Preventive Medicine Reports 36 (2023) 102468

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr

Trend of the polyp and adenoma detection rate by sex and age in asymptomatic average-risk and high-risk individuals undergoing screening colonoscopy, 2012–2019

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ARTICLE INFO

Keywords:
Trend
Colorectal cancer
Screening
Adenoma detection rate
Polyp detection rate
Colonoscopy

ABSTRACT

Adenoma detection rate (ADR) is an imperative quality measure for colorectal cancer (CRC) screening. This retrospective observational study aimed to determine the trend of polyp detection rate (PDR) and ADR in asymptomatic average- and high-risk participants in different age groups who underwent screening colonoscopy over the seven years from April 2012 to March 2019 in a tertiary gastroenterology referral center of Iran. Of 1676 participants, 51.8 % were men (mean age 52.3 years). The overall PDR and ADR were 22.7 %, and 13.5 %, respectively. Both Polyps and adenomas were more common in age groups 51–59 and ≥60 years in high-risk patients than in the corresponding groups of average-risk patients ($p < 0.05$). Also, both PDR and ADR were more frequent in men than in women among all studied age groups, but it was statistically significant only for the youngest age group (16.8 % versus 10.5 %, $p < 0.05$) for PDR and the oldest age group (19.7 % versus 13 %, $p < 0.05$) for ADR, respectively. The trend of total ADR was upward over 7 years in both average-risk (6.7 % to 13.3 %) and high-risk (9.8 % to 27 %) groups and across all age groups in both sexes. Multivariable logistic regression revealed that high-risk individuals had an elevated risk of adenoma compared with average-risk patients (OR: 1.6, $p = 0.006$). Substantial variation in thresholds of polyp and adenoma detection by age, sex, and risk categories emphasizes the need for a risk-adapted approach to CRC screening and prevention programs.

1. Introduction

According to GLOBCANE 2023, after prostate cancer and lung cancer, colorectal cancer (CRC) is one of the three cancers responsible for almost half (45 %) of all incidences in men and in women, and together with breast and lung cancers, it responsible for 52 % of all newly diagnosed cancer cases. It is the third cause of death due to cancer in women and men. (Morgan et al., 2023) 60 % increase in the global burden of CRC and 2.2 million new cases is estimated by 2030 (Arnold et al., 2017). The CRC incidence has a global divergence, with up to 25 times different from country to country. Transitioned countries such as the United States and New Zealand have a high incidence, and an increase in newly diagnosed CRC cases is reported in transitioning countries. Asian countries have shown the highest increase in the rate in recent decades. CRC in Iran has the highest incidence rate per 100,000 (age-standardized incidence rate (ASR) = 14.6) after stomach and prostate cancers in men and the second after breast cancer in women (ASR = 11.1), and the highest mortality rates (ASR = 5.6) after stomach and lung cancers in both sexes (Zendehdel, 2020).

CRC is a heterogeneous disease with various types of precursor lesions (adenomatous polyps). The 5-year survival rate is 90 % if the tumor is limited to the colon mucosa, but when it spreads to the regional lymph nodes, its rate reaches 60 % and in the metastatic state, it is only 10 % (Eriksson et al., 2008). About 10 % to 30 % of CRCs occur in individuals with a family history of CRC, but in most cases, it is sporadic (Dolatabadi et al., 2022). Among various screening techniques, colonoscopy is a precise and highly effective screening tool for detecting bowel polyps (Cardoso et al., 2017). Colonoscopy is the gold standard of

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https://doi.org/10.1016/j.pmedr.2023.102468
Received 7 February 2023; Received in revised form 8 October 2023; Accepted 9 October 2023
Available online 10 October 2023

CRC screening, due to its dual role as a diagnostic and interventional tool to detect and remove adenomas and precancerous lesions. According to a prospective observational study, the incidence and mortality of CRC were reduced by 67 % and 65 %, respectively, in a population who underwent screening colonoscopy compared to the general population (Kahi et al., 2009). Another study showed that screening colonoscopy may reduce the incidence and mortality rates of CRC by 48 % and 81 %, respectively although a new randomized trial reported less than expected reductions after only 10 years (Pezzoli et al., 2007; Bretthauer et al., 2022). The United States National Polyp Study in 1993 reported a 76–90 % reduction in CRC incidence by colonoscopic polypectomy (Menees et al., 2013). Since 1997, the American Gastroenterological Association (AGA) has recommended screening in the average-risk group of the population, including asymptomatic individuals aged 50 and above without a family history of cancer (Ionescu et al., 2015). It has been suggested that about 75 % of all CRCs occur among this group (Niederreiter et al., 2019; Courtney et al., 2012). Otherwise, they would be in the high-risk group and are recommended to receive more intensive screening starting from younger ages (Aghdaei et al., 2017; Keum and Giovannucci, 2019).

Adenoma detection rate (ADR) is defined as the number of colonoscopies in which at least one adenoma is diagnosed, and is an imperative quality indicator for a screening colonoscopy (Atia et al., 2015). To measure ADR, it should be waiting for the histology data, the colonoscopy and pathology reports must be checked for each patient, and finally, the data must be analyzed based on gender. Thus, this process (ADR measurement) can be time-consuming and cumbersome. Considering that the polyp detection rate (PDR) is also an appropriate quality measure for screening, this may help to improve the CRC screening guidelines in developing countries (Aghdaei et al., 2017). The advantage of PDR is that the entry of pathology data is not require and various studies showed good correlation of that with ADR. However, there are few studies that have investigated the related ratio of ADR to PDR in Middle East countries such as Iran.

Besides organized screening programs, there is also opportunistic screening, i.e., people who undergo screening of their own will or those who are recommended for a colonoscopy by their physician for unrelated conditions (Ionescu et al., 2015). Opportunistic CRC screening is not usually recommended for a population because it is both less effective and more costly. On the other hand, since very early-onset CRC incidence (diagnosis of CRC before age 40) is increasing in Middle East countries (20 % compared to 2–8 % reported in the U.S), we need to determine the trend of colorectal polyps especially adenomas in different sex and age groups that undertake opportunistic and standard colonoscopy screening over the last several years. It can help clarify the efficacy of this cancer screening program. Also, to our knowledge, there are very few studies that investigate the changing trend of polyp and adenoma detection over several consecutive years in intermediate-risk and high-risk people. Therefore, the present study was undertaken with two aims: a) to examine the trend of PDR and ADR in asymptomatic average-risk and high-risk patients in different age groups over the last seven years, and b) to identify benchmark PDR and ADR for men and women.

2. Methods

2.1. Study design

We performed a retrospective observational study of patients who underwent colonoscopy at Poursina Hakim Gastroenterology Clinic, Digestive Diseases Research Center (PDDRC), Isfahan, Iran. All data were extracted and collected anonymously from the colonoscopy database and pathology reports between 2012 and 2019 and further analyzed. The study protocol was approved by the Ethics Committee of the Isfahan University of Medical Sciences, Isfahan, Iran (IR.MUI.MED.REC.1398.379).

2.2. Study procedures and patients

The colonoscopy examinations were performed in PDDRC between 2012 and 2019 with the standard colonoscopes (EC-3830L, EC-3840F Pentax; Olympus CF-230I; Fujifilm EC-590, EC-3000MP, Tokyo, Japan) by expert gastroenterologists. The colonoscopies were categorized as complete if the cecum was visualized. Subjects included in the study were both average-risk and high-risk for CRC who underwent total colonoscopy as a primary screening procedure (opportunistic screening or according to the organized screening program) from April 2012 to March 2019. High-risk patients were individuals with i) hereditary nonpolyposis colorectal cancer (HNPCC), or familial adenomatous polyposis (FAP), ii) personal history of inflammatory bowel disease (IBD), colorectal polyps, or CRC, and iii) family history of CRC or colorectal polyps in one or more first-degree relatives. Otherwise, Subjects were placed in the average-risk group. The colonoscopy reports without the essential data described above or with colorectal disease-related symptoms or signs (i.e., gastrointestinal bleeding, change of bowel habit, unexplained weight loss, or miscellaneous lesions) were excluded from this study.

2.3. Data collection

We retrieved the data from patients' records on sex, age, risk categorization, year of the colonoscopy, and colonoscopy report.

2.4. Measurements

We calculated the PDR and ADR in all colonoscopies undergone between 2012 and 2019. PDR and ADR was defined as the number of colonoscopies with at least one polyp and adenoma detected respectively, divided by the total number of complete colonoscopies performed.

2.5. Statistical analysis

Categorical variables were expressed as numbers and percentages and continuous variables as means and standard deviations (±SD). Chi-square test were used for comparing the categorical variables. Differences in the ADR and PDR between the groups were analysed using multivariable logistic regression after confounding adjustment. All analyses were performed using R software version 4.0.2. $p < 0.05$ was considered statistically significant.

3. Results

This study was performed initially on 2358 patients who underwent colonoscopy during the period of 7 years from 2012 to 2019. Due to incomplete data, 682 cases were excluded. The patients' characteristics are shown in Table 1. Among 1676 study participants, 48.2 % were women and 51.8 % were men. The mean age was 52±13.2 for women and 52.6±14 for men. The patients were divided into four age groups including: ≤40, 41–50, 51–59, and ≥60. The majority of patients were at age 60 or older (32.8 %). Polyps were detected in 22.7 % of

Table 1
Distribution of sex by age among 1676 study participants.

	All n (%)	Men n (%)	Women n (%)
All ages	1676 (100)	869 (51.8)	807 (48.2)
≤40	365 (21.8)	194 (22.3)	171 (21.2)
41–50	251 (15)	128 (14.7)	123 (15.2)
51–59	510 (30.4)	243 (28)[a]	267 (33)[b*]
≥60	550 (32.8)	304 (35)[a]	246 (30.5)[b*]
Mean ± SD	52.3±0.33	52.6±14.0	52.0±13.2

Data were analyzed using the Chi-square test. Values in the same row not sharing the same subscript alphabets are significantly different. *, $p < 0.05$.

colonoscopies, whereas histopathology showed 13.5 % of adenomas. According to colonoscopy records, 1116 patients were at average risk (503 women and 613 men) and 560 patients were at high risk (304 women and 256 men; Table 2). Most of high-risk patients aged ≤40, whereas in the average-risk group were mostly ≥60 years old. The participants in all age categories in the average-risk group were more than in the high-risk group and the difference was significant ($p < 0.05$) in two upper age categories (51–59 and ≥60). Furthermore, both PDR and ADR in high-risk patients were higher than that of average-risk patients. The ADR in both sexes in HRs was more than that in the corresponding groups of AR, but PDR was statistically significant only for the high risks' men (Table. 3). Moreover, significantly higher PDR and ADR were found in two upper age groups (51–59 and ≥60) in high-risk patients that of the corresponding groups of average-risk patients ($p < 0.05$).

Multivariable logistic regression was applied to reveal the probable association of age, risk, and sex with the detection of colorectal polyps and adenomas (Table. 4). According to the multivariable logistic regression, men had increased risk for adenomas respect to women (OR, 2.37; CI, 1.75–3.21; $p = 0.00$) but there was no association between PDR and sex. The likelihood of detecting of polyps and adenomas increased with age. The analysis also showed an association between HR and increased risk for detection of polyp and adenomas compared to AR patients.

In all age groups studied, the total detection rate of polyps and adenomas in men was higher than that of women (total PDR of 24.6 % and 20.7 % and total ADR of 15.4 % and 11.5 % in men and women, respectively), but the difference was statistically significant only in the youngest age group for PDR (≤40 years, Fig. 1A) and the oldest age group for ADR (≥60 years, Fig. 1B).

The overall trend of detection of polyps increased over 7 years (2012 to 2019), from 16 % in 2012 to 22.7 % in 2015, and 25.4 % in 2019 (data are not shown). The ADR trends in different sex, age, and risk categories are shown in Fig. 2A – C.

4. Discussion

This study presents the pattern of polyp detection seen in a tertiary gastroenterology referral center between 2012 and 2019 in the central region of Iran. The majority of participants were at average risk for colorectal cancer, aged 60 years or older. The average-risk to high-risk ratio was 2.4 in men and 1.6 in women. The use of colonoscopy for early detection and removal of polyps plays an important role in reducing the incidence and mortality of CRC. There is little national evidence for the evaluation of colorectal polyps (Tolou-Ghamari, 2019; Bafandeh et al., 2008). Evaluation of the PDR and ADR in different ages, sex, and risk categories and implementation of its results into a risk-adapted national screening program could help improve the efficacy of such programs for CRC.

Little is known about PDR and ADR in high-risk individuals undergoing screening colonoscopy compared with those in moderate-risks. Based on the findings of our study, there was a significant higher PDR and ADR in HR compared to the AR patients (PDR: 26.3 vs. 21.0, $p < 0.05$; ADR: 18.4 vs. 11.1, $p < 0.01$, in HR and AR, respectively). While no statistically significant differences for PDR were found considering gender, male patients showed higher ADR respect to females ($p < 0.05$). It was contrary to the study of Cooper et al. which reported that PDR was higher in men respect to women. (Cooper et al., 2005). Although ADR was higher in the men compared to women in both risk categories but it was only statistically significant in AR patients, contracting reports from Sanaka et al. which showed higher ADR in men in comparison with women in both HR and AR participants (Sanaka et al., 2016).

This study also revealed that the overall PDR and ADR trend was upward from 2012 to 2019 (PDR: 17.9 % to 25.4 %; ADR: 10.7 % to 16 %), in both risk categories especially in HR patients (PDR: 19.5 % to 31 %; ADR: 9.8 % to 27 %). This increase may be due to a real increase in the prevalence of adenomatous polyps in the community, the increase in the skills of endoscopists over the years, and the use of more modern polyp detection tools in recent years than in the past. Other studies of different parts of Iran have reported an overall PDR of 14.4 % (Sung et al., 2020; Bafandeh and Yazdanpanah, 2017), 23.5 %, and 42 % (Shadmani et al., 2017; Maajani et al., 2019; Delavari et al., 2014; Almadi et al., 2014). A retrospective study of 559 patients found a PDR of 20 % in patients who had undergone colonoscopy at a Malaysian tertiary hospital (Jun et al., 2019). Results of studies in Asian countries have reported an overall PDR of 20 % and 20.8 % (Cardoso et al., 2017; Soodejani et al., 2020). These prevalence rates from Asia and some African countries (Azad et al., 2020; Boroff et al., 2013) are much lower than in Europe and North America, with reported PDR of 45.8 %, and

Table 2
Distribution of risk by sex and age among study participants, 2012–2019.

Characteristics	Patient Characteristics	
	Average-risk n (%)	High-risk n (%)
All		
Sex	1116 (66.6)	560 (33.4)
Men	613 (70.5)	256 (29.5)**
Women	503 (62.3)	304 (37.7)**
Age group, y		
≤40	196 (17.6)	169 (30.2)
41–50	126 (11.3)	125 (22.3)
51–59	362 (32.4)	148 (26.4)*
≥60	432 (38.7)	118(21.1)*

Data were analyzed using the Chi-square test. Values in the same row not sharing the same subscript alphabets are significantly different. *, $p < 0.01$; **, $p < 0.001$.

Table 3
Polyp detection rate (PDR) and adenoma detection rate (ADR) by risk, sex, and age group, 2012–2019.

Variables	Total	PDR (%)		Total	ADR (%)	
		AR	HR		AR	HR
All	22.7	21.0[a]	26.3[b*]	13.5	11.1[a]	18.4[b**]
Gender						
Men	24.6	21.9[a]	31.3[b*]	15.4	13.9[a]	19.1[b*]
Women	20.7	19.9	22.0	11.5	7.8[a]	17.8[b**]
Age group, y						
≤40	14.8	14.8	14.8	6.8	3.6[a]	10.7[b**]
41–50	21.0	19.0	23.2	11.2	9.5	12.8
51–59	24.3	21.5[a]	31.1[b*]	16.1	11.3[a]	27.7[b**]
≥60	27.3	23.8[a]	39.8[b**]	16.7	14.8[a]	23.7[b*]

AR: average risk, HR: high risk. Data were analyzed using the Chi-square test. Values in the same row not sharing the same subscript alphabets are significantly different. *, $p < 0.05$, **, $p < 0.01$.

Table 4
Logistic regression analysis of factors associated with detection of colorectal adenoma and polyp among the studied groups, 2012–2019.

Variables	Multivariable analysis (ADR)			Multivariable analysis (PDR)		
	OR	95 %CI	p	OR	95 %CI	p
Age at diagnosis, y	1.03	1.022–1.045	0.000	1.024	1.015–1.034	0.000
Sex (men vs. women)	2.37	1.754–3.217	0.000	1.261	0.999–1.592	0.051
Risk (HR vs. AR)	1.7	1.122–2.007	0.006	1.603	1.25–2.057	0.000

OR, odds ratio; CI, confidence interval; AR, average risk; HR, high risk; OR (95 % CI) adjusted for age.

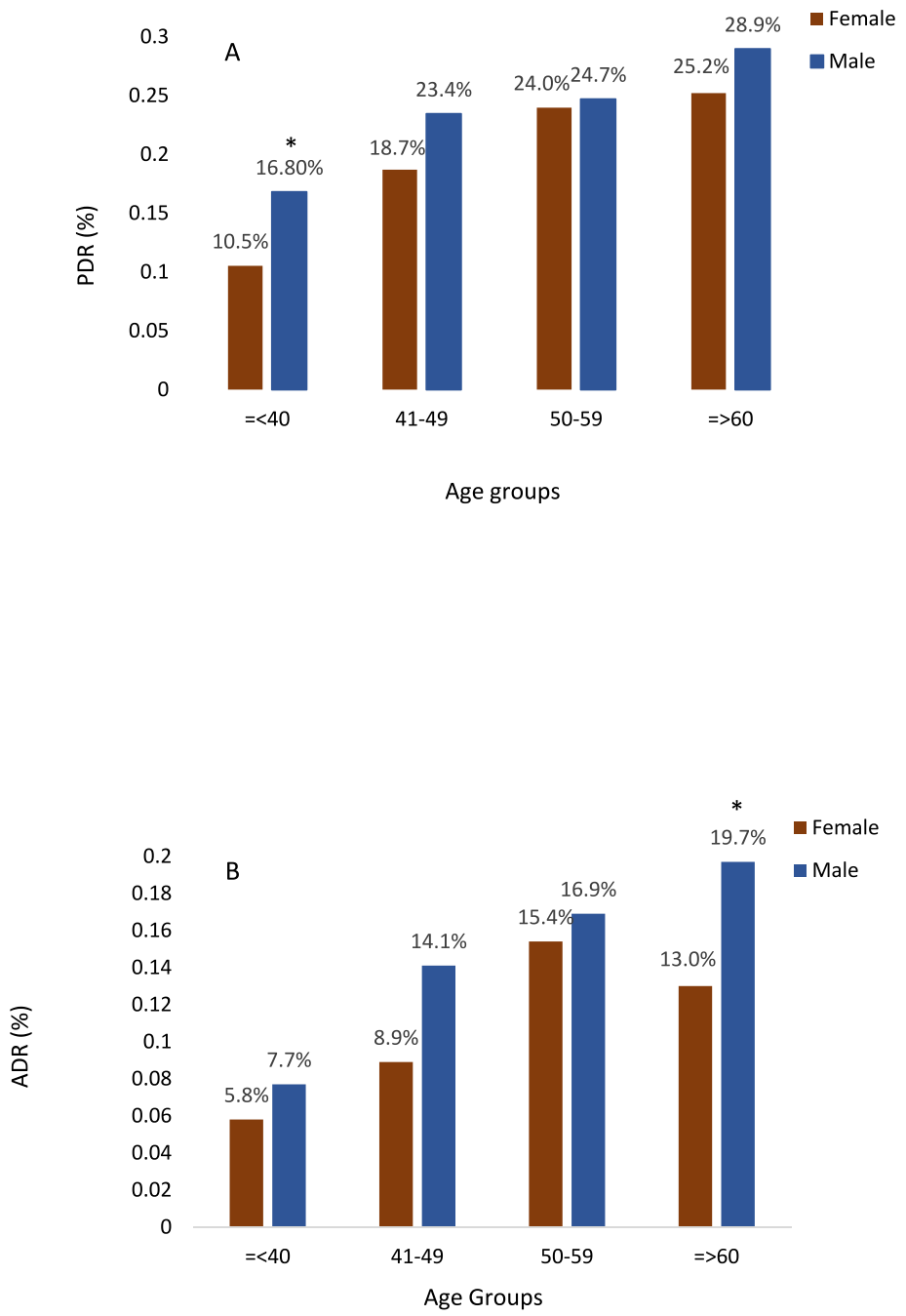

Fig. 1. Comparison of (A) polyp detection rate (PDR), and (B) adenoma detection rate (ADR) between two sexes among the studied age groups, 2012–2019. Data were analyzed using the Chi-square test,*$p < 0.05$.

49.0 % in two studies from Spain, and the United States, respectively, and ADR of 31 % in the US (Aghdaei et al., 2017; Jun et al., 2019; Marcondes et al., 2015; Mehrotra et al., 2018). Detection rate of adenomas in our study was in consistence to reports from some Asian countries like Malaysia, Kuwait, and Oman where ADR of 11.5 %, 10 %, and 12.1 % were reported, respectively (Al-Enezi et al., 2010; Rajendra et al., 2005; Ashktorab et al., 2008).

Differences in PDR and ADR in various regions of the world could be in part related to the endoscopic expertise and endoscope quality, differences in patient selection (Niederreiter et al., 2019; Regula et al., 2006; Anwar et al., 2021), polyp incidence variation by geographical location, as well as study sample size.

Age and sex are the two main determining factors for PDR and ADR, both of which have been studied in our study. The PDR trend was upward from 2012 to 2019 in all age groups studied (11.1 % to 18.3 in 40 years and younger patients, 15.4 % to 22.6 % in patients between 41 and 49, 18.2 % to 25.8 % in patients between 50 and 59 years old, and 16.7 % to 29 % in 60 years and older patients (data are not shown)), and in two sex categories, particularly in men (9.5 % to 28.8 %). A pattern that held true for ADR in all age groups but it was more pronounced in participants between 41 and 49 (7.7 % to 20.8 %) and 60 years and older (8.3 % to 17.2 %). Moreover, the overall PDR in subjects aged 60 or older was about 29 % in men and 25 % in women, and in the youngest age group (≤40), it was 16.8 % in men and 10.5 % ($p < 0.05$) in women. This increase in the detection of polyps by the increase in age was also observed in other studies (Shadmani et al., 2017; Soodejani et al., 2020; Schoenfeld et al., 2005; Kashiwagi et al., 2017). However, the overall ADR in men were markedly higher in the elder age group (60 years and

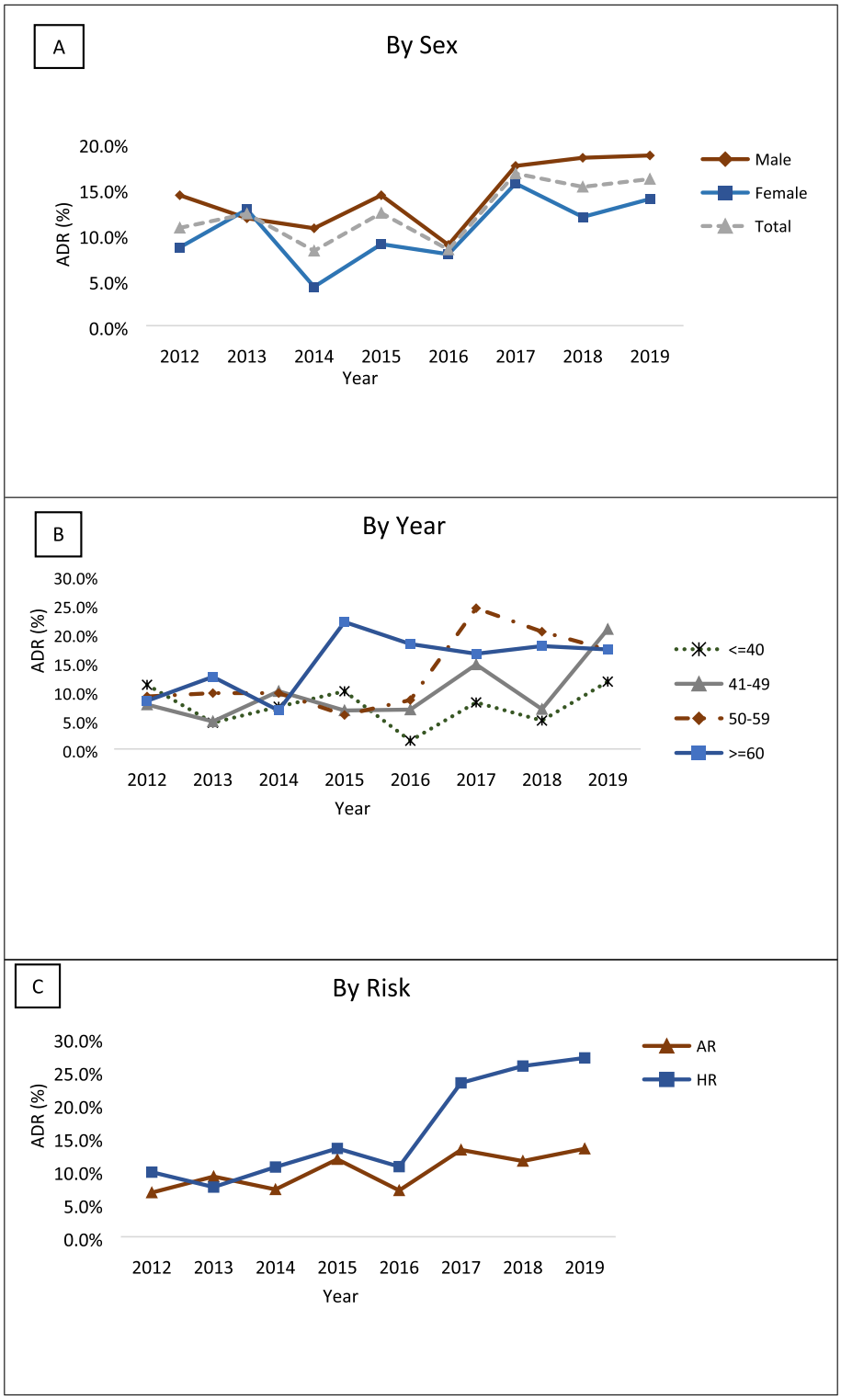

Fig. 2. Trend of adenoma detection rate (ADR) by sex (A), age (B), and risk category (C), 2012–2019. AR, average risk; HR, high risk.

older) respect to that of women (19.7 % vs. 13 %, $p < 0.05$). Furthermore, a higher proportion of PDR in men compared to women was found in the high-risk group, which was consistent with Sanaka et al. study (Sanaka et al., 2016). These findings indicate the importance of considering a combination of demographic factors to develop standards for CRC screening guidelines. In agreement with our study results, Ansari et al. have reported a slight dominance of CRC incidence in men aged 45 years or older than in women (Ansari et al., 2006).

According to Univariate logistic regression, the risk of detecting adenomas in men were more than women (OR,1.4, $p < 0.05$, data are not shown), however, the risk of detecting polyp was not positively associated with male sex (OR,1.22, $p = 0.082$). Multivariable logistic regression showed that the probability of detecting adenoma increased with age and the risk of adenoma increased in high risks respect to average risk patients (OR:1.6, $p = 0.006$). This is inconsistent with the findings of Forsberg et al (Forsberg et al., 2015).

A recent study in Isfahan, Iran showed that the incidence of adenomatous polyps was 483 in men and 316 in women per 100,000 population (Keum and Giovannucci, 2019). There was a difference between our study design and that of Soodejani, et al. (Soodejani et al., 2020). The target population of that study was individuals aged 50 to 70 years who were referred for CRC screening, and only subjects with a family history of CRC, clinical suspicion or positive fecal immunochemical test (FIT) were referred for colonoscopy. Whereas, in our study, all age groups containing both average-risk and high-risk individuals were included in the study. The young average-risk group (≤50) are clearly at low risk for CRC and it might be argued that this was possibly not a screening colonoscopy. But according to the physician's diagnosis, they had been referred mainly for psychological reasons, fear of cancer, or abdominal functional problems.

The overall detection of polyps in this study was lower than in some eastern Asian countries, which may be due to difference in incidence of polyp due to differences in genetics, lifestyle, and diet (Soodejani et al., 2020; Fedewa et al., 2020; Bojuwoye et al., 2018). Previous studies have shown that aging is one of the most important predictors of polyp and cancer outbreaks. In our study, both PDR and ADR peaked in the 6th decade of life in men (PDR: 28.9 %, ADR: 19.7 %). The result is in line with previous study in Iran which reported PDR of 23.5 % and ADR of 12.5 % with the age range of 15–85 years old.

Several studies have proven that CRC incidence increases with advancing age and in men (Fedewa et al., 2020; Mulcahy et al., 2002). Considering the increasing incidence of colorectal malignancy at age 60 and older, screening should begin at age 50, but for those at higher risk for CRC, screening should begin at an earlier age (Sung et al., 2015; Tian et al., 2020).

Unlike cancer, there is little data about colorectal polyps in terms of incidence or prevalence. Results of some large previous studies on patients who had undergone screening or diagnostic colonoscopy have shown similar trends by sex and age (Cooper et al., 2005; Ries et al., 2009). The current study also showed that the PDR and ADR has an increasing time trend in all age groups from 2012 to 2019 and highlights the need for further investigation into the detection rate of adenomatous polyps. In another study, the authors reported that 17 % of all CRC cases occurred in people below 40 years of age (Cooper et al., 2005). They claimed that a high proportion of CRC in young Iranians can be attributed to the high young population of Iran. Another retrospective study has concluded that the mean age for early-onset CRCs was 40 years (Hoseini et al., 2022). They also found that the highest number of CRCs were between age 40 and 50. They argued that this pattern was more noticeable in Asia than in western countries (Siegel et al., 2014) although the rise in incidence of CRC before age 50 is a global phenomenon (Sifaki-Pistolla et al., 2022; Akimoto et al., 2021). This is in line with our finding that trend of ADR was more pronounced in participants aged 41 to 49 over 7-years. It has also been suggested to reduce the minimum age recommended for screening colonoscopy from 50 to 45 (Rex et al., 2015).

It has been shown that a 1 % increase in the detection of adenoma-type polyps can reduce the risk of CRC by 3 % (Ansari et al., 2006). A positive correlation between PDR and ADR has also been reported (Patel et al., 2013). A retrospective study of 14,341 screening colonoscopies, reported that endoscopists' polypectomy rate (PR) correlates well with their ADRs, and recommended the PR as an important quality measure for a screening colonoscopy (Williams et al., 2012). The related ratio of ADR to PDR of the present study was 59.5 %. It has been shown that the conversion factor can estimate ADR from PDR. A systematic review and *meta*-analysis of 42 data sets from 25 studies claimed that the related ratio for calculating ADR from PDR is 68 % (Corley et al., 2014). Therefore, the rate of polyp detection can predict the rate of ADR. Each one percent increase in ADR can reduce incidence and mortality of CRC by 3 % and 5 %, respectively. (Corley et al., 2014).

In our study, total PDR in two younger age categories (41–50 years and ≤40 years) were 21 % and 14.8 % and ADR was 11.2 % and 6.8 %, respectively. Besides, PDR in average-risk individuals was 21.5 % at 50–59 years and 23.8 % at age 60 years or older, and the ADR was 11.3 % and 14.8 %, respectively. Considering that a large part of AR patients at younger age ranges were enrolled in the opportunistic screening program base on their own or recommendation of physician accounting to their unrelated condition rather than population-based mass screening programs with standard programs for recruitment of people for CRC screening, it can be concluded that with increasing age, the detection rate of polyps and adenomas in opportunistic CRC screening will increase that can have an important role in CRC prevention. In this regard, a retrospective study in Romania evaluated the results of opportunistic CRC screening by colonoscopy in a wide age-range population (23–97 years) of average-risk individuals and reported that the ADR significantly increased with age (Ionescu et al., 2015).

The strength of our study was that our data were from a main referral center, with experienced endoscopists, and rather large sample size. There were some limitations in the current study. First, since this study was not population-based, it could be subjected to selection bias. Second, because of lacking data, other important confounding factors, such as diet, exercise, smoking, and obesity, were not considered in this study.

5. Conclusions

In conclusion, our data indicate that the detection rate of polyps and adenomas are different depending on individual's demographics such as age, sex, and risk categories. Thus, the effectiveness of colorectal screening strategies may vary by demographic characteristics as well as risk category for CRC. More prospective studies are recommended to assess whether various thresholds of adenomatous polyps' detection in different age ranges alter the risk of CRC, particularly between two sexes and according to the risk categories. These would ultimately be helpful for development of risk-adapted CRC screening and prevention programs.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

Authors would like to thank Prof. Mahdi Fallah (Leader of Risk Adapted Prevention Group, Decision of Preventive Oncology, German Cancer Research Center) very much for his critical comments and revisions that greatly improved this manuscript.

Funding

This research was funded by Isfahan University of Medical Sciences and Poursina Hakim Digestive Diseases Research Center, grant number 398479, ethics code: IR.MUI.MED.REC.1398.379.

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