Colon cancer incidence: recent trends in the United States

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Between 1976-78 and 1985-87, the age-adjusted incidence rates of invasive colon cancer in the United States rose by 15 percent, 3 percent, 21 percent, and 16 percent among White males, White females, Black males, and Black females, respectively. The increases in incidence occurred in all age groups over age 54 and affected each of the major subsites of the colon nearly equally. The larger rates of increase have resulted in higher incidence among Blacks than Whites by the mid-1980s and an increasingly greater excess of this cancer in males. Trends toward earlier diagnosis of invasive colon cancer were found, with increasing rates for localized and regional diseases coupled with stable or decreasing distant-stage disease-rates. The incidence of *in situ* colon cancer also rose substantially. The findings suggest that changes in diagnostic trends and risk-factor prevalence may be contributing to these patterns, and that the era when colon cancer predominated among White females is clearly over.

Key words: Colon cancer, incidence, race, stage, United States.

Introduction

A rise in colon cancer incidence has been observed in the United States during recent decades.[1,2] This phenomenon may be due to an increase in the prevalence of potential risk factors,[3-5] although recent advances in screening and diagnostic techniques for colon cancer also may result in more complete case ascertainment and earlier diagnosis of the disease.[6,7] The present study updates and evaluates the stage- and age-specific incidence trends of colon cancer by sex and race based on data from a network of population-based cancer registries in the US.

Materials and methods

Data for this study were collected as part of the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) Program which has been described in detail elsewhere.[2,8] Briefly, this program is comprised of nine population-based cancer registries, serving the states of Connecticut, Hawaii, Iowa, New Mexico, and Utah, and the greater San Francisco/Oakland (California), Detroit (Michigan), Seattle (Washington), and Atlanta (Georgia) metropolitan areas. These areas represent approximately 10 percent of the US population. Clinical and demographic data are obtained for all newly diagnosed cases among residents in these areas. The majority of cases are identified from local hospital records, with additional case ascertainment from free-standing pathology laboratories, outpatient clinics, physicians' offices, and death certificates.

Microscopically confirmed cases of *in situ* and invasive cancers of the colon (ICDO codes 153.0 to 153.9),[9] excluding melanomas, sarcomas, and lymphomas, diagnosed between 1976 and 1987 were included in this analysis. Malignant neoplasms arising from appendix (ICDO code 153.5) were excluded because of small numbers and potential confounding by the trends in

Table 1. Age-specific[a] and age-adjusted[b] incidence rates of invasive colon cancer by race and sex, nine SEER areas, 1976-78 to 1985-87

	Time period				Overall change %	AAPC[c]
	1976-78	1979-81	1982-84	1985-87		
White males (No.)	(8,250)	(9,015)	(10,129)	(10,701)		
All ages	35.3	36.9	39.8	40.5	14.8	1.6[d]
Age <55	5.0	4.8	4.8	4.7	− 6.5	− 0.7
55-64	80.2	82.7	88.7	92.0	14.7	1.6[d]
65-74	191.5	198.9	215.6	216.0	12.8	1.5
>74	324.0	353.5	390.7	401.3	23.8	2.5[d]
White females (No.)	(9,454)	(10,313)	(10,928)	(11,487)		
All ages	29.3	29.9	30.1	30.2	2.9	0.3
Age <55	5.1	4.7	4.5	4.2	− 17.4	−2.0[d]
55-64	70.0	69.4	69.3	69.0	− 1.5	− 0.2[d]
65-74	154.7	153.0	153.7	154.8	0.1	0.0
>74	249.3	275.7	284.9	293.3	17.7	1.7[d]
Black males (No.)	(621)	(736)	(816)	(937)		
All ages	34.7	38.3	39.5	41.9	20.7	2.0[d]
Age <55	6.3	5.9	6.4	7.2	14.0	1.7
55-64	90.6	100.2	100.0	99.8	10.2	0.9
65-74	173.2	180.7	192.6	234.5	35.4	3.5
>74	285.6	352.6	355.4	335.6	17.5	1.3
Black females (No.)	(704)	(875)	(966)	(1,061)		
All ages	29.7	33.4	33.9	34.5	16.4	1.5
Age <55	6.6	7.1	5.7	6.3	− 5.7	− 1.3
55-64	77.8	80.7	88.1	91.7	18.0	2.0[d]
65-74	122.9	162.0	188.1	178.7	45.4	3.8
>74	256.6	273.8	257.0	269.4	5.0	0.3

[a] Age-adjusted using five-year groups within each age stratum.
[b] Per 100,000 person-years, age-adjusted to the 1970 US population.
[c] Average annual percent change.
[d] Statistically significant at $P \leq 0.05$.

appendectomy. Cases diagnosed prior to 1976 were excluded because less than 94 percent were confirmed microscopically. The proportion of microscopically confirmed cases increased from 94.4 percent in 1976-78 to 96.8 percent in 1985-87, with little difference between Blacks and Whites. Also excluded were persons with racial origins other than Black or White because their numbers are too few for detailed analysis.

Cases were classified by age (< 55, 55-64, 65-74, and > 74), sex, and race. Trends for colon cancer were evaluated for the following time periods: 1976-78, 1979-81, 1982-84, and 1985-87. Incidence rates were computed using population estimates derived by the US Bureau of Census and the SEER Program, and age-adjusted to the 1970 US population using the direct method and five-year age intervals. Average, annual percent-changes were estimated by a linear regression of the logarithm of the respective rates on calendar year, weighted by the number of cases.[10]

Results

The overall, annual age-adjusted incidence rates of invasive colon cancer rose during the study period (Table 1, Figure 1). Within each gender, the increase was greater in Blacks than Whites, resulting in higher incidence rates of invasive colon cancer among Blacks since 1979-81. Within each race, the incidence rates climbed faster in males than females. Between 1976-78 and 1985-87, colon cancer rates rose by 15 percent, 3 percent, 21 percent, and 16 percent in White males, White females, Black males, and Black females, respectively (Table 1). The trends were generally consistent across the nine study areas, with evidence of convergence toward those in areas with initially high rates (data not shown).

The increases of invasive colon cancer were confined largely to localized and regional diseases, with the incidence of distant cancer generally declining (Figure 1).
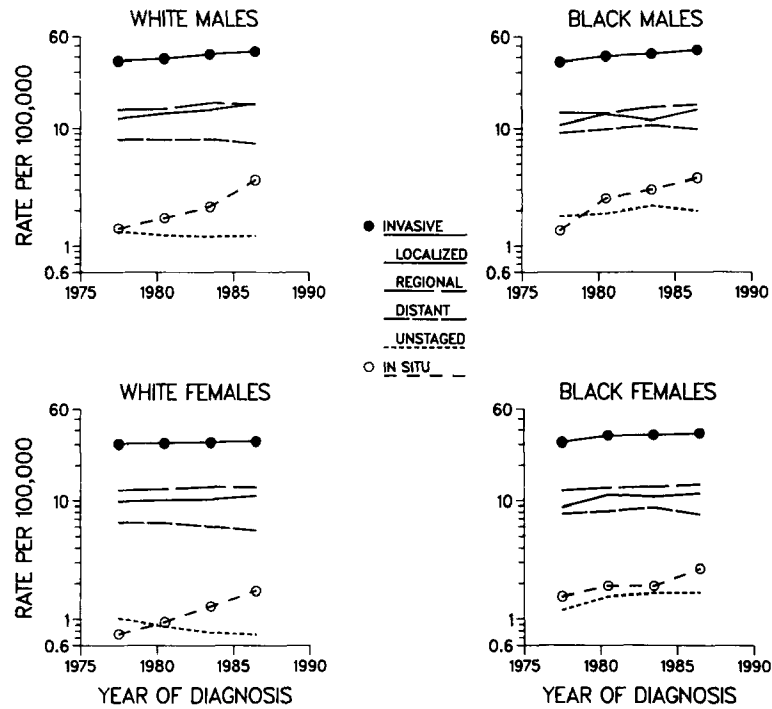
Figure 1. Age-adjusted (1970) trends in colon cancer incidence by race, sex, and stage at diagnosis, nine SEER areas, 1976-78 to 1985-87.

Among Whites, comparable temporal trends and patterns toward earlier diagnosis were observed in all colon subsites, *i.e.*, cecum and ascending, transverse and the two flexures, and descending and sigmoid colon. The age-adjusted rates of invasive cancer rose by 9 percent, 10.3 percent, and 8.4 percent in each of the three subsites, respectively. Rates increased within each subsite more among Blacks than Whites, with the cecum and ascending colon rate rising 30 percent over the study period (12.4 percent and 15.2 percent increases were found for transverse/flexures and descending/sigmoid, respectively). Trends toward earlier diagnosis, with larger increases in localized disease compared with more distant diseases, also were apparent for each subsite among Blacks.

Furthermore, rates of invasive colon cancer rose in all age groups, except below age 55, where the rates generally declined (Table 1). The decrease in incidence at young ages occurred across all disease stages in females but mainly in distant cancers in males (data not shown). Increases were largest among Whites aged 75 or older and among Blacks aged 65-74 years. Throughout the study period, rates among Blacks exceeded those for Whites of the same sex for persons under age 65. For persons older than 74, rates were generally lower in Blacks than Whites. For persons aged 65-74, the age for which incidence increased most rapidly in Blacks of both genders, rates among Blacks were lower

than among Whites in 1976-78, but surpassed those among Whites by 1979-81 in females and 1985-87 in males (Table 1). In general, a pattern of greater increase in localized disease and smaller decline in distant disease was observed in the older population compared with the younger groups (data not shown).

Substantial increases in rates of *in situ* colon cancer also were observed in all race and gender groups (Figure 1), and across all age strata. During the study period, the age-adjusted *in situ* disease rates rose by 163 percent, 134 percent, 181 percent, and 74 percent in White males, White females, Black males, and Black females, respectively. Similar to invasive colon cancer, the *in situ* cancer rates also were higher in Blacks than Whites throughout much of the study period. When *in situ* and invasive cancers are considered together, the percent *in situ* increased among Whites over the study period from 1.6 to 3.5 for cecum and ascending, from 2.3 to 4.0 for transverse, and from 4.4 to 10.0 for descending and sigmoid colon. The corresponding increases in percent *in situ* among Blacks were from 1.9 to 5.2, from 5.2 to 8.1, and from 5.7 to 9.9, respectively.

Discussion

The findings of increasing incidence of invasive colon cancer are consistent with results of earlier investigations.[1,2] Among Whites, colon cancer incidence in the

late 1940s was higher among females than males; however, an excess in incidence among males had emerged by 1970.[1] Our findings showed that the excess in males became more pronounced in the late 1980s, and occurred among both Blacks and Whites. The observations that the incidence rose more rapidly in Blacks than Whites, and that Blacks in recent years have a higher incidence of colon cancer than Whites, however, are not well appreciated generally. Also not well documented previously is the rapid rise in incidence of in situ colon cancer during the past decade.

It is of interest that, contrary to the colon cancer trends, the SEER data revealed fairly stable rectal cancer incidence-trends in this country, and higher rates in Whites than Blacks. Although cancers of colon and rectum often are studied together,[3,5] the present study did not include rectal cancer incidence-trends because their distinct epidemiologic patterns suggest that they may have different etiologic influences.

Although an alteration in reporting procedures or an improvement in case ascertainment may produce an apparent increase in incidence, the procedures for colon cancer case-finding and reporting for the SEER Program did not change during the study period. Fewer than five percent of the cases included for analysis were unstaged, and declines over time among Whites in unstaged cases were insufficient to account for the increases in early-staged diseases. Rates of unstaged cancer among Blacks remained fairly constant.

The current data suggest that invasive colon cancer is being diagnosed at earlier stages, as rates for localized disease rose and distant-staged cancers declined. In addition, in situ colon cancer increased proportionally more than invasive disease. Improved diagnostic techniques,[11-14] heightened awareness of colon cancer,[15] and increased availability of colon cancer screening[16,17] may contribute to the earlier diagnosis of this disease.

Despite the faster rise in overall rates among Blacks, the shifts to earlier stages at diagnosis are less evident among Blacks than Whites. This difference also is reflected in trends in five-year relative survival-rates for colon cancer. Between 1974-76 and 1981-86, the survival rates for Whites increased significantly from 49.6 percent to 56.2 percent; among Blacks, a smaller improvement in survival was observed, from 44.4 percent to 46 percent.[2]

While screening programs generally are credited with the earlier detection of colon cancer,[6,17-19] we were unable to determine what proportions of the increases in early-staged cancers were detected by routine screening in asymptomatic patients. Although Americans who ever had one of the screening procedures for colerectal cancers (i.e., digital rectal examination, stool blood test, or proctoscopic examination) increased by 4 percent, 17 percent, and 11 percent respectively between 1983 and 1987, the majority of the population aged 50 or over still had not had one of these examinations by 1987.[20] Furthermore, the regional-staged cancer rates were consistently higher than localized disease rates in all race and sex groups, suggesting that much improvement still could be made toward earlier detection of colon cancer.

It is generally believed that a large proportion of colon cancer is preceded by adenomatous polyps.[21-23] An effective screening program that routinely detects and treats colon polyps before their progression to carcinoma eventually should reduce the incidence of colon cancer.[19,24] On the other hand, while colorectal cancers were detected at earlier stages in the study group than the control group in a randomized trial of annual multiphasic health checkups, the greater reduction in colorectal cancer mortality in the study than the control group was not attributed to a difference between these two groups in removal of colorectal polyps.[18] A subsequent case-control study conducted by the same investigators,[25] however, revealed that screening by rigid sigmoidoscope within 10 years prior to diagnosis reduced, by more than 50 percent, the risk of fatal cancers arising within the reach of the rigid sigmoidoscope, but not those beyond.

In addition to efforts in early detection of colon cancer, more research should be directed to identifying risk factors for this disease. The disparity in incidence trends of colon cancer between Blacks and Whites, between males and females, and between old and young may provide some clues to its etiology. Other than certain rare, predisposing genetic and medical conditions such as familial polyposis,[26] Crohn's disease,[27] and ulcerative colitis,[28] few specific risk factors for colon cancer have been established.[29] Despite some inconsistencies in published results,[30,31] however, evidence is accumulating that high intake of animal fat, perhaps accompanied by low intake of dietary fiber, may increase the risk of colon cancer.[4,29,32] In addition, limited epidemiologic evidence has suggested that increased intake of fried or barbecued meat may be a risk factor for colon cancer,[33-35] perhaps due to carcinogenic compounds such as heterocyclic amines[33,36,37] and polycyclic aromatic hydrocarbons[38,39] that are produced by high temperature cooking of meat. On the other hand, dietary intakes of calcium,[40-42] vitamins A and C, and fruits and vegetables,[43] have been suggested to reduce colon cancer risk. Other factors, such as high alcohol consumption,[44-46] a sedentary lifestyle,[47-49] increased body weight,[50-52] and low parity in women,[53-56] also have been linked to this disease.

It has been estimated from per capita food-use data

that in the US, the proportion of energy from fat increased from 32 percent to 43 percent, from carbohydrate decreased from 56 percent to 46 percent, and the proportion of energy from protein remained stable between 1909-13 and 1980.[57] This increasing fat content in the American diet may explain, in part, the rising incidence of colon cancer over the past few decades. More recent survey data reported a small increase in grains, poultry, and fish, and a small decrease in red meat in the American diet during the past decade.[58,59] In addition, women consumed more dietary fiber per caloric intake[60] and had a higher ratio of polyunsaturated to saturated fats[61] than men. Dietary differences between Blacks and Whites have been less well characterized, but some studies report that Blacks have lower intakes of dietary fiber,[60] vegetables,[62] dairy products, and calcium[63] than Whites. Although Blacks generally have comparable intakes of fat and calories as Whites, they have a consistently higher intake of dietary cholesterol.[61] These disparities in dietary patterns may have contributed to the lower colon cancer incidence in women than men, and the excess of colon cancer in Blacks than Whites of the same gender. It is not clear whether cooking patterns have changed over time (*e.g.*, more barbecues) and, if so, how they might have influenced the colon cancer trends.

If level of physical activity is a risk factor for colon cancer,[64] it is conceivable that the increased level of leisure-time physical-activity levels over the recent decades[65] may have contributed to the leveling of colon cancer incidence in the youngest age groups. Decreased parity in women and the general reduction in the American family size probably did not have a substantial impact on recent colon cancer incidence-trends, since colon cancer incidence-rates in males have increased faster than those in females, and the incidence in young females has declined during the study period.

In conclusion, control and prevention of colon cancer can be achieved by screening and lifestyle changes. The heightened American consciousness regarding health promotion in recent years, including lowering animal fat intake and increasing exercise,[66] may reduce the incidence of colon cancer in the future. The current finding of leveling colon cancer incidence-trends among the youngest age groups also offers hope in the fight against this disease.

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