

Evaluating the Rising Secular Trends of Incidence and Partial Prevalence of Colorectal Cancer in Iran: Join point regression

Mouhebat Vali

Shiraz University of Medical Sciences

Hossein Molavi Vardanjani

Shiraz University of Medical Sciences

Jafar Hassanzadeh (✉ jafar.hassanzadeh.sums@gmail.com)

Shiraz University of Medical Sciences <https://orcid.org/0000-0002-1055-1418>

Technical advance

Keywords: Incidence, Prevalence, Colorectal Cancer, Predict, joint PointRegression, Iran

Posted Date: July 9th, 2019

DOI: <https://doi.org/10.21203/rs.2.11099/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background Colorectal cancer (CRC) is expected to be of the most common cancers in developing countries, where the its mortality is high and less services are available for cancer survivors. Methods To assess the incidence rate, firstly, the incidence rates of colon and rectum reported in the two sites of <http://globocan.iarc.fr> and <http://healthdata.org> from 1990 to 2017 were extracted based on gender and age groups (less than 40 and more than 40 years old), In the next step, according to the incidence and APC(annual percentage change) provided in the previous step, we predicted the incidence for the next years according to the formulas. we Estimated the prevalence of 1-year, 2-3 year and 4-5 year using survival and incidence according to the formula. At the end we predicted prevalence by 2030 in Iran. Results In our study, AAPC(average annual percentage change) for women was found to be 4.07%(CI: 3.76-4.39) in all age groups and AAPC= 4.30%(CI: 4.14-4.47) for men in all age groups. the predicted incidence in the group under 40 that in men it reaches from about 12 to 15 per 100,000 and for women from about 10 to 11 per 100,000. While the increase of 100/ 10000 was found in the women over 40 years and the increase of 150/100,000 was obtained in men. And In all groups, predicted prevalence rate increases. In the group under 40 and the group over 40 prevalence increase about 2000 and 26000 numbers respectively in women and men from 2000 to 2030. Conclusions With regard to the above mentioned cases, there is a strong need for cancers registry, which is the population information and follow-up of patients, and the establishment of research institutes to determine the basic needs of patients.

Abstract

Background: Colorectal cancer (CRC) is expected to be of the most common cancers in developing countries, where the its mortality is high and less services are available for cancer survivors.

Methods:To assess the incidence rate, firstly, the incidence rates of colon and rectum reported in the two sites of <http://globocan.iarc.fr> and <http://healthdata.org> from 1990 to 2017 were extracted based on gender and age groups (less than 40 and more than 40 years old), In the next step, according to the incidence and APC(annual percentage change) provided in the previous step, we predicted the incidence for the next years according to the formulas. we Estimated the prevalence of 1-year, 2-3 year and 4-5 year using survival and incidence according to the formula. At the end we predicted prevalence by 2030 in Iran.

Results: In our study, AAPC(average annual percentage change) for women was found to be 4.07%(CI: 3.76-4.39) in all age groups and AAPC= 4.30%(CI: 4.14-4.47) for men in all age groups. the predicted incidence in the group under 40 that in men it reaches from about 12 to 15 per 100,000 and for women from about 10 to 11 per 100,000. While the increase of 100/ 10000 was found in the women over 40 years and the increase of 150/100,000 was obtained in men. And In all groups, predicted prevalence rate increases. In the group under 40 and the group over 40 prevalence increase about 2000 and 26000 numbers respectively in women and men from 2000 to 2030.

Conclusions: With regard to the above mentioned cases, there is a strong need for cancers registry, which is the population information and follow-up of patients, and the establishment of research institutes to determine the basic needs of patients.

key words: Incidence, Prevalence, Colorectal Cancer, Predict, joint PointRegression, Iran

Introduction

Cancer is a common disease among all age groups in the world [1]. It is the leading cause of mortality in developed countries and the second cause of mortality in developing countries [2]. Regardless of the level of resources in the next decades, it will be the major cause of mortality in every region of the world [2-4]. Iran, as an Asian country, will experience increased cancer-associated mortality rates, while cancer is still the third leading cause of death in the country [5].

Gastrointestinal cancers are one of the most common cancers and generally one of the public health concerns in some parts of the world [6]. Colorectal Cancer (CRC) is one of the most common forms of neoplasia in industrialized countries [7] and the third leading cause of cancer mortality in the world [8]. The geographical distribution of CRC is strongly related to environmental factors. Hence, there is sometimes a 20-fold difference in the distribution from one region to another [6].

The epidemiological characteristics of CRC, such as incidence and age distribution, are extensively different in various parts of the world [9, 10]. The occurrence of CRC also varies considerably throughout the world. The highest adapted age range of 25-35 per 100,000 has been found in North America, Western Europe, and Australia, while it is very low in Africa, except for South Africa [11]. Although the annual incidence of CRC is about 30-50/100,000 in North America and Europe is about 30-50/ 100,000 [9], it is about 3-7/100,000 in most Middle Eastern countries [12, 13]. In Western countries, only 2-8% of total CRCs occur in young patients (40 years old) [14-18]. In contrast, several studies indicated that 15-35% of CRCs occurred at the age of 40 years in Middle Eastern countries [19-21].

According to numerous studies of motility and morbidity, many cancers in Iran are increasing and this increase is expected to continue. Evidence suggests that colorectal cancer is one of those cancers that is on the rise despite prostate, breast, stomach, and cancers [5, 22, 23].

With the increase in cancer in low and middle resource countries, it calls for special attention to the design and implementation of preventive and control programs in these areas [24]. Access to valid statistics is one of the vital components in planning, controlling and monitoring cancer [25, 26].

Including population -based rates of incidence, prevalence and survival. The lack of appropriate cancer registries in such areas makes all these criteria uncalculated, especially for the outbreak and survival rates that need to be tracked by cancer patients. As a result, evidence-based policy is out of the question [27].

Several attempts have been made to estimate the incidence of cancer based on incidence and survival data in Iran, but due to the incomplete initial information required for mortality-based methods, they have failed to meet the expectations of researchers and policymakers[28, 29].

Considering the epidemiological transition, population aging, and industrial lifestyle, the future increase in the CRC burden is felt in Iran. The incidence and mortality rates of CRC are also still relatively high in Iran[30-34]. Thus, the population of CRC survivors is considerably increasing in Iran. However, to the best of our knowledge, limited information is available regarding the incidence of CRC in Iran [23, 35, 36]. This shortcoming is mainly due to the lack of population-based cancer information in Iran [37]. We suspect that the adapted method can estimate the prevalence of cancer with a desirable accuracy. The aim of this study was to evaluate the total prevalence of 5 years, 4-5 years, 2-3 years and the prevalence of 1 year old cancer in Iran. Hence, the present study aims to predict the incidence of CRC up to 2030 and to explain its incidence and prevalence trends. The study results can be used by policymakers for future planning in this regard.

Materials And Methods

A secondary data analysis and modeling study was done in three phases as follow:

Phase I: Incidence

As data on the cancer incidence in Iran is not available for each year due to instability of Iranian cancer registry, we have to use the most accurate and update data. The most updated data on the incidence of CRC in 2012 has been published by IARC based on the latest published Iranian national cancer report. We retrived number of new CRC cases in Iran during 2012 by age groups and gender.

Second source of available data on the cacner in Iran was the online website of the global burden of disease (GBD 2016). These data are provided by modelings which are mainly based on the reports from the Golestan Cancer Registry and the Iranian national cancer registry. Although these data may provide an acceptable overview on the temporal trends on cancer incidence in Iran, the provided absolute values may not be useful. Data on the CRC incidence during 1990 to 2017 was reterived from the GBD website. Data were retierved for males and females in terms of age-specific incidence rate.

Temporal trends were analyzed for two types of rates including “overall age standardized”, and “crude incidence” rates in males and females, sparatly. Join point regression was applied for trend analysis using joinpoint regression software. Annual percentage change (APC) and average annual percent changes (AAPC) and their 95% confidence intervals were estimated.

Considering incompleteness of case scertainment of Iranain cancer registries, absolute values retrerived from GLOBOCAN 2012 were corrected for incompleteness rate. Age and gender stratum specific incompleteness rate were assumed based on previous reports on the quality of the Iranian national or

subnational cancer data. In each age and gender subgroups, the corrected number of CRC cases were estimated applying the following equation:

Corrected new CRC cases by 2012= # of new cases reported by GLOBOCAN 2012*[1+(1-completeness rate)]

We predicted the incidence for the next years according to the following formulas [38]:

$AAPC_i > 0; \# \text{ of cases} = \text{corrected } I_d \times (AAPC_i 100 + 1)^n$

$AAPC_i < 0; \# \text{ of cases} = \text{corrected } I_d (AAPC_i 100 + 1)^n$

Where I_d is stratum specific incident cases in the last year of the given data, and AAPC is the stratum specific AAPC of overall trend of crude rates during 1990 to 2017, n is the number of years for which the incidence will be predicted.

Phase II: Estimation and projection of colorectal cancer prevalence:

At this stage, in order to assess the prevalence, we estimated the 5-years prevalence of CRC including; 1-year, 2-3 years, and 4-5 years partial prevalence. we used the survival and incidence from the following formula to calculate these occurrences, then evaluated the prevalence rate in patients with 1-5 years of diagnosis.

$\int_{i=1}^n IC_{k-1} \times S_{k-1}(i-0.5)^{[4]}$

Where the n-year prevalence in the age k was calculated based on year-specific incidence rates and survival probability. In this formula IC_k is the number of new patients at the age of k and S is absolute survival, $S_k(t)$ is the proportion of patients diagnosed at the age of k that survived in year t, and n is the number of years after diagnosis.

To implement this formula, we extracted the incidence from the two sites described in Phase I, and for the survival, the data were used provided in <http://www.cancerresearchuk.org>, by Gelband et al. [39], the international IARC study [40], and the article of Crooki et al. [41]. Considering the best and worst scenarios with a 95% uncertainty level, we estimated the lower bound and upper bound of the survival rate of cancer, and finally, according to the formula, we calculated the prevalence for less than 1 year (patients in the early stages of treatment), 2 to 3 years (clinical follow up Patients) and 4 to 5 years (cure phase) over the given time (1990 to 2017). Ultimately, considering the predicted incidence in the considered year, assuming a constant survival, and obtaining coverage of cancer in Iran (minimum and maximum percent for completeness of case identification at IR.NCR) between 70 and 85%, the prevalence less than one year, 2 to 3 years, and 4 to 5 years were predicted to 2030.

Results

Results

The incidence of CRC from 1990 to 2017

The results revealed that AAPC was 4.07% among females in all age groups (CI:3.76-4.39) and 4.30% among males in all age groups (CI:4.14-4.47).

The incidence of CRC in both males and females aged less than 40 years has been depicted in Figure 1. Accordingly, the incidence was higher in females than in males in 2004. However, the incidence of the disease in males surpassed that in females since 2005. AAPC was 0.67% among females less than 40 years old (CI:10.9-30.4) and 1.76% among males aged less than 40 years (CI:1.61-1.92). Therefore, the average annual change was higher in males compared to females at the below 40 age group. Meanwhile, the highest APC among the females younger than 40 years was reported in 2007-2012 (5.40%). This measure was reported to be 4.97% among males in 2005-2011.

The incidence of CRC among males and females aged above 40 years has been presented in Figure 2. Accordingly, the incidence of CRC was higher in males than in females aged over 40 years. Indeed, AAPC was 1.67% among in females over 40 years old (CI:1.84-1.5) and 2.08% among males in the same age group (CI:1.88-2.88). Thus, similar to the previous age group, the average annual change was higher in males than in females. Moreover, the highest APC reported among females aged over 40 years was 6.77 in 2004-2009. Considering males, this measure was obtained as 4.66 in 2001-2010.

The prediction of CRC incidence from 2017-2030

According to AAPCs, the incidence rates predicted up to 2030 based on the gender and age groups have been presented in Table 1 (see Supplementary Files). As the table depicts, the predicted incidence was slightly higher among both females and males in the under 40 age group. Accordingly, it reached from about 12 to 15 per 100,000 among males and from about 10 to 11 per 100,000 among females. Additionally, a 100/10,000 and 100/100,000 increase was found among females and males over 40 years, respectively.

Trend and prediction of the prevalence of CRC:

The trends of 1-, 2-3-, and 4-5-year prevalence rates in gender and age groups have been depicted in Figure 3. Accordingly, the prevalence rate increased in all age groups. It reached 3201 among males less than 40 years old and 34077 among those aged above 40 years by 2030. Considering females, this measure reached 2407 and 28673 in the below and above 40 age groups, respectively.

Discussion

In the present study, the incidence and prevalence of CRC were investigated from 1990 to 2017 and its incidence and prevalence by 2030 were predicted. The results indicated an increasing trend in the below 40 age group, but this increase was not absolute and not very high and ranged from 8 to 12 per 100,000.

However, the incidence trend was absolute and almost higher reaching from around 280 to 555 per 100,000 in the over 40 age group. Moreover, an incremental trend was observed in both gender and age groups regarding the prevalence rate of CRC from 1990 to 2017. Therefore, as outlined in other studies, the prevalence data are required in addition to incidence and mortality rates for more effective cancer planning [42]. Generally, prevalence is considered to be an appropriate criterion in the area of healthcare planning and care provision for patients [42]. This refers to the number of people in the community requiring a given method of care [42]. Recent progresses in timely diagnosis and treatment of the disease as well as the increase in the number of new cancer cases, especially in developing countries, have led to an increase in the number of cancer survivors who have fundamental requirements in social and medical contexts at different stages of the disease [43, 44]. Patients may be depressed or anxious due to the fear of recurrence of cancer, loss of their jobs, or their social and intellectual abilities [45, 46]. Indeed, many cancer survivors sometimes encounter challenges beyond medical issues, including their ability to continue working and maintain insurance coverage [47]. Hence, every national cancer control program needs to cover this growing population and its requirements.

Furthermore, in predicting the incidence until 2030, an incremental trend was also observed that was still not growing significantly in the group under 40 years old in predicting the incidence until 2030, while in the age group over 40 years this increase was absolute and high.

Considering the prediction of CRC incidence until 2030, a non-significant incremental trend was observed in the below 40 age group, while this trend was absolute and high in the over 40 age group. There was also an increasing trend in the prevalence of CRC that was almost the same in the two age groups. The 5-year prevalence of the disease reached 34077 among males over 40 years old by 2030, which is almost twice the value estimated in other studies by 2020 [37]. Considering these values, about 24% of patients are in the early stages of the treatment and need surgical interventions, chemotherapy, and radiation therapies. Nonetheless, most CRC patients are diagnosed in the second and third stages of the disease [48]. In addition, most patients are at the end of the clinical phase, accounting for 33% of CRC survivors. These patients require further medical examinations to prevent the recurrence of the disease and must be further supported socially and psychologically [49].

The results of the present study indicated that the incidence and prevalence of CRC was higher at the ages over 40 years, with a higher proportion in males than in females. This can help policymakers focus on the given group and gender in terms of both prevention and treatment. However, there are few reports related to needs assessment of CRC patients in Iran. Except for a charity center in Tehran, most cancer survivors are not supported in medical and social terms. Besides, due to the incomplete and underestimated statistics, the growing population of cancer survivors and their social, medical, insurance, and financial requirements have been forgotten by Iranian cancer researchers [37].

Although the current study estimated and reported the prevalence of CRC, it involved some limitations, including lack of survival estimations on the basis of the Iranian population. Thus, the required information was obtained with the help of other non-Iranian studies. Nonetheless, these studies were not

population-based. To solve this problem, the survival was computed using the confidence intervals reported by other studies, which eliminated this limitation to some extent. Another study limitation was that CRC coverage percentage was reported differently in various resources, which made the researchers take advantage of their confidence intervals for estimation and modeling.

Conclusion

Based on the study results, the need for cancer registration including the patients' population- and follow up-based data is highly felt. In addition, considering the growth of CRC patients one and five years after diagnosis of their disease with specific medical, social, and psychological requirements, it is recommended to establish institutes for identifying and meeting the patients' needs.

Abbreviations

CRC: Colorectal cancer

APC: annual percentage change

AAPC: average annual percentage change

IARC: International agency for research on cancer

GBD: Global Burden of Disease

CI: Confidence interval

Declarations

Acknowledgement:

Hereby, the authors would like to thank Ms. A. Keivanshekouh at the Research Improvement Center of Shiraz University of Medical Sciences for improving the use of English in the manuscript.

Funding: This work was supported by the Research Vice-chancellor of Shiraz University of Medical Sciences [grant numbers [1396-01-04-16440](#)].

Authors' contributions: MV (Principal Investigator) led the design and conduct of the study throughout, and drafted the manuscript. JH coordinated the study and intervention development process, and contributed to drafting the manuscript. H MV contributed to the design and analysis of the study. All authors read and approved the final version of the manuscript.

Ethics approval and consent to participate:

Not applicable.

Consent for publication: Not applicable. This article does not contain information from any individual person that would require consent.

Competing interests: All the authors declared that they have no direct or indirect financial and/or personal relationships with other people or organizations that could inappropriately influence (bias) their work.

References

1. Akbari ME, Rafiee M, Khoei MA, Eshrati B, Hatami H. Incidence and survival of cancers in the elderly population in Iran: 2001-2005. *Asian Pac J Cancer Prev*. 2011;12(11):3035-9.
2. Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. *CA: a cancer journal for clinicians*. 2011;61(2):69-90.
3. Alwan A. Global status report on noncommunicable diseases 2010: World Health Organization; 2011.
4. Ferlay J, Shin HR, Bray F, Forman D, Mathers C, Parkin DM. Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. *International journal of cancer*. 2010;127(12):2893-917.
5. Mousavi SM, Gouya MM, Ramazani R, Davanlou M, Hajsadeghi N, Seddighi Z. Cancer incidence and mortality in Iran. *Annals of oncology*. 2008;20(3):556-63.
6. Kelsen D. Principles and practice of gastrointestinal oncology: Lippincott Williams & Wilkins; 2008.
7. Dunlop M. Screening for large bowel neoplasms in individuals with a family history of colorectal cancer. *British journal of surgery*. 1992;79(6):488-94.
8. Parkin DM. Global cancer statistics in the year 2000. *The lancet oncology*. 2001;2(9):533-43.
9. Schottenfeld D, Winawer S. Cancers of the large intestine. *Cancer Epidemiology and Prevention*. New York: Oxford University Press; 1996.
10. Parkin DM, Bray F, Devesa S. Cancer burden in the year 2000. The global picture. *European journal of cancer*. 2001;37:4-66.
11. Parkin D, Pisani P, Ferlay J. Estimates of the worldwide incidence of eighteen major cancers in 1985. *International journal of cancer*. 1993;54(4):594-606.
12. Parkin D, Whelan S, Ferlay J, Teppo L, Thomas D. Cancer incidence in five continents Vol. VIII. IARC scientific publications. 2002;155.
13. Stewart B, Wild CP. World cancer report 2014. Health. 2017.
14. Bülow S. Colorectal cancer in patients less than 40 years of age in Denmark, 1943–1967. *Diseases of the Colon & Rectum*. 1980;23(5):327-36.

15. Griffin PM, Liff JM, Greenberg RS, Clark WS. Adenocarcinomas of the colon and rectum in persons under 40 years old: a population-based study. *Gastroenterology*. 1991;100(4):1033-40.
16. MacGillivray D, Swartz S, Robinson A, Cruess D, Smith L. Adenocarcinoma of the colon and rectum in patients less than 40 years of age. *Surgery, gynecology & obstetrics*. 1991;172(1):1-7.
17. Guillem JG, Puig-La Calle J, Cellini C, Murray M, Ng J, Fazzari M, et al. Varying features of early age-of-onset "sporadic" and hereditary nonpolyposis colorectal cancer patients. *Diseases of the colon & rectum*. 1999;42(1):36-42.
18. Mityr E, Benhamiche A-M, Jouve J-L, Clinard F, Finn-Faivre C, Faivre J. Colorectal adenocarcinoma in patients under 45 years of age: comparison with older patients in a well-defined French population. *Diseases of the colon & rectum*. 2001;44(3):380-7.
19. Isbister WH. Colorectal cancer below age 40 in the Kingdom of Saudi Arabia. *ANZ Journal of Surgery*. 1992;62(6):468-72.
20. Al-Jaberi TM, Ammari F, Gharieybeh K, Khammash M, Yaghan RJ, Heis H, et al. Colorectal adenocarcinoma in a defined Jordanian population from 1990 to 1995. *Diseases of the colon & rectum*. 1997;40(9):1089-94.
21. Soliman AS, Bondy ML, Levin B, Hamza MR, Ismail K, Ismail S, et al. Colorectal cancer in Egyptian patients under 40 years of age. *International journal of cancer*. 1997;71(1):26-30.
22. Taghavi A, Fazeli Z, Vahedi M, Baghestani AR, Pourhoseingholi A, Barzegar F, et al. Increased trend of breast cancer mortality in Iran. *Asian Pacific Journal of Cancer Prevention*. 2012;13(1):367-70.
23. Moradpour F, Fatemi Z. Estimation of the projections of the incidence rates, mortality and prevalence due to common cancer site in Isfahan, Iran. *Asian Pac J Cancer Prev*. 2013;14(6):3581-5.
24. Lawlor D, Wills A, Fraser A, Sayers A, Fraser W. Investment in cancer studies in countries of low and middle income. *Lancet Oncol*. 2013;14:e239-48.
25. Sharp L, Deady S, Gallagher P, Molcho M, Pearce A, Thomas AA, et al. The magnitude and characteristics of the population of cancer survivors: using population-based estimates of cancer prevalence to inform service planning for survivorship care. *BMC cancer*. 2014;14(1):767.
26. Takiar R, Krishnan SK, Shah VP. A model approach to calculate cancer prevalence from 5 years survival data for selected cancer sites in India—part II. *Asian Pac J Cancer Prev APJCP*. 2014;15(14):5681-4.
27. Hadji M, Nahvijou A, Seddighi Z, Beiki O, Mohagheghi MA, Mosavi-Jarrahi A, et al. Challenges to promoting population-based cancer registration in Iran: a workshop report. *Asian Pac J Cancer Prev*. 2013;14(10):6189-93.

28. Maracy MR, Moradpour F, Hosseini SM, Tirani M. Cancer incidence and prevalence in isfahan: application of mortality data to estimates and projects for the period 2001-2015. *International journal of preventive medicine*. 2012;3(12):867.
29. Rashidian H, Daroudi R, Ghiasvand R, Harirchi I, Zendehtdel K. Prevalence and Incidence of premenopausal and postmenopausal breast cancer in Iran in 2010. *Basic & Clinical Cancer Research*. 2013;5(3):2-10.
30. Hassanzade J. Incidence and mortality rate of common gastrointestinal cancers in south of Iran, a population based study. *Iranian journal of cancer prevention*. 2011;4(4):163.
31. 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.
32. Najafi F, Mozaffari H, Karami M, Izadi B, Tavvafzadeh R, Pasdar Y. Trends in incidence of gastrointestinal tract cancers in Western Iran, 1993-2007. *Iranian Red Crescent Medical Journal*. 2011;13(11):805.
33. Pourhoseingholi MA, Fazeli Z, Ashtari S, Bavand-Pour FSF. Mortality trends of gastrointestinal cancers in Iranian population. *Gastroenterology and hepatology from bed to bench*. 2013;6(Suppl 1):S52.
34. Masoompour SM, Yarmohammadi H, Rezaianzadeh A, Lankarani KB. Cancer incidence in southern Iran, 1998–2002: Results of population-based cancer registry. *Cancer epidemiology*. 2011;35(5):e42-e7.
35. Vardanjani HM, Baneshi MR, Haghdoost A. Total and partial prevalence of cancer across Kerman Province, Iran, in 2014, using an adapted generalized Network scale-up method. *Asian Pac J Cancer Prev*. 2015;16(13):5493-8.
36. Esna-Ashari F, Sohrabi M, Abadi A, Mehrabian A, Kolahi A, Yavari P, et al. Colorectal cancer prevalence according to survival data in Iran in 2007. *Research in Medicine*. 2008;32(3):221-5.
37. Vardanjani HM, Haghdoost A, Bagheri-Lankarani K, Hadipour M. Estimation and Projection of Prevalence of Colorectal Cancer in Iran, 2015–2020. *Advanced biomedical research*. 2018;7.
38. Rahib L, Smith BD, Aizenberg R, Rosenzweig AB, Fleshman JM, Matrisian LM. Projecting cancer incidence and deaths to 2030: the unexpected burden of thyroid, liver, and pancreas cancers in the United States. *Cancer research*. 2014.
39. Gelband H, Sankaranarayanan R, Gauvreau CL, Horton S, Anderson BO, Bray F, et al. Costs, affordability, and feasibility of an essential package of cancer control interventions in low-income and middle-income countries: key messages from Disease Control Priorities. *The Lancet*. 2016;387(10033):2133-44.

40. Bray F, Ren JS, Masuyer E, Ferlay J. Global estimates of cancer prevalence for 27 sites in the adult population in 2008. *International journal of cancer*. 2013;132(5):1133-45.
41. Crooke H, Kobayashi M, Mitchell B, Nwokeji E, Laurie M, Kamble S, et al. Estimating 1-and 5-year relative survival trends in colorectal cancer (CRC) in the United States: 2004 to 2014. *American Society of Clinical Oncology*; 2018.
42. Pisani P, Bray F, Parkin DM. Estimates of the world-wide prevalence of cancer for 25 sites in the adult population. *International journal of cancer*. 2002;97(1):72-81.
43. Simard S, Thewes B, Humphris G, Dixon M, Hayden C, Mireskandari S, et al. Fear of cancer recurrence in adult cancer survivors: a systematic review of quantitative studies. *Journal of Cancer Survivorship*. 2013;7(3):300-22.
44. Mitchell AJ, Ferguson DW, Gill J, Paul J, Symonds P. Depression and anxiety in long-term cancer survivors compared with spouses and healthy controls: a systematic review and meta-analysis. *The lancet oncology*. 2013;14(8):721-32.
45. Rock CL, Doyle C, Demark-Wahnefried W, Meyerhardt J, Courneya KS, Schwartz AL, et al. Nutrition and physical activity guidelines for cancer survivors. *CA: a cancer journal for clinicians*. 2012;62(4):242-74.
46. Tsunoda A, Nakao K, Hiratsuka K, Yasuda N, Shibusawa M, Kusano M. Anxiety, depression and quality of life in colorectal cancer patients. *International journal of clinical oncology*. 2005;10(6):411-7.
47. Earle CC, Chretien Y, Morris C, Ayanian JZ, Keating NL, Polgreen LA, et al. Employment among survivors of lung cancer and colorectal cancer. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*. 2010;28(10):1700-5.
48. Fazeli MS, Adel MG, Lebaschi AH. Colorectal carcinoma: a retrospective, descriptive study of age, gender, subsite, stage, and differentiation in Iran from 1995 to 2001 as observed in Tehran University. *Diseases of the colon & rectum*. 2007;50(7):990-5.
49. El-Shami K, Oeffinger KC, Erb NL, Willis A, Bretsch JK, Pratt-Chapman ML, et al. American Cancer Society colorectal cancer survivorship care guidelines. *CA: a cancer journal for clinicians*. 2015;65(6):427-55.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Table1.jpg](#)
- [fig3.pdf](#)
- [fig2.pdf](#)

- [fig1.pdf](#)