Journal of Gastrointestinal Cancer (2021) 52:414–421
https://doi.org/10.1007/s12029-020-00574-x

REVIEW ARTICLE

Incidence and Risk Factors of Colorectal Cancer in the Iranian Population: a Systematic Review

Hossein Mozafar Saadati[1] · Batool Okhovat[2] · Farzad Khodamoradi[3,4,5]

Accepted: 17 December 2020 / Published online: 4 January 2021

Abstract

Purpose Colorectal cancer (CRC) is one of the most common cancers in the world. The aim of this study was to investigate its incidence and risk factors in the Iranian population.

Methods A literature search was conducted in PubMed, Web of Science, Scopus, SID, and Magiran from inception until 2019. Studies that reported the incidence rate and risk factors of colorectal cancer were included in this review.

Results Twenty-one articles that reported the incidence rate and 13 that reported the risk factors were included. The incidence rate was different according to the population type, gender, age, and study year in different regions. The main risk factors for colorectal cancer were high consumption of red meat and fried food and low intake of fruits and vegetables, diabetes, a positive family history, and obesity.

Conclusion The incidence of CRC has a marked variation in different parts of Iran, and various risk factors are associated with colorectal cancer. According to incidence rate and various risk factors, precise planning is needed to control colorectal cancer in the future.

Keywords Colorectal cancer · Incidence rate · Risk factors · Iran

Abbreviations

CRC	Colorectal cancer
ASR	Age-specific incidence rate
WHO	World Health Organization
NOS	Newcastle-Ottawa quality assessment scale

Introduction

Colorectal cancer (CRC) is one of the most common and important cancers in the world. According to GLOBOCAN and the World Health Organization, 1.8 million new cases and 880,792 deaths related to CRC were reported in 2018 [1, 2]. The incidence of CRC has changed dramatically worldwide, with the highest rates seen in parts of Europe (such as Slovakia, the Netherlands, Norway, and Hungary). The age-specific incidence rate (ASR) is up to 60 per 100,000 in men and up to 35 per 100,000 in women [3]. The ASR is 2 to 3 times lower in Asia than in Europe [3]. The global burden of CRC is increasing rapidly with population growth and demographic and lifestyle changes, making CRC the third most common cancer and the fourth leading cause of cancer death in the world [1, 4]. CRC is more common in men than in women and is 3 to 4 times more common in developed versus developing countries [5]. Among Iranians, CRC is the third and fourth most common cancer in men and women, respectively [6]. CRC is a multifactorial disease with several risk factors including genetic factors, dietary pattern (such as low intake of fruits and vegetables), smoking and alcohol consumption, obesity, stressful life events, hormonal factors,

✉ Farzad Khodamoradi
f_khodamoradi@yahoo.com

[1] Department of Epidemiology, School of Public Health, Shahid Beheshti University of Medical Sciences, Tehran, Iran

[2] Tehran West Health Center, Iran University of Medical Sciences, Tehran, Iran

[3] Department of Community Medicine, School of Medicine, Dezful University of Medical Sciences, Dezful, Iran

[4] Department of Epidemiology and Biostatistics, Tehran University of Medical Sciences, Tehran, Iran

[5] Tehran, Iran

and low physical activity [1, 7, 8]. About 10–15% of CRC cases are genetic that are generally more common in the elderly [8]. Information on the incidence rate and risk factors of CRC is necessary for planning to reduce the burden of this cancer. Because of limited information on CRC, and regarding rapidly increasing incidence rates in several areas that historically at low risk, based on the World Health Organization (WHO)'s reports, including Asia and Eastern Europe, this systematic review used a comprehensive literature search to determine the incidence and risk factors of CRC in the Iranian population.

Methods

Search Strategy

For a systematic investigation, Persian (national) and English (international) electronic databases were searched. The included databases were PubMed (MESH terms), Web of Science, Scopus, SID, and Magiran from inception to 2019. The following keywords were used: risk, population at risk, risk factors, prognostic factors, colorectal neoplasm, colorectal cancer, epidemiology, and Iran. Totally, the search yielded 441 and 290 publications for incidence rate and risk factors of colorectal cancer, respectively. Initially, two authors reviewed the titles and abstracts. The inclusion criteria were articles published in Persian or English and original studies that investigated the incidence rate and risk factors of colorectal cancer in Iran. In addition, letters to the editor and case reports were excluded. Moreover, articles published in languages other than English or Persian were excluded. A total of 264 duplicates and irrelevant articles were removed. The remaining 467 articles were reviewed by title and abstract. Afterward, 85 articles were reviewed by full text. Consequently, after reviewing the full texts, 37 and 14 articles were found to be irrelevant in terms of incidence rate and risk factors of colorectal cancer, respectively. After excluding these articles, 21 and 13 full texts were included and examined by two authors (Figs. 1 and 2).

Quality Assessment

The quality of studies was assessed using the Newcastle-Ottawa quality assessment scale (NOS) adapted for observational studies [9]. The NOS is based on three domains, including the selection of study groups, comparability of groups, and description of exposure and outcome. This scale assesses the quality of each study in each domain using eight items and a star scoring system. All items except the comparability domain have one star (the comparability domain has a maximum score of two stars). Totally, the earned stars are calculated as the total quality score for each study. A cut-off score of 6 or higher was considered as high quality. Two reviewers completed quality assessment independently. In cases of disagreement or for items that remained unclear, a third reviewer was consulted.

Data Collection and Analysis

Two reviewers (FKH and HMS) screened the titles and abstracts to identify the studies that met the inclusion criteria. The studies were selected independently, and the results were discussed to make the final selection. A final decision was made for each study after reading its full text. In cases of disagreement, a third reviewer was consulted.

Data Extraction

We used a structured form to extract the data, including the study type and sample size, study place, incidence rate, risk factors, and protective factors of colorectal cancer. The same reviewers who selected the studies performed data extraction. All disagreements were discussed with a third reviewer, if necessary.

Results

The Characteristics of Included Studies

The results of the systematic search and article selection stages are shown in Figs. 1 and 2. The search yielded 731 studies, of which 264 duplicates were excluded. The remaining studies were assessed by title and abstract, resulting in the exclusion of 381 studies. Full-text screening was performed for 85 studies; finally, 34 articles meet the inclusion criteria. From included studies, 21 studies were cross-sectional, 10 case-control, 2 prospective, and 1 study retrospective. Moreover, 7 studies were conducted based on cancer registry data for all country, and all other studies used provincial data. Regarding the language of studies, 23 studies were in English and 11 in Persian.

Quality of Studies

Based on the Newcastle-Ottawa quality assessment scale (NOS) for observational studies for incidence rate, 17 articles were of moderate to high quality, and 4 were of poor quality. Based on risk factors, 10 articles were of moderate to high quality, and 3 were of poor quality.

Incidence Rate

Twenty-one articles were selected for incidence rate. The algorithm of selecting the studies and their characteristics are

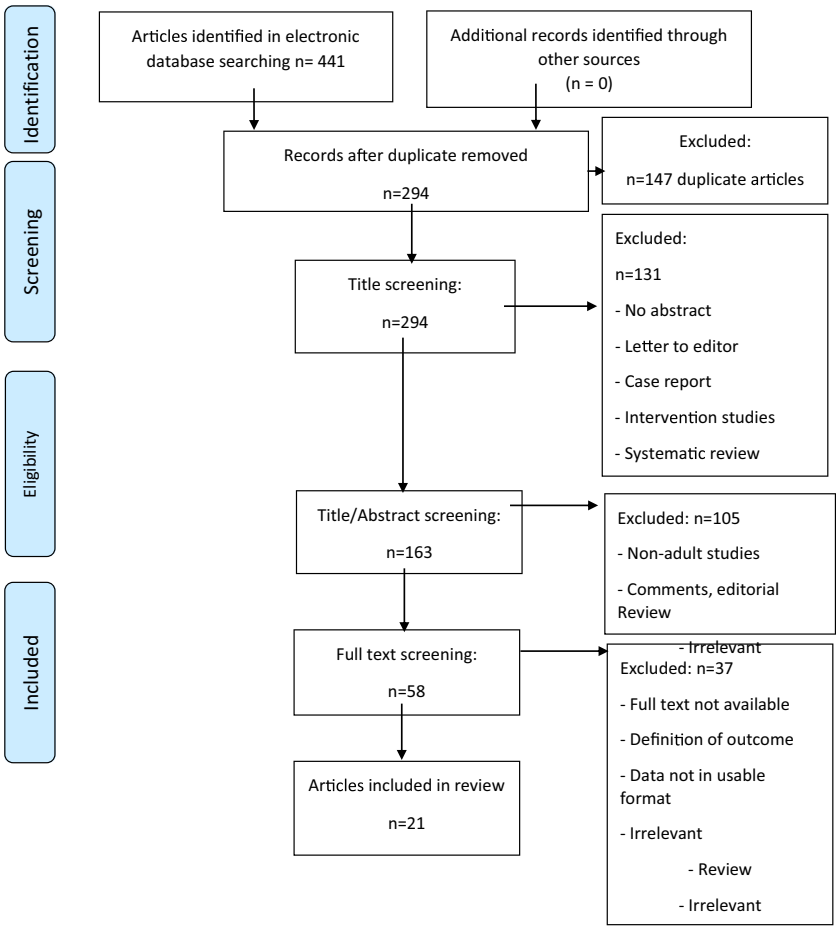

Fig. 1 Flow chart depicting the study selection process (incidence rate)

presented in Fig. 1 and Table 1, respectively. The incidence rate of colorectal cancer has been shown in different regions of Iran. The incidence rate was different according to the population type, gender, age, and study year in different regions. In women the lowest standardized incidence of CRC was in Fars province (2.41% per 100,000), and the highest standardized incidence was in East Azerbaijan (43.51% per 100,000). In men the lowest standardized incidence of CRC was in Fars province (3.26% per 100,000), and highest standardized incidence was in East Azerbaijan (63.02% per 100,000). Also standardized incidence was higher in the elderly than in the young and has increased over time in many studies. Table 1 shows the results of 21 studies reporting the incidence rate in different cities and population in Iran.

Risk Factors

Thirteen articles were selected for risk factors. The algorithm of selecting the studies and their characteristics are presented in Fig. 2 and Table 2, respectively.

Table 2 shows the results of 13 studies reporting the risk factors of CRC in different Iranian cities and populations. Risk factors were different in different regions of Iran, although some factors have a protective role against cancer. The main risk factors of CRC were high consumption of red meat and fried food and low intake of fruits and vegetables, diabetes, a positive family history, and obesity. Protective factors that have been shown in various studies to play a role in the prevention of CRC include level of education and literacy of individuals, consuming fruits and vegetable, and physical activity.

Discussion

This review study was conducted to determine the incidence of colorectal cancer in different regions of Iran. The incidence rate varied in different regions according to the population type, gender, age, and study year. This variation may be related lifestyle and diet [13]. Moreover, the high prevalence of obesity, low physical activity, dietary habits, and certain lifestyles in different regions can explain the difference in the incidence of colorectal cancer between different regions of Iran [42]. The high incidence of this cancer in young people in some areas can be attributed to diet and lifestyle favoring a Westernized pattern. Lifestyle and diet modification may help

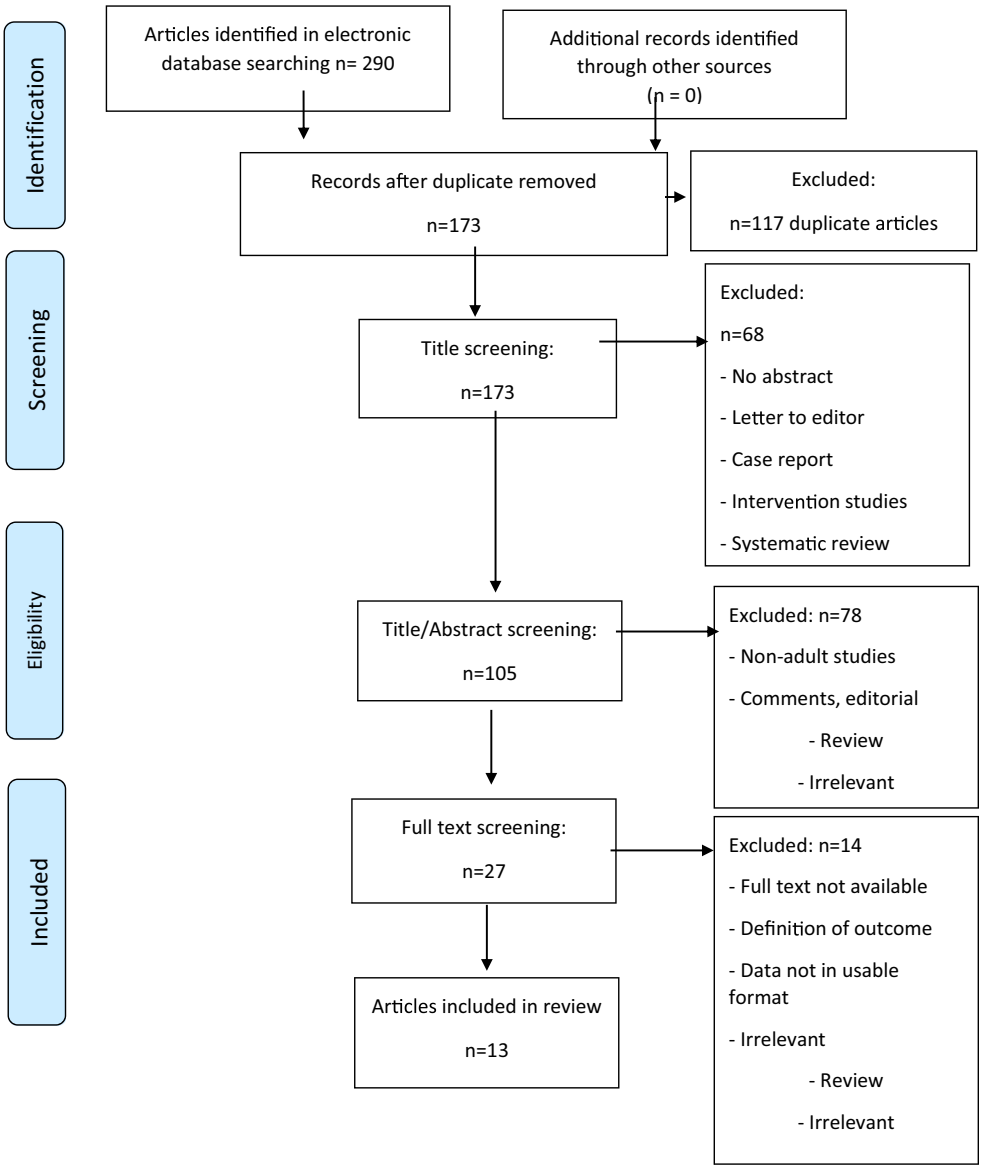

Fig. 2 Flow chart depicting the study selection process (risk factors)

to reduce the burden of the disease in areas with a high incidence [42]. The incidence of colorectal cancer was higher in men than in women. One of the reasons that can explain this trend is that women are more sensitive to their health than men are and present to health centers with the smallest signs of illness to receive treatment, so the disease can be diagnosed and treated in the early stages [14]. According to the results, the prevalence of CRC is on the rise in both genders. Regardless of the demographic characteristics of individuals, part of this increase could be due to improvement in cancer registration in Iran [17]. Improved life expectancy in the country and population aging can be other causes for this increase.

This study showed an association between several risk factors and colorectal cancer; however, these risk factors may vary in different countries. Low consumption of fruits and vegetables is one of the main risk factors of CRC. It is reasonable to assume that fiber, fruits, and vegetables reduce the density of carcinogens as well as the contact time of carcinogens with the gastrointestinal tract, which can prevent colorectal cancer. Some fruits such as the orange and lemon and vegetables contain vitamin C, vitamin B, and antioxidants and reduce the incidence of colorectal cancer [8]. Genetic factors also play a role in colorectal cancer. Genetic sensitivity can affect every stage of the cancer, including modifying the effect of environmental carcinogens [38]. One of the factors that is related to colorectal cancer is the use of opioids. A suggested mechanism for the relationship between opium use and cancer is that opium and its alkaloids, including morphine, may have mutagenic effects. Some of the impurities added to opioids during their processing in Iran may have carcinogenic effects. One of these materials is lead, which is added to make it heavier [39]. Furthermore, a relationship was

Table 1 General characteristics of the studies about incidence rate of colorectal cancer

Row	First author	Year	Type of study	Number of participants	Place of study	ASR (per 100,000 persons)	Source
1	Saeid Razi	2015	Cross-sectional	In 2003: 1296 In 2008: 2658	Iran (Cancer Registry data)	The lowest in 2003: 5.47 The highest in 2008: 11.12	[10]
2	Dr. Nahid Khademi	2014	Cross-sectional (women)	2009: 1976 2010: 2233	Kermanshah	In 2009: 7.8 In 2010: 8.7	[11]
3	Najibullah Baraadeh	2015	Cross-sectional	5617	Khorasan Razavi	7.4 in men 7.5 in women	[12]
4	Reza Ansari	2006	Cross-sectional	2033	Iran (Cancer Registry data)	8.2 in men 7 in women The highest in males in Golestan: 10.7 The highest in females in Mazandaran: 8.4	[13]
5	Zeinab Almasi1	2016	Cross-sectional	7163	Iran (Cancer Registry data)	11.1	[14]
6	Mehrabani	2008	Cross-sectional	In men: 112 In women: 85	Fars Province	In men: 3.26 In women: 2.41	[15]
7	Gholamreza Roshandel	2014	Cross-sectional	In men:345 In women: 266	Golestan Province	In males 12.4 In females 9.5	[16]
8	Mehri Rejali	2018	Cross-sectional	2902	Isfahan	In 2000: 3.47 In 2011: 10.22	[17]
9	Somi	2009	Cross-sectional (in people over 65 years of age)	In men: 78 In women: 47	East Azerbaijan	In men: 63.02 In women: 43.51	[18]
10	Mohammad Hossein Somi	2014	Cross-sectional	In men: 4341 In women: 2540	East Azerbaijan	In men: 11.2 In women: 8.93	[19]
11	Edris Abdifard	2013	Cross-sectional	762	West of Iran	Minimum 1.5 in 2000 Maximum 4.8 in 2005	[20]
12	Neda Amoori	2014	Cross-sectional	14,893	Khuzestan Province of Iran	In males 11.6 In females 10	[21]
13	H.A. Nikbakht	2015	Cross-sectional	237 Patients	Babol City	In 2007: 7.7 In 2012:14.6	[22]
14	Mahmood Vakili	2014	Cross-sectional	4631	Yazd	The highest in females in 2008: 10.4 The lowest in females in 2006: 5.1 The highest in males in 2009: 9.9 The lowest in males in 2005: 6.1	[23]
15	Amori	2017	Retrospective study	301,055	In Iran	In males 8.29 In females 7.75	[24]
16	Mehdi Darabi	2016	Cross-sectional	In 2001 In men: 379 In women: 344 In 2010 In men: 3443 In women: 2641	Registration of the Ministry of Health In Iran	In 2001, it was 2.12 in males and 1.2% in women, in 2010 in males it was 11.28 in males and 10.33 in women	[25]
17	Fatemeh Khosravi Shadmani	2017	Cross-sectional	6185	Iran (National Cancer Registry)	The highest in males in Tehran: 20.58 The highest in females in Guilan: 20.48	[26]
18	Seyed Vahid Hosseini	2004	Cross-sectional	In the 1970s to 80s: 64 In the 1990s to 2000s: 264	Shiraz	In males from 1970s to 1980s, 1.9 to 4.2 In females from 1990s to 2000, 2.35 to 2.72.	[27]
19	Marzieh Rohani-Rasaf	2017	Cross-sectional	In people over 65: 3104 In young people: 7948	Tehran	In people over 65: 86.13 In young people: 14.4	[28]
20	Seyed Masoom Masoompour	2016	Cross-sectional	In men: 5594 In women: 4628	Fars province	7.49	[29]
21	Edris Abdifard	2016	Cross-sectional	36,650	Iran (National Cancer Registry System)	In men, in 2000: 1.6 in 2009: 11/3 In women, in 2000: 1.6 in 2009: 10.9	[30]

Table 2 General characteristics of the studies about risk factors of colorectal cancer

Row	First author	Year	Place of study	Type of study	Number of participants	Risk factor(s)	Protective factor	Source
1	Naeimeh Keyghobadi	2013	Yazd	Case-control	60 case 120 control	High consumption of red meat and fried food and low consumption of fruit		[31]
2	Hossein Azizi	2014	Tabriz	Case-control	207 case 207 control	Diabetes Consumption of high fat and red meat		[7]
3	Ali Ahmadi	2014	Mazandaran	Prospective investigation	1127	Old age Smoking Family history of colorectal cancer	Level of education and literacy of individuals	[32]
4	Kamran moshafaghi	2010		Case-control	70 case 140 control	Lower education Living rental home History of the disease in family Red meat Daily intake of dairy products High-fat diet History of laxative Use and history of gastrointestinal diseases		[33]
5	Azadeh Safayee	2009	Tehran	Case-control	393 case 393 control	Family history		[34]
6	Shadi dehghanzadeh	2012	Rasht	Case-control	150 case 150 control	BMI Inflammatory bowel disease History of polyp Diabetes Consuming red meat Smoking cigarettes	Consuming fruits Vegetable	[35]
7	Abbas Ali Keshtkar	2009	Golestan	Case-control	47 case 47 control	Frying food Fat consumption Increased total energy consumption		[36]
8	Ali Hosseinzadeh	2011	Esfahan	Case-control	125 case 135 control	Use of high-fat diet	Physical activity	[37]
9	Hedayat Abbastabar	2015	Iran	Ecological study Cross-sectional	89,404 individuals	Diabetes mellitus hypertension lacking or low physical activity High education high intake of dairy products non-consumption of vegetables and fruits		[8]
10	Saeideh Ebrahimkhani	2012	Tehran	Case-control	100 case 100 control	Genetic factors		[38]
11	Ahmad NAGHIBZADEH-TAHAMI	2016	Kerman	Case-control	175 case 350 control	Opioids		[39]
12	Anahita Nosrati	2016	Sari	Case-control	50 case 50 control	Genetic factors		[40]
13	Mohammad Movahedi	2015	Iran	Prospective investigation	937 participants	Obesity Body mass index		[41]

found between family history and colorectal cancer. Increased risk of cancer in first-degree relatives of cancer patients may be explained by a common genetic or environmental factor during a specific time. In general, it is not possible to clearly distinguish between the environmental and genetic components in a susceptible family. Identification of the family history of colorectal cancer is important for prevention and management. In other words, evaluation of the first-degree relatives of CRC patients may result in detecting more people who are at risk for this cancer [34].

Our study has several limitations. First, most of the studies in this review are cross-sectional and case-control, and we need stronger studies such as cohort reviews to obtain more evidence in the future. Second, this study has been conducted in Iran, and in order to more accurately study the risk factors and identify the most dangerous areas of the world, a worldwide study will be needed.

Conclusion

The incidence rate of CRC was different according to the population type, gender, age, and study year in different regions. Also risk factors were different in different regions of Iran, although some factors have a protective role against cancer. The main risk factors of CRC were high consumption of red meat and fried food and low intake of fruits and vegetables, diabetes, a positive family history, and obesity. According to incidence rate and various risk factors, precise planning is needed to control colorectal cancer in the future.

Authors' Contributions Farzad Khodamoradi and Hossein Mozafar Saadati had the idea for the article. Farzad Khodamoradi and Hossein Mozafar Saadati performed the literature search and data analysis. Farzad Khodamoradi and Hossein Mozafar Saadati and Batool Okhovat drafted and/or critically revised the work.

Data Availability This study is a review study.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest.

Code Availability Not applicable.

References

1. Wong MC, Ding H, Wang J, Chan PSF, Huang J. Prevalence and risk factors of colorectal cancer in Asia. Intest Res. 2019;17(3):317–29.
2. Saadati HM, Khodamoradi F, Salehiniya H. Associated factors of survival rate and screening for colorectal cancer in Iran: a systematic review. J Gastrointest Cancer. 2020;51(2):401–11.
3. Zhang L, Cao F, Zhang G, Shi L, Chen S, Zhang Z, et al. Trends in and predictions of colorectal cancer incidence and mortality in China from 1990 to 2025. Front Oncol. 2019;9:98.
4. Araghi M, Soerjomataram I, Jenkins M, Brierley J, Morris E, Bray F, et al. Global trends in colorectal cancer mortality: projections to the year 2035. Int J Cancer. 2019;144(12):2992–3000.
5. Rawla P, Sunkara T, Barsouk A. Epidemiology of colorectal cancer: incidence, mortality, survival, and risk factors. Prz Gastroenterol. 2019;14(2):89.
6. Arani SH, Kerachian MA. Rising rates of colorectal cancer among younger Iranians: is diet to blame? Curr Oncol. 2017;24(2):e131.
7. Azizi H, Esmaeili ED. Stressful life events and risk of colorectal cancer: a case-control study of Iran. Asian Pac J Cancer Prev. 2015;16(6):2403–7.
8. Abbastabar H, Roustazadeh A, Alizadeh A, Hamidifard P, Valipour M, Valipour AA. Relationships of colorectal cancer with dietary factors and public health indicators: an ecological study. Asian Pac J Cancer Prev. 2015;16(9):3991–5.
9. Wells G, Shea B, O'Connell D, Peterson J, Welch V, Losos M, et al. The Newcastle–Ottawa Scale (NOS) for assessing the quality of non-randomized studies in meta-analysis. Appl Eng Agric. 2014;18(6):727–34.
10. Razi S, Salehiniya H, Dizaji MFL. Epidemiology of prevalent cancer among Iranian women and its incidence trends from 2003-2009 in Iran. J Arak Univ Med Sci. 2015;18(2):17–24.
11. Khademi N, Khassi K. Epidemiological study of common cancers in women in Kermanshah province during 2009-2010 Kermanshah University of Medical Sciences. J Lab Diagn. 2014;24.
12. Baeradeh N, Zamani M. Epidemiology of prevalent cancers in Khorasan Razavi province in 2008. Med J Mashhad Univ Med Sci. 2015;57(8):926–31.
13. Ansari R, Mahdavinia M, Sadjadi A, Nouraie M, Kamangar F, Bishehsari F, et al. Incidence and age distribution of colorectal cancer in Iran: results of a population-based cancer registry. Cancer Lett. 2006;240(1):143–7.
14. Almasi Z, Mohammadian-Hafshejani A, Salehiniya H. Incidence, mortality, and epidemiological aspects of cancers in Iran; differences with the world data. J BUON. 2016;21(4):994–1004.
15. Mehrabani D, et al. Cancer occurrence in Fars Province, Southern Iran. Iran Red Crescent Med J. 2008;10(4):314–22.
16. Roshandel G, et al. Cancer incidence in Golestan province: report of an ongoing population-based cancer registry in Iran between 2004 and 2008. Arch Iran Med. 2012;15(4):196–200.
17. Rejali M, et al. Temporal trends of incidence of colorectal Cancer in Isfahan, Iran, 2000-2011. Int J Prev Med. 2018;9:22.
18. Somi MH, et al. Cancer incidence among the elderly population in the northwest of Iran: a population based study. Iran J Cancer Prev. 2009;2(3):117–26.
19. Somi MH, Golzari M, Farhang S, Naghashi S, Abdollahi L. Gastrointestinal cancer incidence in East Azerbaijan, Iran: update on 5 year incidence and trends. Asian Pac J Cancer Prev. 2014;15(9):3945–9.
20. Abdifard E, Ghaderi S, Hosseini S, Heidari M. Incidence trends of colorectal cancer in the west of Iran during 2000-2005. Asian Pac J Cancer Prev. 2013;14(3):1807–11.
21. Amoori N, Mirzaei M, Cheraghi M. Incidence of cancers in Kuzestan province of Iran: trend from 2004 to 2008. Asian Pac J Cancer Prev. 2014;15(19):8345–9.
22. Nikbakht HA, et al. Trends in the incidence of colorectal cancer and epidemiologic and clinical characteristics of survivors in Babol city in 2007-2012. J Babol Univ Med Sci. 2015;17(1):15–21.
23. Vakili M, Pirdehghan A, Adimi M, Sadeghian M, Akhondi M. Epidemiology and trend of cancer in Yazd, a central province of Iran, 2005-2009. J Res Health Sci. 2014;14(3):210–3.

24. Amori N, Aghajani M, Asgarian FS, Jazayeri M. Epidemiology and trend of common cancers in Iran (2004–2008). Eur J Cancer Care. 2017;26(5):e12449.
25. Darabi M, et al. Trends in gastrointestinal cancer incidence in Iran, 2001-2010: a joinpoint analysis. Epidemiol Health. 2016;38: e2016056.
26. Khosravi Shadmani F, Ayubi E, Khazaei S, Sani M, Mansouri Hanis S, Khazaei S, et al. Geographic distribution of the incidence of colorectal cancer in Iran: a population-based study. Epidemiol Health. 2017;39:e2017020.
27. Hosseini SV, Izadpanah A, Yarmohammadi H. Epidemiological changes in colorectal cancer in Shiraz, Iran: 1980-2000. ANZ J Surg. 2004;74(7):547–9.
28. Rohani-Rasaf M, et al. Cancer incidence rate in the elderly inhabitants of Tehran: Is there really any cluster? Int J Cancer Manag. 2017;10(7).
29. Masoompour SM, Lankarani KB, Honarvar B, Tabatabaee SH, Moghadami M, Khosravizadegan Z. Changing epidemiology of common cancers in southern Iran, 2007-2010: a cross sectional study. PLoS One. 2016;11(5):e0155669.
30. Abdifard E, et al. Incidence trends of colorectal cancer in Iran during 2000-2009: a population-based study. Med J Islam Repub Iran. 2016;30:382.
31. Keyghobadi N., et al. Nutritional factors related to colorectal cancer in the residents of Yazd City, Iran. 2013.
32. Ahmadi A, Mobasheri M, Hashemi Nazari SS. Survival time and relative risk of death in patients with colorectal cancer in an Iranian population: a cohort study. J Mazandaran Univ Med Sci. 2014;24(111):2–8.
33. Moshfeghi K, et al. Evaluation the role of nutritional and individual factors in colorectal cancer. Zahedan J Res Med Sci. 2011;13(4).
34. Safaee A, Moghimi-Dehkordi B, Pourhoseingholi MA, Vahedi M, Maserat E, Ghiasi S, et al. Risk of colorectal cancer in relatives: a case control study. Indian J Cancer. 2010;47(1):27–30.
35. Dehganzadeh S., Jafaraghai F, Tabari KR. Relationship between demographic characteristics, lifestyle and exposure to stressor events and colorectal cancer. 2012.
36. Keshtkar A, et al. Colorectal cancer nutritional risk factors: a population based case-control study. Iran J Cancer Prev. 2010;3(2):93–7.
37. Hosseinzadeh A, Daraei A. Environmental factors associated with sporadic colorectal cancer. 2012.
38. Ebrahimkhani S, Asgharian AM, Nourinaier B, Ebrahimkhani K, Vali N, Abbasi F, et al. Association of GSTM1, GSTT1, GSTP1 and CYP2E1 single nucleotide polymorphisms with colorectal cancer in Iran. Pathol Oncol Res. 2012;18(3):651–6.
39. Naghibzadeh-Taham A, et al. Can opium use contribute to a higher risk of colorectal cancers? A matched case-control study in Iran. Iran J Public Health. 2016;45(10):1322–31.
40. Nosrati A, Torabizadeh Z. Study of chemokine marker CXCR4 in colorectal cancer in Northern Iran. J Mazandaran Univ Med Sci. 2016;25(134):60–8.
41. Movahedi M, Bishop DT, Macrae F, Mecklin JP, Moeslein G, Olschwang S, et al. Obesity, aspirin, and risk of colorectal cancer in carriers of hereditary colorectal cancer: a prospective investigation in the CAPP2 study. J Clin Oncol. 2015;33(31):3591–7.
42. Roshandel G, Boreiri M, Sadjadi A, Malekzadeh R. A diversity of cancer incidence and mortality in West Asian populations. Ann Glob Health. 2014;80(5):346–57.