, **36**, 2251-70.
- Nadel MR, Blackman DK, Shapiro JA, Seeff LC (2002). Are people being screened for colorectal cancer as recommended? Results from the National Health Interview Survey. *Prev Med*, **35**, 199-206.
- Parkin DM, Whelan SL, Ferlay J, Teppo L, Thomas DB (2002). *Cancer Incidence In Five Continents*, vol. VIII. Lyon, France: International Agency for Research on Cancer [IARC Scientific Publication No. 155].
- Rex DK, Johnson DA, Lieberman DA, Burt RW, Sonnenberg A (2000). Colorectal cancer prevention 2000. Screening recommendations of the American College of Gastroenterology. *American College of Gastroenterology. Am J Gastroenterol*, **95**, 868-77.
- Ruthotto F, Papendorf F, Wegener G, et al (2007). Participation in screening colonoscopy in first-degree relatives from patients with colorectal cancer. *Ann Oncol*, **18**, 1518-22.
- Schmiegel W, Pox C, Adler G et al (2004). S3-guidelines conference 'colorectal carcinoma' 2004. *Z Gastroenterol*, **42**, 1129-77.
- Sewitch MJ, Fournier C, Dawes M, et al (2007). Do physician recommendations for colorectal cancer screening differ by patient age? *Can J Gastroenterol*, **21**, 435-8.
- Tastan S, Andsoy II, Iyigun E (2013). Evaluation of the knowledge, behavior and health beliefs of individuals over 50 regarding colorectal cancer screening. *Asian Pac J Cancer Prev*, **14**, 5157-63.
- Vasen HF (2008). Can the identification of high risk groups increase the effectiveness of colon cancer screening programmes? *Z Gastroenterol*, **46**, 41-42.
- Winawer S, Fletcher R, Rex D, et al (2003). Colorectal cancer screening and surveillance: clinical guidelines and rationale-Update based on new evidence. *Gastroenterology*, **124**, 544-60.
- Winawer SJ, Zauber AG, Ho MN, et al (1993). Prevention of colorectal cancer by colonoscopic polypectomy. *N Engl J Med*, **32**, 1977-81.
- Yusoff HM, Daud N, Noor NM, Rahim AA (2012). Participation and barriers to colorectal cancer screening in Malaysia. *Asian Pac J Cancer Prev*, **13**, 3983-7.