

# Assessing demographic and socioeconomic factors in patients with advanced colorectal cancer

## *Evaluación de factores demográficos y socioeconómicos en pacientes con cáncer colorrectal avanzado*

Mario Trejo-Avila\*, Danilo Solórzano-Vicuña, and Omar Vergara-Fernández

Department of Colorectal Surgery, Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán, Mexico City, Mexico

### Abstract

**Background:** The aim of the study was to determine the socioeconomic and demographic factors associated with advanced colorectal cancer (CRC) presentation at our institution. **Methods:** From January 2009 to January 2018, patients that underwent CRC surgery at our institution were included and retrospectively analyzed. Univariate and multivariate logistic regression were used to determine independent risk factors for presenting with advanced CRC. **Results:** A total of 277 patients were included, 53.5% presented with advanced CRC. The multivariate analysis identified that living in a rural area (odds ratio [OR] = 5.25; 95% confidence interval [95% CI]: 2.27-12.10;  $p < 0.001$ ), weight loss (OR = 2.33; 95% CI: 1.35-4.09;  $p = 0.002$ ), needing emergency surgery (OR = 4.68; 95% CI: 1.25-17.49;  $p = 0.022$ ), location in the rectum in comparison with colon (OR = 2.66; 95% CI: 1.44-4.91;  $p = 0.002$ ), and location in the mid rectum (OR = 6.10; 95% CI: 2.31-16.12;  $p < 0.001$ ) were associated with higher odds of advanced CRC stage at presentation. **Conclusions:** Patients with lower socioeconomic status, with symptoms, and needing emergency surgery were associated with advanced CRC stage at presentation. Special interventions to improve access to care in this population should be planned to enhance CRC outcomes.

**Keywords:** Colorectal cancer. Socioeconomic factors. Advanced colorectal cancer. Health disparities.

### Resumen

**Introducción:** El objetivo del presente estudio es determinar los factores socioeconómicos y demográficos asociados con la presentación de cáncer colorrectal (CCR) en etapas avanzadas en nuestra institución. **Métodos:** De Enero 2009 a Enero 2018, aquellos pacientes operados por CCR fueron incluidos y analizados de forma retrospectiva. Se realizó análisis de regresión logística para determinar los factores de riesgo independientes para presentar CCR avanzado. **Resultados:** Se incluyeron un total de 277 pacientes, de los cuales 53.5% se diagnosticaron con CCR avanzado. En el análisis multivariable: vivienda en zona rural (OR = 5.25; 95% CI: 2.27-12.10;  $p < 0.001$ ), pérdida de peso (OR = 2.33; 95% CI: 1.35-4.09;  $p = 0.002$ ), necesidad de cirugía de urgencia (OR = 4.68; 95% CI: 1.25-17.49;  $p = 0.022$ ), tumores en recto (OR = 2.66; 95% CI: 1.44-4.91;  $p = 0.002$ ), fueron factores asociados a mayor probabilidad de presentación avanzada del CCR. **Conclusiones:** Pacientes con nivel socioeconómico bajo, aquellos que acuden sintomáticos, y los que requieren de inicio cirugía de urgencia, fueron factores asociados a presentaciones avanzadas de CCR. Se requieren intervenciones especiales para mejorar el acceso a un diagnóstico temprano y oportuno en estos grupos poblacionales.

**Palabras clave:** Cáncer colorrectal. Factores socioeconómicos. Cáncer colorrectal avanzado. Disparidades en acceso a la salud.

#### \*Correspondence:

Mario Trejo-Avila  
E-mail: mario.trejo.avila@gmail.com

Date of reception: 26-01-2022

Date of acceptance: 19-05-2022

DOI: 10.24875/CIRU.22000068

Cir Cir. 2023;91(3):312-318

Contents available at PubMed

www.cirugiaycirujanos.com

0009-7411/© 2022 Academia Mexicana de Cirugía. Published by Permanyer. This is an open access article under the terms of the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Introduction

Colorectal cancer (CRC) is one of the most commonly diagnosed cancer in the world, representing the third most common cancer worldwide, and ranks second in terms of mortality<sup>1,2</sup>. Thus, there is a need to constantly improve screening programs and treatment outcomes of patients with CRC.

Regardless of the advances in screening strategies, chemotherapy, radiation therapies, and advanced surgical techniques, socioeconomic inequalities persist in cancer incidence, morbidity, mortality, and survival<sup>3-6</sup>. Socioeconomic status is considered a surrogate for the capacity of patients to seek and obtain appropriate medical treatment<sup>7</sup>. Social disparities in cancer incidence may be related to socioeconomic and demographic differences in cancer-related risk factors and behaviors<sup>3,8-11</sup>. Disparities in health care access and use, particularly in preventive services, may contribute to differentials in cancer stage distributions and prognosis<sup>3,6,12</sup>. Some previous studies have explored the relationships between race or ethnicity and socioeconomic status on the outcomes in CRC, mainly related to the decreased access to care<sup>2,6,7,13,14</sup>. In a previous study, rectal cancer patients with high socioeconomic factors had better survival, with almost a 4-year difference in median overall survival between the highest and lowest socioeconomic groups<sup>7</sup>.

Despite the fact that socioeconomic, demographic or ethnicity status have been previously explored in several articles, all the data come from developed countries<sup>2,3,7</sup>. Furthermore, the literature is more robust on outcome differences between African American and Caucasian patients<sup>2,13</sup>. The impact of those factors in underdeveloped or developing countries has not been widely studied.

In Mexico, it is estimated that nearly 70% of cancer cases are diagnosed in advanced stages<sup>15,16</sup>. Mexico does not have a single coordinating body for cancer prevention, there is no federal program for screening colonoscopy, no national policy nor a national cancer registry exists, and there are no complete and accurate data on the extent and social impact of CRC<sup>15</sup>.

The aim of the study was to assess the socioeconomic and demographic factors associated with advanced CRC presentation at a single center in a developing country.

## Methods

From January 2008 to January 2018, patients that underwent CRC surgery at Instituto Nacional de

Ciencias Médicas y Nutrición “Salvador Zubirán” in Mexico City, Mexico, were included in the study. Data for these patients were retrospectively retrieved and analyzed from the hospital medical records. Patients with incomplete data were excluded from the study.

Socioeconomic and demographic factors included in the study were as follows: Sex, age, presence of other comorbidities and previous diagnosis of another cancer, family history of cancer (first- and second-degree relatives with any type of cancer), socioeconomic status divided in low, mid, and high (as determined by our social workers), marital status (single, married, divorced and widowed), place of residence (urban or rural), educational level (illiterate, literate, college, and above), and religion (catholic, muslim, jew, or others). The socioeconomic status was determined by the social workers of our institution and was calculated according with: mean familiar income, number of individuals depending on that income, mean monthly expense, employment status, and housing characteristics. Patients in our hospital do not have health insurance. Urban residency was considered when living in a place with more than 2500 inhabitants<sup>17</sup>. Rural residency was considered when living in a place with < 2500 inhabitants, and places located outside capital cities. Education level was divided in illiterate (patients unable to read or write), literate (we include in this definition to patients who read and write, and patients who had pre-college studies), and college (patients with university studies or more).

CRC diagnosis was confirmed with histology of the primary site (either with colonoscopy or after surgical resection). Staging evaluation included thoracic computed tomography (CT) scan, contrast-enhanced abdominal-pelvic CT scan, colonoscopic evaluation as required, carcinoembryonic antigen, and pelvic magnetic resonance for rectal cancer. CRC was categorized as localized (Stages I and II), and advanced (Stages III and IV). The stage at presentation was considered either during first clinical appointment or during emergency department consultation.

Factors associated with CRC diagnosis analyzed in the study were as follows: diagnosis of CRC by screening colonoscopy, initial symptoms related to CRC (patients debuting with: bleeding, weight loss, obstruction, perforation, anemia, abdominal pain, and change in bowel habits), colon cancer location (right, transverse, or left colon), and rectal cancer location (high, mid, or low rectum). Obstructing symptoms included those presenting with partial and total malignant obstruction. Symptoms of perforation included

those of acute abdomen and peritonitis. Diagnosis by screening colonoscopy was considered when the recommendations of international guidelines were followed<sup>18</sup>.

Patients that underwent emergent surgical resection and that resulted in CRC diagnosis were also included in the study. Clinical stage was determined according with the American Joint Committee on Cancer (AJCC) Cancer Staging Manual eight edition and expressed as tumor, nodes, and metastasis<sup>19</sup>.

### Statistical analysis

All data were collected retrospectively in a digital database. Patients were divided in two groups depending on their clinical stage at presentation: Stages I and II (early CRC: E-CRC) and Stage III-IV (advanced-CRC: A-CRC). Categorical data were presented as totals (n) and proportions as percentages. Categorical data were compared using the Chi-square test or Fisher exact test (analyzing patients in two groups: E-CRC vs. L-CRC groups). All tests were two-sided and used an alpha of 0.05. Univariate binomial logistic regression analysis was performed. All variables with p-value inferior to 0.05 in the univariate analysis were considered as potential risk factors (predictors of advanced CRC presentation) and were entered manually into the multivariate forward logistic regression analysis. The variables representing the lowest risk for advanced CRC presentation were considered to be the reference group (odds ratio [OR] = 1.0). OR and 95% confidence intervals (95% CI) were calculated. Models were checked for goodness of fit using the Hosmer–Lemeshow test. Subgroup analysis examining the interaction between socioeconomic factors and stage at presentation, as well as symptoms at presentation and CRC stage, were performed. All p-values were two-tailed, and p < 0.05 was considered to be statistically significant. All data were analyzed using the Statistical Package for the Social Sciences Version 22.0 (IBM Corporation, Armonk, New York, NY).

### Results

A total of 277 patients who fulfill the inclusion criteria were analyzed in our study. Based on their clinical stage at presentation, 129 (46.5%) patients were included in the early CRC group (E-CRC), and 148 (53.5%) were included in the advanced CRC group (A-CRC). No differences were found on regard of sex and age at presentation between both groups. Table 1 describes the different socioeconomic factors

**Table 1. Patient demographics and clinical features**

Factors	Stage I-II (n = 129)	Stage III-IV (n = 148)	p < 0.05
Sex, n (%)			0.985
Female	60 (46.5)	69 (46.6)	
Male	69 (53.5)	79 (53.4)	
Age groups, n (%)			0.108
< 50	20 (15.5)	27 (18.2)	
50-70	55 (42.6)	77 (52)	
> 70	54 (41.9)	44 (29.7)	
Other comorbidities, n (%)			0.362
Yes	92 (71.3)	98 (66.2)	
No	37 (28.7)	50 (33.8)	
Other malignancy, n (%)			0.746
Yes	21 (16.3)	22 (14.9)	
No	108 (83.7)	126 (85.1)	
Family history of cancer, n (%)			0.009
Yes	55 (42.6)	41 (27.7)	
No	74 (57.4)	107 (72.3)	
Socioeconomic status, n (%)			0.028
Low	44 (34.1)	70 (47.3)	
Mid	68 (52.7)	69 (46.6)	
High	17 (13.2)	9 (6.1)	
Marital status, n (%)			0.446
Single	23 (17.8)	35 (23.6)	
Married	70 (54.3)	76 (51.4)	
Divorced	12 (9.3)	17 (11.5)	
Widowed	24 (18.6)	20 (13.5)	
Place of residence, n (%)			<0.001
Urban	121 (93.8)	108 (73)	
Rural	8 (6.2)	40 (27)	
Education level, n (%)			0.040
Illiterate	4 (3.1)	14 (9.5)	
Literate	113 (87.6)	127 (85.8)	
College	12 (9.3)	7 (4.7)	
Religion, n (%)			0.325
Yes	114 (88.4)	136 (91.9)	
No	15 (11.6)	12 (8.1)	
Diagnosed by screening colonoscopy, n (%)			0.268
Yes	8 (6.2)	5 (3.4)	
No	121 (93.8)	143 (96.6)	
Initial symptoms, n (%)			
Bleeding	68 (52.7)	98 (66.2)	0.022
Weight loss	70 (54.3)	102 (68.9)	0.012
Obstruction	19 (14.7)	37 (25)	0.034
Perforation	2 (1.6)	12 (8.1)	0.013
Anemia	63 (48.8)	76 (51.4)	0.676
Change in bowel habit	89 (69)	108 (73)	0.466
Pain	72 (55.8)	92 (62.2)	0.284
Colorectal tumor site, n (%)			0.029
Right colon	54 (41.9)	52 (35.1)	
Transverse	8 (6.2)	5 (3.4)	
Left colon	43 (33.3)	38 (25.7)	
Rectum	23 (17.8)	50 (33.8)	
Synchronous	1 (0.8)	3 (2)	
Rectal cancer location, n (%)			0.019
High rectum	6 (4.7)	4 (2.7)	
Mid rectum	6 (4.7)	29 (19.6)	
Low rectum	11 (8.5)	17 (11.5)	
Emergency surgery, n (%)			0.005
Yes	3 (2.3)	16 (10.8)	
No	126 (97.7)	132 (89.2)	

**Table 2. Univariate and multivariate analysis of factors associated with late stage CRC presentation**

Factors	Univariate analysis		Multivariate logistic regression	
	Unadjusted OR (95% CI)	p value	Adjusted OR (95% CI)	p value
SE status				
High	1 (Reference)			
Mid	1.91 (0.79-4.59)	0.145		
Low	3.00 (1.23-7.33)	0.016		
Family history of cancer		0.010		
Yes	1 (Reference)			
No	1.94 (1.17-3.20)			
Place of residence				< 0.001
Urban	1 (Reference)		1.00	
Rural	5.60 (2.51-12.49)	< 0.001	5.25 (2.27-12.10)	
Education level				
College	1 (Reference)			
Literate	1.92 (0.73-5.06)	0.183		
Illiterate	6.00 (1.40-25.58)	0.015		
Bleeding	1.75 (1.08-2.85)	0.023		
Weight loss	1.86 (1.14-3.05)	0.013	2.33 (1.35-4.09)	0.002
Obstruction	1.93 (1.05-3.56)	0.035		
Perforation	5.60 (1.23-25.52)	0.026		
Emergency Surgery				0.022
No	1 (Reference)		1.00	
Yes	5.09 (1.44-17.89)	0.011	4.68 (1.25-17.49)	
CRC Tumor site				0.002
Colon	1 (Reference)	0.003	1.00	
Rectum	2.35 (1.33-4.13)		2.66 (1.44-4.91)	
Rectal cancer location				
High rectum	1 (Reference)		1.00	
Mid rectum	5.22 (2.08-13.13)	< 0.001	6.10 (2.31-16.12)	< 0.001
Low rectum	1.67 (0.74-3.74)	0.212	0.89 (0.23-3.44)	0.877

SE: socioeconomic. For multivariable logistic regression analysis odds ratio (OR) and 95% confidence interval (CI) are presented. Odds ratios are calculated for CRC late stage presentation. Only significant results are shown. The reference category has an odds ratio of 1.00. Backward conditional. CRC: colorectal cancer.

evaluated in the study and their association to the stage at diagnosis.

In the unadjusted analyses (Table 2), low socioeconomic status, no history of cancer in the family members, living in a rural area, being illiterate, presenting with bleeding, weight loss, obstruction, and perforation, the surgery performed as an emergency, and tumor located in the mid rectum were associated with advanced CRC presentation. The multivariate logistic regression analysis identified five independent risk factors for advanced CRC presentation: living in a rural area (OR = 5.25; 95% CI: 2.27-12.10;  $p < 0.001$ ), presenting with weight loss (OR = 2.33; 95% CI: 1.35-4.09;  $p = 0.002$ ), the CRC surgery performed as an emergency (OR = 4.68; 95% CI: 1.25-17.49;  $p = 0.022$ ), location in the rectum in comparison with colon (OR = 2.66; 95% CI: 1.44-4.91;

$p = 0.002$ ), and location in the mid rectum (OR = 6.10; 95% CI: 2.31-16.12;  $p < 0.001$ ).

In the subgroup analysis combining the effect of only the socioeconomic factors (Table 3), multivariate analysis identified two independent risk factors for advanced CRC presentation: living in a rural area (OR = 5.28; 95% CI 2.35-11.84;  $p < 0.001$ ) and no history of cancer in the family members (OR = 1.77; 95% CI: 1.05-2.97;  $p = 0.031$ ).

When only the symptoms at presentation were combined (Table 4), the multivariate analysis revealed that presenting with bleeding (OR = 1.93; 95% CI: 1.16-3.21;  $p = 0.010$ ), weight loss (OR = 1.97; 95% CI: 1.19-3.28;  $p = 0.008$ ), and signs of perforation (OR = 8.05; 95% CI: 1.68-38.39;  $p = 0.009$ ) were independent risk factors for advanced CRC.

**Table 3. Subgroup analysis: Combined effect of socioeconomic factors on late stage CRC at presentation**

Socioeconomic factors	Multivariate logistic regression		
	Adjusted OR	95% CI	p value
Income status			
High	1 (Reference)		
Mid	1.78	0.65-4.83	0.258
Low	4.11	0.89-18.86	0.069
Place of residence			< 0.001
Urban	1 (Reference)		
Rural	5.28	2.35-11.84	
Education level			
College	1 (Reference)		
Literate	1.78	0.65-4.83	0.258
Illiterate	4.11	0.89-18.86	0.069
Family history of cancer			0.031
Yes	1 (Reference)		
No	1.77	1.05-2.97	

For multivariable logistic regression analysis odds ratio (OR) and 95% confidence interval (CI) are presented. Odds ratios are calculated for CRC late stage presentation. Only significant results are shown. The reference category has an odds ratio of 1.00. CRC: colorectal cancer.

**Table 4. Subgroup analysis: Combined effect of debuting symptoms on late stage CRC at presentation**

Symptoms at presentation	Multivariate logistic regression		
	Adjusted OR	95% CI	p value
Bleeding	1.93	1.16-3.21	0.010
Weight loss	1.97	1.19-3.28	0.008
Obstruction	1.88	0.99-3.56	0.053
Perforation	8.05	1.68-38.39	0.009

For multivariable logistic regression analysis odds ratio (OR) and 95% confidence interval (CI) are presented. Odds ratios are calculated for CRC late stage presentation. Only significant results are shown. The reference category has an odds ratio of 1.00. CRC: colorectal cancer.

## Discussion

In our study, 53.5% of CRC cases were diagnosed at an advanced stage. We found that patients with the lower socioeconomic status, living in a rural area, illiteracy, not having family members with history of cancer, as well as patients consulting with symptoms (bleeding, weight loss, obstruction, and perforation), needing emergency surgery, and tumors located in the mid rectum, were associated with advanced CRC stage at presentation. The findings of this study are concordant with the patterns identified in previously published studies<sup>2,3,5,7</sup>.

Socioeconomic, racial, and demographic disparities in the survival of patients with CRC have been documented in the previous publications<sup>2,9-11,20</sup>. These disparities may be attributed to many factors including differences in socioeconomic status, disease stage at diagnosis, tumor biology, screening programs, access to care, quality of care, and post-treatment surveillance<sup>9-11,20</sup>. In a 2014 systematic review<sup>2</sup>, the impact of socioeconomic status on incidence, mortality, and survival of CRC patients was analyzed. They included 62 studies, being the majority from the USA and Europe, and only 1 study from South America (Puerto Rico)<sup>2,21</sup>. This reflects the lack of data from developing countries.

Authors from developed countries have suggested that a substantial proportion of the socioeconomic disparity of new onset CRC may be attributable to the higher prevalence of adverse health behaviors on low socioeconomic status populations<sup>2,22</sup>. We believe that the conclusions from other studies are not applicable to underdeveloped countries, because there is more social inequity, more poverty, less appropriate health-care services, less educational level, as well as different patterns of risk behaviors. This highlights the importance of our results.

The previous studies have shown that the diagnostic interval (time from presentation with symptoms to diagnosis) is inversely related to survival<sup>23,24</sup>, the so-called “waiting time paradox.” This paradox refers to a scenario, in which patients with shorter diagnostic interval have more advanced disease and poorer outcomes<sup>23</sup>. Although we did not have data to estimate the diagnostic interval, we found that patients presenting with symptomatic disease (bleeding, weight loss, obstruction and perforation) were associated with advanced CRC stages. This seems related to the fact that most patients with CRC are diagnosed after presentation with symptoms<sup>23,25</sup>.

Asymptomatic patients are usually diagnosed with CRC screening programs and generally had earlier and more treatable disease<sup>5,25</sup>. In the USA, approximately 34-59% of Americans for whom screening is recommended undergo recommended CRC screening<sup>25,26</sup>. Unfortunately, we found in our study an alarmingly low rate of cancer detected by screening colonoscopy (overall 4.7%). Under this scenario, we should remark that there is no mass population screening strategy for CRC in Mexico. As previously stated, the Mexican health system has serious deficiencies in its physical infrastructure and medical personnel that will be difficult to amend in the short term<sup>15</sup>.

An estimated 15% of CRCs present as a surgical emergency in the USA<sup>25,27</sup>. We found in our cohort an overall 6.8% (E-CRC 2.3% vs. A-CRC 10.8%) of patients presenting as a surgical emergency. Despite the number of patients that required emergency surgery in our cohort is lower than that reported in the USA, this could be the result of a selection or information bias in our study.

Although this study provides some evidence that lower socioeconomic status and some demographic factors are associated with advanced CRC stages, due to the nature of the study, it could not be possible to generalize the results to a national population. The fact that this study is based on retrospective data from a single center predispose to several bias (selection bias, information bias) inherent to the design. It is important to consider that there is a lack of a uniform set of indices for measuring socioeconomic status<sup>2</sup>, so the comparability between this and other studies may be compromised. This is also true for comparisons between larger studies in developed countries.

A large population-based study could provide more data about the social, demographic, and economical factors related to late CRC presentation in developing countries. Unfortunately, nation-wide databases or CRC registries are not available in our country<sup>15,28</sup>. The implementation of a national cancer registry program is of utmost importance to understand the detailed burden of cancer in our country<sup>28,29</sup>.

Despite these limitations, our results add to the published literature that in a developing country patients living in rural areas, with low socioeconomic and educational status, those needing an emergency surgery, and those presenting with symptomatic disease were associated with higher risk of advanced CRC stage presentation. Although we found some associations with advanced CRC presentation, more research is needed to determine the causal factors underlying socioeconomic and demographic risk gradients in our institution and in our country. Special focus to these vulnerable groups should conduce to health care improving policies and reduction in disparities in cancer care access and outcomes. There are several strategies that could be recommended to reduce the risk of CRC in vulnerable populations. One strategy is to perform massive screening programs in rural areas either by FIT test (fecal immunochemical test) or rectosigmoidoscopy. Other strategy is creating educational programs with massive diffusion to inform about the risks of CRC and the importance of scrutiny in rural and urban areas. A complementary strategy

is to improve the primary prevention with lifestyle habits modifications, avoiding alcohol and smoking, take control of the weight (reducing obesity), and improve eating habits. Focusing in screening programs and primary prevention instead of building costly third level hospitals or paying expensive surgeries and chemotherapy should be considered as a cost-effective alternative to this problem.

## Conclusions

In our study, patients with features related to lower socioeconomic status (low status, rural residence, and illiteracy), as well as patients consulting with symptoms and needing emergency surgery (history of bleeding, weight loss, obstruction, and perforation), were associated with higher odds of advanced CRC stage at presentation. Special interventions to improve access to care in this population should be planned and executed to enhance CRC outcomes.

## Funding

There were no grants/funds used for this research project.

## Conflicts of interest

The authors declare that they have no conflicts of interest.

## Ethical disclosures

**Protection of human and animal subjects.** The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

**Confidentiality of data.** The authors declare that they have followed the protocols of their work center on the publication of patient data.

**Right to privacy and informed consent.** The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

## References

1. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin.* 2018;68:394-424.

2. Manser CN, Bauerfeind P. Impact of socioeconomic status on incidence, mortality, and survival of colorectal cancer patients: a systematic review. *Gastrointest Endosc.* 2014;80:42-60.e9.
3. Clegg LX, Reichman ME, Miller BA, Hankey BF, Singh GK, Lin YD, et al. Impact of socioeconomic status on cancer incidence and stage at diagnosis: selected findings from the surveillance, epidemiology, and end results: national Longitudinal Mortality Study. *Cancer Causes Control.* 2009;20:417-35.
4. Link BG, Phelan JC. Understanding sociodemographic differences in health—the role of fundamental social causes. *Am J Public Health.* 1996;86:471-3.
5. Ho C, Kornfield R, Vittinghoff E, Inadomi J, Yee H, Somsouk M. Late presentation of colorectal cancer in a vulnerable population. *Am J Gastroenterol.* 2013;108:466-70.
6. Zhang Q, Wang Y, Hu H, Huang R, Xie L, Liu E, et al. Impact of socioeconomic status on survival of colorectal cancer patients. *Oncotarget.* 2017;8:106121-31.
7. Kim J, Artinyan A, Mailey B, Christopher S, Lee W, McKenzie S, et al. An interaction of race and ethnicity with socioeconomic status in rectal cancer outcomes. *Ann Surg.* 2011;253:647-54.
8. Faggiano F, Partanen T, Kogevinas M, Boffetta P. Socioeconomic differences in cancer incidence and mortality. *IARC Sci Publ.* 1997;138:65-176.
9. Le H, Ziogas A, Lipkin SM, Zell JA. Effects of socioeconomic status and treatment disparities in colorectal cancer survival. *Cancer Epidemiol Biomarkers Prev.* 2008;17:1950-62.
10. Du XL, Meyer TE, Franzini L. Meta-analysis of racial disparities in survival in association with socioeconomic status among men and women with colon cancer. *Cancer.* 2007;109:2161-70.
11. Marcella S, Miller JE. Racial differences in colorectal cancer mortality. The importance of stage and socioeconomic status. *J Clin Epidemiol.* 2001;54:359-66.
12. Hoffman-Goetz L, Breen NL, Meissner H. The impact of social class on the use of cancer screening within three racial/ethnic groups in the United States. *Ethn Dis.* 1998;8:43-51.
13. Polite BN, Dignam JJ, Olopade OI. Colorectal cancer model of health disparities: understanding mortality differences in minority populations. *J Clin Oncol.* 2006;24:2179-87.
14. Cairns AL, Schlottmann F, Strassle PD, Di Corpo M, Patti MG. Racial and Socioeconomic disparities in the surgical management and outcomes of patients with colorectal carcinoma. *World J Surg.* 2019;43:1342-50.
15. Reynoso-Noverón N, Meneses-García A, Erazo-Valle A, Escudero-de Los Ríos P, Kuri-Morales PA, Mohar-Betancourt A. Challenges in the development and implementation of the National Comprehensive Cancer Control Program in Mexico. *Salud Publica Mex.* 2016;58:325-33.
16. López-Carrillo L, Torres-Sánchez L, López-Cervantes M, Rueda-Neria C. Identification of malignant breast lesions in Mexico. *Salud Publica Mex.* 2001;43:199-202.
17. Palacio-Mejía LS, Rangel-Gómez G, Hernández-Avila M, Lazcano-Ponce E. Cervical cancer, a disease of poverty: mortality differences between urban and rural areas in Mexico. *Salud Publica Mex.* 2003;45 Suppl 3:S315-25.
18. Rex DK, Boland CR, Dominitz JA, Giardiello FM, Johnson DA, Kaltenbach T, et al. Colorectal cancer screening: recommendations for physicians and patients from the U.S. Multi-Society task force on colorectal cancer. *Am J Gastroenterol.* 2017;112:1016-30.
19. Amin MB, Edge SB, Greene FL, Gershenwald JE, Brookland RK, Meyer L, et al. Colorectal cancer. In: *AJCC Cancer Staging.* 8<sup>th</sup> ed. New York: Springer; 2017.
20. White A, Vernon SW, Franzini L, Du XL. Racial disparities in colorectal cancer survival: to what extent are racial disparities explained by differences in treatment, tumor characteristics, or hospital characteristics? *Cancer.* 2010;116:4622-31.
21. Torres-Cintrón M, Ortiz AP, Ortiz-Ortiz KJ, Figueroa-Vallés NR, Pérez-Irizarry J, Díaz-Medina G, et al. Using a socioeconomic position index to assess disparities in cancer incidence and mortality, Puerto Rico, 1995-2004. *Prev Chronic Dis.* 2012;9:E15.
22. Doubeni CA, Major JM, Laiyemo AO, Schootman M, Zauber AG, Hollenbeck AR, et al. Contribution of behavioral risk factors and obesity to socioeconomic differences in colorectal cancer incidence. *J Natl Cancer Inst.* 2012;104:1353-62.
23. Leiva A, Esteva M, Llobera J, Macià F, Pita-Fernández S, González-Luján L, et al. Time to diagnosis and stage of symptomatic colorectal cancer determined by three different sources of information: a population based retrospective study. *Cancer Epidemiol.* 2017;47:48-55.
24. Droste JS, Oort FA, van der Hulst RW, Coupé VM, Craanen ME, Meijer GA, et al. Does delay in diagnosing colorectal cancer in symptomatic patients affect tumor stage and survival? A population-based observational study. *BMC Cancer.* 2010;10:332.
25. Moreno CC, Mittal PK, Sullivan PS, Rutherford R, Staley CA, Cardona K, et al. Colorectal cancer initial diagnosis: screening colonoscopy, diagnostic colonoscopy, or emergent surgery, and tumor stage and size at initial presentation. *Clin Colorectal Cancer.* 2016;15:67-73.
26. Taylor DP, Cannon-Albright LA, Sweeney C, Williams MS, Haug PJ, Mitchell JA, et al. Comparison of compliance for colorectal cancer screening and surveillance by colonoscopy based on risk. *Genet Med.* 2011;13:737-43.
27. Smothers L, Hynan L, Fleming J, Turnage R, Simmang C, Anthony T. Emergency surgery for colon carcinoma. *Dis Colon Rectum.* 2003;46:24-30.
28. Gómez-Dantés H, Lamadrid-Figueroa H, Cahuana-Hurtado L, Silverman-Retana O, Montero P, González-Robledo MC, et al. The burden of cancer in Mexico, 1990-2013. *Salud Publica Mex.* 2016;58:118-31.
29. Quezada-Gutiérrez C, Álvarez-Bañuelos MT, Morales-Romero J, Sampieri CL, Guzmán-García RE, Montes-Villaseñor E. Factors associated with the survival of colorectal cancer in Mexico. *Intest Res.* 2020;18:315-24.