Gender Differences in Colorectal Cancer Incidence in the United States, 1975–2006

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Abstract

Background: Gender differences have been documented among patients diagnosed with colorectal cancer (CRC). It is still not clear, however, how these differences have changed over the past 30 years and if these differences vary by geographic areas. We examined trends in CRC incidence between 1975 and 2006.

Methods: The study population consisted of 373,956 patients ≥ 40 years diagnosed with malignant CRC between 1975 and 2006 who resided in one of the nine Surveillance, Epidemiology and End Results (SEER) regions of the United States. Age-adjusted incidence rates over time were reported by gender, race, CRC subsite, stage, and SEER region.

Results: Overall, CRC was diagnosed in roughly equal numbers of men (187,973) and women (185,983). Men had significantly higher age-adjusted CRC incidence rates across all categories of age, race, tumor subsite, stage, and SEER region. Gender differences in CRC age-adjusted incidence rates widened slightly from 1975 to 1988, reached a peak in 1985–1988, and have narrowed over time since 1990. The largest gap and decline in CRC incidence rates between men and women were observed among those ≥ 80 years ($p < 0.001$), followed by those 70–79 and then 60–69 years. Gender differences in CRC incidence rates for the 40–49 and 50–59 age categories were small and increased only slightly over time ($p = 0.003$).

Conclusions: Higher CRC age-adjusted incidence among men than among women has persisted over the past 30 years. Although gender differences narrowed in the population ≥ 60 years, especially from 1990 to 2006, gender gaps, albeit small ones, in those younger than 60 increased over time. Future studies may need to examine the factors associated with these differences and explore ways to narrow the gender gap.

Introduction

WITH AN ESTIMATED 142,570 NEW CASES in 2010, colorectal cancer (CRC) is the third most commonly diagnosed cancer in the United States.^{1,2} Because it typically develops slowly, there is the potential for reducing the disease burden by early detection and removal of precancerous or early stage lesions.^{1–5} Although CRC incidence rates have declined in recent years for both men and women across all races and ethnicities, the disease burden remains high, and incidence trends have differed considerably between subpopulations.^{4,6–16} Much of the health disparity research in CRC has focused on race/ethnicity, socioeconomic status (SES), and other sociodemographic factors^{17–19}; fewer studies have examined the role of gender in CRC incidence and eventual health outcomes.^{20–23}

Gender is an important factor that should be considered in the design and analyses of health studies and biomedical re-

search.^{24–27} Although gender is often acknowledged as an independent influence on CRC incidence and several investigators have identified the general determinants of CRC incidence in population-based studies, few have examined how these factors differ between men and women and how differences may vary over time.^{8,9,28–31} Gender typically is controlled for in analysis.³¹ As a result, our understanding of most influences on health-related outcomes is based on effects independent of gender.³² Some investigators have studied the moderating role of gender in CRC incidence,^{11,33,34} whereas others have called for its consideration in screening recommendations and population-based screening interventions.^{20,35–38} A recent study on the incidence trend of CRC by anatomic site and disease stage concluded that the proportion of ascending colon and hepatic flexure cancers increased over time,³¹ but it is unclear how gender differences in CRC incidence have changed over a long period of time.^{8,9,28–31} Two important studies specifically examined gender disparities in

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cancer incidence.^{8,9} The report by Cook et al.⁸ examined sex disparities in multiple tumor sites between 1975 and 2004, but gender differences in CRC incidence by age and geographic areas were not reported. The other study by Murphy et al.⁹ examined sex disparities in CRC incidence in 1993–2006 by anatomic subsite, race, and age but did not report sex disparities by geographic areas and their changes over time. We aimed to further examine gender differences in CRC incidence beyond the scopes of previous studies by (1) using large population-based cohorts over the past 30 years from 1975 to 2006, (2) examining the changes in gender differences over time by age, race, and tumor stage, and (3) investigating gender differences by geographic areas. The detailed examination of these factors may enhance our understanding of potential causes of gender differences in CRC incidence.

Materials and Methods

Data sources and study population

We used the Surveillance, Epidemiology and End Results (SEER) public dataset released in April 2009. The SEER program of the National Cancer Institute (NCI) provides information on CRC incident cases and demographic characteristics.² Data for the population denominators used to calculate incidence rates were derived from the estimates based on the United States Census data. Data on more than 6 million *in situ* and invasive cancer cases are included in the database.² The SEER program is a source of population-based historical and current information on patient survival and disease stage. The program obtains and reports mortality data from the National Center for Health Statistics.² The population data used to calculate cancer rates are obtained periodically from the U.S. Census Bureau. By the year 2000, there were 18 SEER registries that covered 26.2% of the U.S. population.² Because our study aimed to examine the time trend of gender disparity in CRC incidence over the past 30 years, only the original nine registries, which have been part of the SEER program from 1975 through 2006, were included. These registries are Atlanta, Connecticut, Detroit, Hawaii, Iowa, New Mexico, San Francisco-Oakland, Seattle-Puget Sound, and Utah. The study population consisted of 394,986 men and women from these registries who were diagnosed with CRC at age ≥ 40 years. We included patients aged ≥ 40 years because the median age at diagnosis for CRC is 70 years,² and CRC is extremely rare in populations of < 40 years old, making the incidence rates unstable, with wide confidence intervals (CIs). This analysis of SEER data was approved by the Institutional Review Board of the University of Texas Health Science Center at Houston.

Study variables

The primary independent variable in this study was gender (male or female). The primary outcome variable was cumulative incidence measured as the ratio of the number of CRC cases to the population at risk. Incident cases of invasive primary CRC, coded C18.0–C18.9, C19.9, C20.9, and C26.0 according to the *International Classification of Diseases for Oncology*, 3rd ed. (ICD-O-3) topography (site), were included in the study.^{2,29} CRC was divided into three major anatomic subsite groups in some analyses: proximal colon, distal colon, and rectum.²⁹ The right or proximal colon includes the cecum

(C18.0), ascending colon (C18.2), hepatic flexure (C18.3), transverse colon (C18.4), and splenic flexure (C18.5). The left or distal colon includes the descending colon (C18.6) and sigmoid colon (C18.7). The rectum includes the rectosigmoid junction (C19.9) and the rectum–not otherwise specified (NOS) (C20.9). Based on the methods of Wu et al.,¹¹ we included cancers of the appendix (C18.1), colon–NOS (C18.9), overlapping subsites (C18.8), and intestinal tract–NOS (C26.0) in the statistics for the total colon and rectum but not for the specific anatomic subsites. In line with Wu et al.¹¹ and Rim et al.,¹² we chose this definition of proximal vs. distal sites because it aligns better with the use of colonoscopy vs. sigmoidoscopy.

We used the SEER path-historic staging system to stage CRC cases. Malignant, microscopically confirmed invasive tumors confined to the colon or rectum were defined as localized; tumors that had invaded surrounding tissues, organs, or lymph nodes were defined as regional; metastasized tumors were defined as distant; and cancers of unknown stage were defined as unstaged. Sociodemographic variables include race, defined as white, black, and other (Asian/Pacific Islander, American Indian, and Native Alaskan); age in 5-year and 10-year categories from 40; and SEER registry.

Statistical analysis

Annual gender-specific age-adjusted incidence rates per 100,000 were computed by age, race, anatomic subsite, cancer stage, and geographic region. The year 2000 U.S. standard population was used to obtain age-adjusted rates. The absolute differences in annual incidence rates between men and women were computed and examined for trends. A significance level of 0.05 (two-tailed) was used for all analyses. SEER*Stat version 6.5.2,³⁹ a statistical program hosted on the NCI website, was used for all analyses.

Results

Between 1975 and 2006, a total of 394,986 eligible CRC patients aged ≥ 40 years were reported in the nine SEER registries. Of those cases, 5% were *in situ* tumors and 95% were invasive malignant tumors. For the purpose of this study, we considered invasive tumors only ($n=373,956$). Table 1 presents the distribution of demographic and tumor characteristics of patients who were diagnosed with CRC at ages 40–85+ years. Within the study population, 50.3% of invasive CRCs (187,973) occurred in men, and 49.7% (185,983) occurred in women. Of these cases, 69.8% occurred among those ≥ 65 years; 85.6% were white, 8.1% were black, and 6.2% were classified as other (Asian/Pacific Islander, American Indian, Alaska Native, or unknown). Cancer of the proximal colon accounted for 41.6% of invasive CRCs, and cancer of the distal colon and rectum accounted for 29.1% and 29.3%, respectively. By stage at diagnosis, 39.2% of patients had localized, 37.2% had regional, and 18.2% had distant stage disease; 5.4% of CRCs were unstaged. Geographically, eastern (Atlanta and Connecticut) and midwestern registries (Detroit and Iowa) accounted for 23.7% and 34.1%, respectively; southwestern (New Mexico and Utah) and western registries (San Francisco-Oakland, Seattle-Puget Sound, and Hawaii) accounted for 8.8% and 33.4%, respectively.

The overall age-adjusted CRC incidence rates in the SEER geographic regions from 1975 to 2006 was 125.7/100,000 for

TABLE 1. DEMOGRAPHIC AND TUMOR CHARACTERISTICS OF PATIENTS DIAGNOSED WITH COLORECTAL CANCER RESIDING IN NINE SURVEILLANCE, EPIDEMIOLOGY AND END RESULTS REGIONS, 1975–2006

Characteristic	Total		Male		Female	
	n	%	n	%	n	%
Age at diagnosis, years						
40–44	7,023	1.9	3,677	2.0	3,346	1.8
45–49	12,324	3.3	6,512	3.5	5,812	3.1
50–54	21,266	5.7	11,666	6.2	9,600	5.2
55–59	30,875	8.3	17,332	9.2	13,543	7.3
60–64	41,623	11.1	23,662	12.6	17,961	9.7
65–69	52,916	14.2	29,314	15.6	23,602	12.7
70–74	59,655	16.0	31,397	16.7	28,258	15.2
75–79	59,387	15.9	28,992	15.4	30,395	16.3
80–84	47,743	12.8	20,808	11.1	26,935	14.5
85+	41,144	11.0	14,613	7.8	26,531	14.3
Race						
White	319,842	85.5	160,345	85.3	159,497	85.8
Black	30,206	8.1	14,338	7.6	15,868	8.5
Other	22,989	6.1	12,796	6.8	10,193	5.5
Tumor stage						
Localized	146,665	39.2	75,341	40.1	71,324	38.3
Regional	139,256	37.2	68,217	36.3	71,039	38.2
Distant	67,954	18.2	34,671	18.4	33,283	17.9
Unstaged	20,081	5.4	9,744	5.2	10,337	5.6
Tumor site						
Proximal/right colon	155,731	41.6	70,129	37.3	85,602	46.0
Distal/left colon	108,799	29.1	56,714	30.2	52,085	28.0
Rectum	109,426	29.3	61,130	32.5	48,296	26.0
SEER registries						
San Francisco-Oakland	58,859	15.7	29,396	15.6	29,463	15.8
Connecticut	65,261	17.5	32,658	17.4	32,603	17.5
Detroit (Metro)	66,205	17.7	33,334	17.7	32,871	17.7
Hawaii	16,643	4.5	9,714	5.2	6,929	3.7
Iowa	61,373	16.4	29,256	15.6	32,117	17.3
New Mexico	16,968	4.5	8,951	4.8	8,017	4.3
Seattle (Puget Sound)	49,432	13.2	25,229	13.4	24,203	13.0
Utah	15,898	4.3	8,299	4.4	7,599	4.1
Atlanta (Metro)	23,317	6.2	11,136	5.9	12,181	6.5
Total	373,956	100.0	187,973	100.0	185,983	100.0

all patients aged ≥ 40 , 149.7/100,000 for men, and 108.4/100,000 for women (Table 2). The incidence rate ratio between men and women was 1.38. The higher incidence rates in men than in women persisted in all age strata, tumor sites, tumor stages, and geographic area. The CRC incidence rates rose dramatically with age, with the highest rates observed among patients ≥ 70 years. By race, incidence was the highest among blacks (134.4/100,000), followed by whites (126.2/100,000) and other race/ethnic groups (102.8/100,000). The highest incidence by tumor site was proximal colon (53.0/100,000), rectum (36.4/100,000), and distal colon (36.4/100,000). The incidence rate for colon (proximal and distal combined) was 131.7/100,000. Geographically, the midwestern areas recorded the highest incidence rate (136.6/100,000), followed by the eastern (132.3/100,000), western (122.6/100,000), and southwestern regions (93.1/100,000). CRC incidence rates were higher in men than in women among all strata, and within these strata, men had 14.2% (in the youngest age category) to 66.5% (for rectal cancer) higher incidence rates than women.

Overall, annual CRC incidence rates between 1975 and 2006 showed a downward trend for both men and women

(Fig. 1). The time periods of increasing CRC incidence were interspersed with time periods of declining incidence for both genders. Incidence rates peaked in 1986, declined afterward, rose again in 1998, and then saw a steep decline. The gender gap also rose and declined in tandem with incidence rates. Gender differences in CRC incidence rates widened slightly from 1975 to 1988 and reached a peak in 1985–1988, decreased between 1988 and 1996, then slightly increased from 1996 to 1999, and later decreased over time from 1999 to 2006.

Across all demographic and tumor characteristics, men had higher CRC incidence rates than women by calendar year, even though rates consistently declined for both genders over time (Table 1 and supplemental table; supplemental material available on line at www.liebertonline.com). The largest rate gap between men and women in CRC incidence and the largest rate reduction in incidence over time were observed among the oldest age category (80+ years) ($p < 0.001$), followed by the 70–79 and 60–69 year age groups (Fig. 2A). By the year 2000, the gender gap for those ≥ 80 years had fallen below the gap for 70–79-year-olds, and it has continued to decline substantially. Similarly, the gender difference has

TABLE 2. GENDER DIFFERENCES IN COLORECTAL CANCER INCIDENCE RATES BY DEMOGRAPHIC AND TUMOR CHARACTERISTICS, 1975–2006

Characteristic	Colorectal cancer incidence rate (per 100,000 population)						Incidence rate difference between men and women
	Total		Male		Female		
	Rate	95% CI	Rate	95% CI	Rate	95% CI	
Age, year							
40–49	18.9	18.6-19.1	20.1	19.7-20.5	17.6	17.3-18.0	2.5
50–59	65.1	64.5-65.6	74.4	73.6-75.3	56.2	55.5-57.0	18.2
60–69	164.8	163.7-165.8	198.9	197.2-200.6	135.2	133.9-136.5	63.7
70–79	305.7	304.0-307.5	370.6	367.6-373.6	259.1	257.0-261.2	111.5
80+	418.5	415.8-421.3	502.1	496.9-507.4	376.8	373.6-380.0	125.3
Race							
White	126.2	125.8-126.7	150.7	150.0-151.5	108.6	108.1-109.1	42.1
Black	134.4	132.9-136.0	155.6	152.9-158.3	120.6	118.7-122.5	35
Other	102.8	101.5-104.2	126.4	124.1-128.7	83.6	82.0-85.3	42.8
Tumor site							
Colon	131.7	131.2-132.1	156.3	155.6-157.1	113.8	113.3-114.3	42.5
Proximal colon	53.0	52.7-53.2	57.8	57.4-58.3	49.5	49.2-49.8	8.3
Distal colon	36.3	36.1-36.5	44.6	44.2-45.0	30.5	30.3-30.8	14.1
Rectum	36.4	36.2-36.7	47.3	46.9-47.7	28.4	28.1-28.6	18.9
Tumor stage							
Localized	49.2	49.0-49.5	59.9	59.4-60.3	41.6	41.3-41.9	18.3
Regional	46.8	46.5-47.0	54.0	53.6-54.4	41.5	41.2-41.8	12.5
Distant	22.7	22.6-22.9	27.2	26.9-27.5	19.5	19.3-19.7	7.7
Unstaged	7.0	6.9-7.1	8.6	8.4-8.8	5.9	5.8-6.0	2.7
Geographic area							
East	132.3	131.5-133.2	160.6	159.0-162.2	113.4	112.3-114.4	47.2
West and Hawaii	122.6	121.9-123.3	146.0	144.8-147.1	104.9	104.1-105.8	41.1
Midwest	136.6	135.8-137.3	162.5	161.2-163.8	118.5	117.6-119.4	44
Southwest	93.1	92.1-94.1	109.7	108.1-111.4	80.0	78.8-81.3	29.7
Total	125.7	125.3-126.1	149.7	149.0-150.4	108.4	107.9-108.9	41.3

CI, confidence interval.

narrowed significantly among patients ≥ 70 –79 years over the study period ($p=0.025$). Although there was a trend toward a narrowing gender gap among 60–69-year-olds, this trend was not statistically significant. The gender differences in CRC incidence rates for the 40–49 and 50–59 age categories were small and appeared relatively stable, but the gaps between men and women widened slightly over time ($p=0.003$).

Although there was a decline in gender difference among whites with CRC, it was not statistically significant over the study period (Fig. 2B). In contrast, among blacks, there was a nonstatistically significant trend toward a widening gender gap in incidence. The largest decline over time was observed

among other racial/ethnic populations ($p=0.001$). Since 1990, CRC subsite showed a statistically significant narrowing trend of the gender gap over the study period ($p<0.001$), particularly for colon cancer (Fig. 2C). The gender differences in incidence were greater for local or regional stages than for distant or unstaged disease (Fig. 2D). Although the gender gap for all disease stages showed a downward trend over the study period, significant trends were observed only for distant stage ($p=0.015$) and for unstaged CRC ($p=0.007$). Geographically, the gender gap narrowed significantly in the eastern ($p=0.001$) and western regions ($p=0.011$) but not significantly in the midwestern or southwest regions (Fig. 2E).

FIG. 1. Trends in age-adjusted colorectal cancer (CRC) incidence showing historical events, 1975–2006.

For example, the gender differences, although the lowest in the southwest region between 1975 and 1990, increased more sharply than in other regions and reached a peak in 1987–1988. The gender differences in this region decreased only slightly after 1990 and were almost the same as in the other three regions between 1999 and 2006.

Discussion

Overall, CRC incidence rates have decreased between 1975 and 2006 for both genders, but men consistently had higher rates than women. Gender gaps in CRC incidence rates were narrowed over time, stratified by race, tumor subsites, disease stages, and geographic regions, particularly in the early 1990s. However, the narrowing gaps over time between men and

women were limited to those aged ≥ 60 in the study population.

Our findings were similar to those of two recent studies in the United States.^{8,9} For example, a study by Cook et al.⁸ reported an incidence rate ratio of 1.37 between men and women in the original 9 SEER areas in 1975–2004. The study by Murphy et al.⁹ in the 13 SEER areas in 1992–2006 reported an incidence rate ratio of 1.37 between men and women for non-Hispanic whites, 1.48 for Hispanics, 1.30 for blacks, and 1.43 for Asians. Other researchers also observed a significant gender gap at CRC diagnosis by age. In a Polish study of 50,148 participants in a colonoscopy screening program, researchers concluded that in order for the incidence disparity between genders to be eliminated, different CRC screening recommendations based on age and gender may have to be

FIG. 2. Trends in gender differences in age-adjusted CRC incidence, 1975–2006. (A) Age at diagnosis. (B) Race. (C) Cancer site. (D) Stage at diagnosis. (E) Surveillance, Epidemiology and End Results (SEER) geographic areas. (Continued →)

FIG. 2. (Continued).

considered.⁴⁰ Brenner et al.³⁶ quantified this incidence difference as between 4 and 8 years in favor of women. Our finding that the incidence difference between 40–59-year-old men and women has widened over the years lends support to the view that CRC screening recommendations should take gender into account.

We observed that, over time, men tended to be diagnosed with a higher proportion of distal (left colon) CRC, especially cancer of the rectum. It is unclear if the trend toward a greater proportion of proximal CRC among both genders would favor uniform screening interventions. Although Brenner et al.³⁶ have suggested that this distinction is important for screening programs based on sigmoidoscopy, it should be noted that there is an increasing trend toward colonoscopy use in the United States while sigmoidoscopy use appears to be waning.⁴¹ The introduction of new procedures, such as fecal DNA testing and virtual colonoscopy, are likely to further reduce sigmoidoscopy use. These periodic variations in CRC incidence appeared to correspond roughly with the periods that precede introduction of new screening guidelines, such as fecal occult blood testing (FOBT) and sigmoidoscopy in the 1980s, introduction of Medicare reimbursement for CRC screening for the elderly in 1998, and more use of colonoscopy since 2000. Although gender gaps in incidence were found in all four CRC stages, the largest gaps were in the localized and regional stages. Although we could find no regional studies that tracked temporal trends in gender differences by CRC stage, several studies reported no association between gender and CRC stage.^{21,22,42}

The etiology of gender differences in CRC is complex, and many factors may require further investigation. Cook et al.^{8,23} reviewed those risk factors that are likely to explain the sex differences in cancer incidence, which include sex hormones, sex chromosome alterations, gene expression anti-oxidative capacity, and immune competence. A recent study on sex disparities in cancer mortality and survival using SEER data found that male-to-female mortality rates differed markedly, whereas gender differences in cancer survival were less pronounced. Based on these observations, the authors concluded that sex differences in cancer-related outcomes are more strongly related to etiology than to prognosis.²³ It is still unclear whether or to what extent the gender differences in cancer screening explained the gender differences in incidence and mortality. Within the United States, the gender differences in CRC testing varied substantially. Some studies report that women were more likely than men to have FOBT and less likely to have endoscopy,^{41,43–45} whereas other studies found that men reported higher testing rates than women in the three CRC testing modalities (FOBT, sigmoidoscopy, colonoscopy).^{46–48} Our findings that gender differences were associated with geographic areas might indicate potential etiologic factors related to gender, including lifestyle and environmental exposures.

There are several strengths of this study. First, the study included a large, nationwide cohort of population-based cases from nine SEER registries across the United States, over a period of 30 years. These areas accounted for 9% of the U.S. population. Second, to study trends in CRC incidence, we

used a robust statistical package SEER*Stat, which has been well validated and tested over many years, thus making the results easily comparable to many other reports in the literature. Third, although two other studies^{8,9} have examined gender differences in CRC incidence by tumor subsite and race, neither examined trends over such an extended period of time and by tumor stage, which can provide a more complete picture of the direction and magnitude of these changes. In particular, our study addressed gender differences in CRC incidence by geographic regions and identified some interesting patterns of gender differences and trends in these regions, which may lead to or stimulate further studies by geographic areas. Furthermore, relative to the national surveys, the NCI's population-based SEER cancer registry data provide more complete, representative, and continuous information on true incident cases of CRC.

This study also has several limitations. First, we were unable to examine the influence of SES on gender differences because of unavailability of these data at the individual or community level. Other studies, however, have shown that these factors are important in healthcare access, screening intention, and screening behavior.^{29,49} It is possible that differences in such factors as education, income, employment, and insurance might have explained some of the gender gaps in CRC incidence rates. Second, the analysis was limited to nine SEER registries in the period 1975–2006, which may affect the generalizability of the study findings to all SEER areas. We chose to use nine registries in order to examine trends over a longer period of time. Finally, we did not examine, in detail, gender disparities within some racial categories. Of particular note was the lack of specification of Hispanic, Asian, American Indian, and Alaskan Native as separate race/ethnicity categories. Future trend analysis of gender differences should consider disaggregating race/ethnicity. Future studies should also explore the factors that contribute to the widening gender gap among the 40–59-year-old population, such as change over time in education, health belief and attitude toward cancer screening and early detection, and lifestyle as it relates to the disease etiology.

In conclusion, higher CRC incidence in men than in women persisted over the 30 years of this study. Although gender differences narrowed among those ≥ 60 years, especially from 1990 to 2006, gender gaps, although small, in younger age groups increased over time. Future studies may need to examine the factors associated with these differences and explore ways to narrow the gender gap.

Acknowledgments

P.N.A was the recipient of a predoctoral fellowship under an NCI training grant (R25-CA057712; PI: Patricia Mullen, Ph.D.). Thanks to Kay L. Bartholomew, Ed.D., for serving on the student dissertation committee and to Karyn Popham and Carol Kohn for helpful editorial reviews.

Disclosure Statement

The authors have no conflicts of interest to report.

References

1. American Cancer Society. Cancer facts and figures 2010. Atlanta: American Cancer Society; 2010.
2. National Cancer Institute. Surveillance, Epidemiology, and End Results (SEER). Available at seer.cancer.gov/. Accessed February 25, 2011.
3. American Cancer Society. Guidelines for the early detection of cancer. CA: Cancer J Clin 2001;51:87–88.
4. Umar A, Greenwald P. Alarming colorectal cancer incidence trends: A case for early detection and prevention. Cancer Epidemiol Biomarkers Prev 2009;18:1672–1673.
5. Levin B, Smith RA, Feldman GE, et al. Promoting early detection tests for colorectal carcinoma and adenomatous polyps: A framework for action: The strategic plan of the National Colorectal Cancer Roundtable. Cancer 2002;95:1618–1628.
6. Coughlin SS, Richards TB, Thompson T, et al. Rural/non-rural differences in colorectal cancer incidence in the United States, 1998–2001. Cancer 2006;107(Suppl 5):1181–1188.
7. Coughlin SS, Costanza ME, Fernandez ME, et al. CDC-funded intervention research aimed at promoting colorectal cancer screening in communities. Cancer 2006;107(Suppl 5):1196–1204.
8. Cook MB, Dawsey SM, Freedman ND, et al. Sex disparities in cancer incidence by period and age. Cancer Epidemiol Biomarkers Prev 2009;18:1174–1182.
9. Murphy G, Devesa SS, Cross AJ, Inskip PD, McGlynn KA, Cook MB. Sex disparities in colorectal cancer incidence by anatomic subsite, race and age. Int J Cancer. 2011;128:1668–1675.
10. Gao RN, Neutel CI, Wai E. Gender differences in colorectal cancer incidence, mortality, hospitalizations and surgical procedures in Canada. J Public Health 2008;30:194–201.
11. Wu CX, Chen VW, Steele B, et al. Subsite-specific incidence rate and stage of disease in colorectal cancer by race, gender, and age group in the United States, 1992–1997. Cancer 2001;92:2547–2554.
12. Rim SH, Seeff L, Ahmed F, King JB, Coughlin SS. Colorectal cancer incidence in the United States, 1999–2004: An updated analysis of data from the National Program of Cancer Registries and the Surveillance, Epidemiology, and End Results Program. Cancer 2009;115:1967–1976.
13. Lai SM, Zhang KB, Uhler RJ, Harrison JN, Clutter GG, Williams MA. Geographic variation in the incidence of colorectal cancer in the United States, 1998–2001. Cancer 2006;107(Suppl 5):1172–1180.
14. Siegel RL, Jemal A, Ward EM. Increase in incidence of colorectal cancer among young men and women in the United States. Cancer Epidemiol Biomarkers Prev 2009;18:1695–1698.
15. Wong MD, Ettner SL, Boscardin WJ, Shapiro MF. The contribution of cancer incidence, stage at diagnosis and survival to racial differences in years of life expectancy. J Gen Intern Med 2009;24:475–481.
16. Singh GK, Miller BA, Hankey BF, Edwards BK, eds. Area socioeconomic variations in U.S. cancer incidence, mortality, stage, treatment, and survival, 1975–1999. NCI Cancer Surveillance Monograph Series, Number 4 ed. Bethesda, MD: National Cancer Institute. NIH Publication No. 03-0000, 2003.
17. Palmer RC, Schneider EC. Social disparities across the continuum of colorectal cancer: A systematic review. Cancer Causes Control 2005;16:55–61.
18. Berry J, Bumpers K, Ogunlade V, et al. Examining racial disparities in colorectal cancer care. J Psychosoc Oncol 2009;27:59–83.
19. Ollberding NJ, Nomura AM, Wilkens LR, Henderson BE, Kolonel LN. Racial/ethnic differences in colorectal cancer

- risk: The multiethnic cohort study. *Int J Cancer* 2010. [Epub ahead of print]
20. Lieberman D. Race, gender, and colorectal cancer screening. *Am J Gastroenterol* 2005;100:2756–2758.
 21. Woods SE, Basho S, Engel A. The influence of gender on colorectal cancer stage: The state of Ohio, 1996–2001. *J Womens Health* 2006;15:877–881.
 22. Woods SE, Narayanan K, Engel A. The influence of gender on colon cancer stage. *J Womens Health* 2005;14:502–506.
 23. Cook MB, McGlynn KA, Devesa SS, Freedman ND, Anderson WF. Sex disparities in cancer mortality and survival. *Cancer Epidemiol Biomarkers Prev* 2011;20:1–9.
 24. Mustard CA, Kaufert P, Kozyskyj A, Mayer T. Sex differences in the use of health care services. *N Engl J Med* 1998;338:1678–1683.
 25. Bertakis KD, Azari R, Helms LJ, Callahan EJ, Robbins JA. Gender differences in the utilization of health care services. *J Fam Pract* 2000;49:147–152.
 26. Murad MH, Gjerde CL, Bobula J, Ostrov M, Murad MS. Gender and patient complaints: Are they related? *Quality Primary Care* 2009;17:351–357.
 27. U.S. Institute of Medicine. Executive summary of the Institute of Medicine report. Exploring the biological contributions to human health: Does sex matter? *J Womens Health Gender Based Med* 2001;10:433–439.
 28. Troisi RJ, Freedman AN, Devesa SS. Incidence of colorectal carcinoma in the U.S.: An update of trends by gender, race, age, subsite, and stage, 1975–1994. *Cancer* 1999;85:1670–1676.
 29. Edwards BK, Ward E, Kohler BA, et al. Annual Report to the Nation on the Status of Cancer, 1975–2006, featuring colorectal cancer trends and impact of interventions (risk factors, screening, and treatment) to reduce future rates. *Cancer* 2010;116:544–573.
 30. Cress RD, Morris C, Ellison GL, Goodman MT. Secular changes in colorectal cancer incidence by subsite, stage at diagnosis, and race/ethnicity, 1992–2001. *Cancer* 2006;107:1142–1152.
 31. Cheng L, Eng C, Nieman LZ, Kapadia AS, Du XL. Trends in colorectal cancer incidence by anatomic site and disease stage in the United States from 1976 to 2005. *Am J Clin Oncol* 2011;34:573–580.
 32. Merzel C. Gender differences in health care access indicators in an urban, low-income community. *Am J Public Health* 2000;90:909–916.
 33. Slattery ML, Kinney AY, Levin TR. Factors associated with colorectal cancer screening in a population-based study: The impact of gender, health care source, and time. *Prev Med* 2004;38:276–283.
 34. Wu X, Chen VW, Martin J, et al. Subsite-specific colorectal cancer incidence rates and stage distributions among Asians and Pacific Islanders in the United States, 1995 to 1999. *Cancer Epidemiol Biomarkers Prev* 2004;13:1215–1222.
 35. Nguyen SP, Bent S, Chen YH, Terdiman JP. Gender as a risk factor for advanced neoplasia and colorectal cancer: A systematic review and meta-analysis. *Clin Gastroenterol Hepatol* 2009;7:676–681.
 36. Brenner H, Hoffmeister M, Arndt V, Haug U. Gender differences in colorectal cancer: Implications for age at initiation of screening. *Br J Cancer* 2007;96:828–831.
 37. Shergill AK, Terdiman JP. Refining colorectal cancer screening recommendations based on gender. *Gastroenterology* 2007;132:2605–2606.
 38. Callcut RA, Kaufman S, Stone-Newsom R, Remington P, Mahvi D. Gender disparities in colorectal cancer screening: True or false? *J Gastrointest Surg* 2006;10:1409–1417.
 39. National Cancer Institute. Surveillance Research Program. SEER*Stat software version 6.5.2 (released in April 2009).
 40. Regula J, Rupinski M, Kraszewska E, et al. Colonoscopy in colorectal-cancer screening for detection of advanced neoplasia. *N Engl J Med* 2006;355:1863–1872.
 41. Fenton JJ, Cai Y, Green P, Beckett LA, Franks P, Baldwin LM. Trends in colorectal cancer testing among Medicare subpopulations. *Am J Prev Med* 2008;35:194–202.
 42. Campbell RJ, Ferrante JM, Gonzalez EC, Roetzheim RG, Pal N, Herold A. Predictors of advanced stage colorectal cancer diagnosis: Results of a population-based study. *Cancer Detect Prev* 2001;25:430–438.
 43. McQueen A, Vernon SW, Meissner HI, Klabunde CN, Rakowski W. Are there gender differences in colorectal cancer test use prevalence and correlates? *Cancer Epidemiol Biomarkers Prev* 2006;15:782–791.
 44. McMahon LF Jr, Wolfe RA, Huang S, Tedeschi P, Manning W Jr, Edlund MJ. Racial and gender variation in use of diagnostic colonic procedures in the Michigan Medicare population. *Med Care* 1999;37:712–717.
 45. Ko CW, Kreuter W, Baldwin L. Persistent demographic differences in colorectal cancer screening utilization despite Medicare reimbursement. *BMC Gastroenterol* 2005;5:10.
 46. Meissner HI, Breen N, Klabunde CN, Vernon SW. Patterns of colorectal cancer screening uptake among men and women in the United States. *Cancer Epidemiol Biomarkers Prev* 2006;15:389–394.
 47. Rosen AB, Schneider EC. Colorectal cancer screening disparities related to obesity and gender. *J Gen Intern Med* 2004;19:332–338.
 48. Shapiro JA, Seeff LC, Nadel MR. Colorectal cancer-screening tests and associated health behaviors. *Am J Prev Med* 2001;21:132–137.
 49. Sifri R, Rosenthal M, Hyslop T, et al. Factors associated with colorectal cancer screening decision stage. *Prev Med* 2010;51:329–331.

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