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Interesting Trends In Incidence and Mortality Rates of Colorectal Cancer in the United States of America

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Abstract

Introduction: Colorectal cancer is ranked as one of the top three leading causes of cancer deaths according to the American Cancer Society. Colorectal Cancer is defined as cancer affecting the cecum, ascending, transverse, descending, sigmoid colon and finally the rectum. The types of cancers in the colon and rectum consist of adeno carcinomas, carcinoid tumors, gastrointestinal stromal tumors, lymphomas and sarcomas.

Materials and methods: Incidence and Mortality rates were obtained from the cancer query system of the Surveillance Epidemiology and End Results (SEER) database from the year 2000-2009. Data was placed into 4 categories according to age and analyzed by ethnicity and gender. All datasets were placed into an Excel spreadsheet for proper manipulation. Statistical significance was found based on the averages and calculated using the CHITEST function to test for independence, which returns the value from the chi-squared (χ^2) distribution for the statistic and the appropriate degrees of freedom. The level of significance of <0.05 was used for all analyses.

Results: The information obtained from the SEER database returned 40 different queries, organized by ethnicity, race and gender. The following findings were noted: Black males have an overall incidence rate of 66.9 per 100,000 and Black females have an overall incidence of 66.3 per 100,000. White males have an overall incidence of 53.1 per 100,000 and White females of 39.2. Asian males have an overall incidence of 44.9 and Asian females 34.2. Indian males have an overall incidence of 45.2 and Indian females 38.0. Hispanic males have an overall incidence of 45.2 and Hispanic females 31.5. Black males have an overall mortality of 29.8, while Black females have an overall mortality of 19.8. White male mortality appears to be 19.5 and White females 13.6. The Asian male mortality rate is 13.1 and Asian females are 9.6. The Indian male population shows a mortality rate of 18.8 and females 14.6. Finally, hispanic males at 15.3 and hispanic females 10.2.

Conclusion: Colorectal Cancer continues to be a growing concern among physicians. Our data once again proves the black population is at overall highest risk of colorectal cancer, while Hispanics appear to be at lowest risk. This trend carries over into the mortality rate discussion as the black population was shown to have the highest mortality rate and Asians appear to have the lowest mortality rate. Updated screening inclusions may be needed.

Keywords: Adenocarcinomas; Carcinoid tumors; Gastrointestinal stromal tumors; Lymphomas and sarcomas

Introduction

According to the American Cancer Society (ACS), colorectal cancer is the third leading cause of cancer deaths in the United States when looking at gender individually [1]. Interestingly, when genders are combined and analyzed, colorectal cancer jumps to the second leading cause of cancer deaths in the United States. The Centers for Disease Control estimated that in 2008, over 142,000 people were diagnosed with colorectal cancer, with over 73,000 being male and 69,000 female. Approximately 52,000 people died from this disease [2].

Colon Cancer is defined as cancer affecting the cecum, ascending, transverse, descending and finally the sigmoid colon. Cancers that form in the last several inches of the large intestine, closest to the anus is defined as rectal cancer. These cancers almost ways start as benign polyps that slowly undergo cellular transformation into malignant tumors years later. There are several risk factors for colorectal cancer; these risk factors can be divided into categories of age, genetics and lifestyle. Risk of colorectal cancer increases with age and is greater in men than women. Predisposition of susceptible individuals develops colorectal cancer due to inherited genetic mutations. Furthermore, susceptible racial and ethnic disparities exist in the incidence, mortality, and clinical trends of colorectal cancer [3].

The types of cancers in the colon and rectum, shown in table 1, consist of adenocarcinomas, carcinoid tumors, gastrointestinal stromal tumors, lymphomas and sarcomas. Adenocarcinomas begin in the mucus secreting glandular cells of the gastrointestinal tract. Carcinoid tumors arise from specialized hormone-producing cells in the intestine. Gastrointestinal stromal tumors can be benign or malignant and are found anywhere within the digestive tract and begin in the *interstitial cells of Cajal*. Lymphomas are cancers of the immune system and usually begin in the lymph nodes; however, they may occur in the colon and rectum. Sarcomas are tumors that can start in blood vessels as well as the muscle and connective tissue in the wall of the colon and rectum.

Cancer Type	Description
Adenocarcinoma	Arise from mucus secreting glandular cells of the GI tract
Carcinoid	Arise from Specialized hormone producing cells in the intestine
Gastrointestinal Stromal Tumor	Arise within the *interstitial cells of Cajal*
Lymphomas	Arise within lymph nodes
Sarcomas	Arise from blood vessels, muscle and connective tissue

Table 1: Description of cancers found within the colon and rectum.

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Currently, regular screening may detect and prevent incidences of colorectal cancer. The tests consist of flexible sigmoidoscopy, colonoscopy, double-contrast barium enema, CT colonoscopy, fecal occult blood test, as well as a fecal immunochemical test. Each test is fairly quick and provides no absolute risk detection to the colon. The ACS recommends at the beginning of age 50, males and females at average risk for developing colorectal cancer should be tested every 5-10 years to prevent the development of cancer, as compared to those who are at high risk every 1-2 years. Treatment for colon and rectal cancer are mainly surgery, radiation therapy, chemotherapy and targeted therapy. Surgery is the main treatment; however, two or more of these types of treatments may be combined for proper treatment and is dependent on the stage of the cancer.

By systematically reviewing the data obtained from the Surveillance Epidemiology and End Results (SEER) database, our goal is to identify correlation and disparity between race, gender and age in the incidence and mortality of colorectal cancer in 2000-2009.

Materials and Methods

The Surveillance Epidemiology and End Results (SEER) database is a national program of the National Institute of Health in which cancer statistics are recorded and tracked in the United States [1]. The information obtained from this database is collected from hospitals, health care providers, clinics and public records across the nation.

When first established in the 1970s, the database included information from Connecticut, Hawaii, Utah, New Mexico and Iowa on the statewide level and Atlanta, Detroit, San Francisco-Oakland and Settle on a metropolitan level. As the database grew, additional metropolitan areas were added which included Los Angeles, San Jose, rural Georgia as well as the Alaska Native Tumor Registry [1]. Finally, the last addition in 2000 included greater California, Louisiana, New Jersey and Kentucky. The information from these states and metropolitan areas provide a total of 6,127,828 cases in which can be queried [1]. These cases are representative of African Americans, Hispanics, Whites, American Indians and Alaska Natives, Asians and Hawaiian and Pacific Islanders.

The SEER database was accessed via [4]. The database was then queried using the Cancer Query System provided by the website. Specific data points that were collected for the purpose of this project include annual age-adjusted incidence and mortality rates per 100,000 patients diagnosed with cancer of the colon and rectum from the year 2000 through 2009. The information retrieved was then placed into an Excel spreadsheet and categorized into four groups (1-4) according to age, gender and ethnicity for ease of data processing. Age group 1 was defined as ages 20-49, age group 2 50-64, age group 3, 65-74 and age group 4, 75 and older. Ethnicity was defined as White, Asian, African American, Hispanic, American Indian and Alaskan Native or Hawaiian and Pacific Islanders. The incidence and mortality rates were averaged according to gender, race and age group. Statistical significance was found based on the averages and calculated using the CHITEST function to test for independence, which returns the value from the chi-squared (χ^2) distribution for the statistic and the appropriate degrees of freedom. The χ^2 test determines whether the hypothesized results are verified by an experiment. The level of significance of<0.05 was used for all analyses.

Results

The information obtained from the SEER database returned 40 different queries, organized by ethnicity, race and gender. The information was then correlated and manipulated to produce the following results:

Incidence

Our data shows that Black males have an overall incidence rate of 66.9 per 100,000 and black females have an overall incidence of 66.3 per 100,000. White males have an overall incidence of 53.1 per 100,000 and White females of 39.2. Asian males have an overall incidence of 44.9 and Asian females 34.2. Indian males have an overall incidence of 45.2 and Indian females 38.0. Hispanic males have an overall incidence of 45.2 and Hispanic females 31.5. A query of all the combined races shows an incidence rate for males of 54 and females 40.2. The median age for initial colorectal cancer diagnosis appears to be 69 years of age. Subsequent breakdowns of age groups show nearly 0.1% were diagnosed under the age of 20, 1.1% between 20-34 years of age, 4.0% between 35-44 years of age, 13.4% between 45-54 years, 20.4% between 55-64, 24.0% between 65-74, 25.0% between 75-84, 12% 85 or older. The overall age-adjusted incidence rate for colorectal cancer among men and women appears to be 46.3 per 100,000 per year.

Mortality

We then turned to analyzing the mortality rate of this disease. Black males have an overall mortality of 29.8, while Black females have an overall mortality of 19.8. White male mortality appears to be 19.5 and White females 13.6. The Asian male mortality rate is 13.1 and Asian females are 9.6. The Indian male population shows a mortality rate of 18.8 and females 14.6. Finally, hispanic males at 15.3 and hispanic females 10.2. The overall mortality for all races show males have a higher mortality rate than females at 20.2 vs. 14.1 respectively. The median age of death from colorectal cancer was found to be at 74 years of age. 0% died under the age of 20, 0.6% died between the ages of 20-34, 2.5% between 35-44 (Figure 1), 8.6% between 45-54, 16.5% between 55-64 (Figure 2), 22% between 65-74 (Figure 3), 29% between 75-84, and 20.8% died at age 85 and older (Figure 4). The overall age-adjusted mortality rate for men and women combined was calculated to be approximately 16.7 per 100,000 per year.

Discussion

There have been numerous studies previously published showing the incidence and mortality rates of certain ethnicities. Each individual study focused specifically on one or a maximum of two ethnicities. There appears to be a lack of research investigating and comparing all ethnicities together. Our study analyzed both the incidence

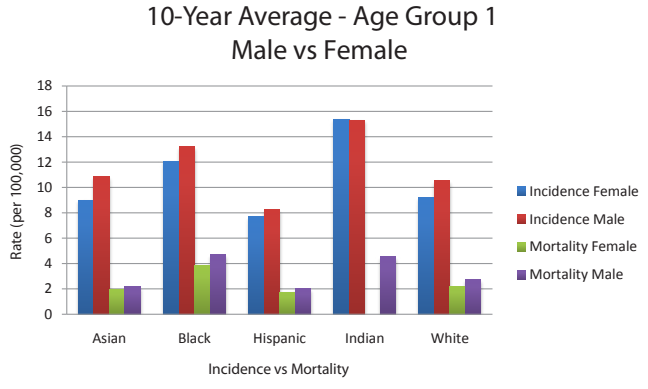

Figure 1: 10-year average showing both incidence and mortality rates of population ages 20-49.

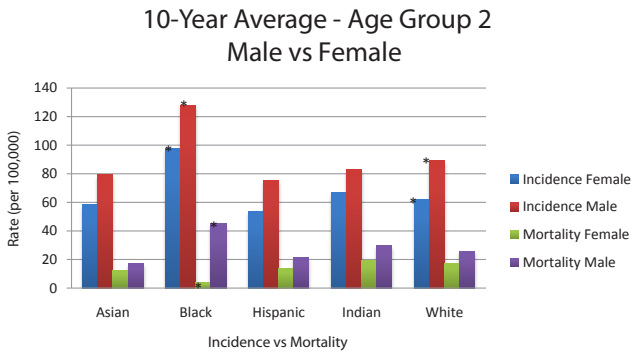

Figure 2: 10-year average showing both incidence and mortality rates of population ages 50-64. Bars marked with * indicate statistical significance.

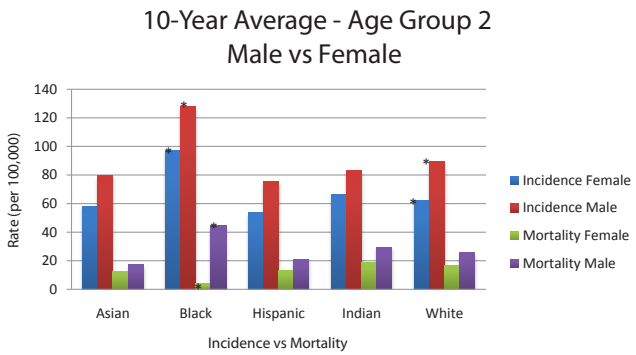

Figure 3: 10-year average showing both incidence and mortality rates of population ages 65-74. Bars marked with * indicate statistical significance.

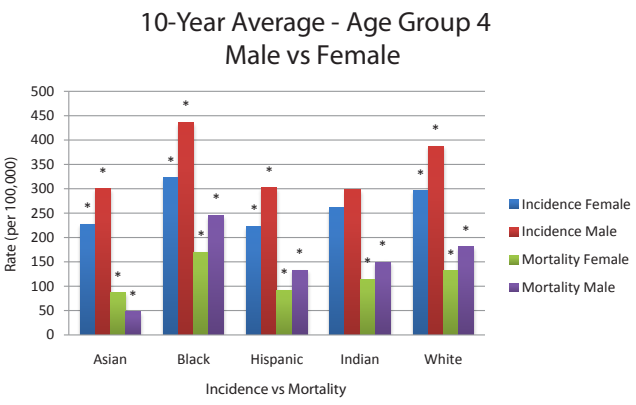

Figure 4: 10-year average showing both incidence and mortality rates of population ages 75 and older. Bars marked with * indicate statistical significance.

and mortality rates of all ethnicities provided within the database. Furthermore, these rates were categorized by age and gender to obtain the largest single source of mortality and incidence rates for colorectal cancer according to our background research.

The data, gathered from the SEER Database, takes into consideration age, race and gender for incidence and mortality of colorectal cancer for a population of 100,000 for each inputted data. The data first looks at the incidence rate for each race and gender broken down into four categories according to the age group in which each participant belongs to. The mortality also was broken down into a four-category collection of data by age of each participant according to their race and gender.

Incidence

The incidence data looked at age divided into four categories; ages 20-49 (Group-1), ages 50-64 (Group-2), ages 65-74 (Group-3) and ages 75 and over (Group-4) (Figures 1-4). Each of the age groups consisted of five ethnicities (Asian, Black, Hispanic, Indian and White) which were further divided into gender. For each ethnicity and gender, there consisted a ten-year data collection from years 2000 to 2009 in which each year was averaged together to achieve a single ten-year average for each ethnicity according to gender. These ten-year averages were then used to find statistical significance (p-value) of colorectal cancer incidence amongst males versus females, as well as each racial group being compared against all other racial group data in the study. Only p-values < 0.05 were considered statistically significant.

An overall trend could be seen when looking at males versus females with males having a higher incidence of colorectal cancer than do females with a p-value < 0.05. However, it is important to mention that in Group 1, Indian females actually show higher incidence of colorectal cancer amongst the male versus female comparison within this age category; p-value ≠< 0.05. The results of this analysis appear to follow the published norms of blacks having a high incidence rate of colorectal cancer.

When analyzing Group 1, it is noted that there are no statistically significant correlations amongst colorectal cancer incidence when comparing the different racial groups amongst one another. When considering Group 2 however, it is noted that there are eight correlations with a p-value < 0.05, those of which are: Asian males and females versus Black males and females with p=0.000731431 and 0.001686037 respectively, Black males and females versus Hispanic males and females with p=0.000225888 and 0.000383621 respectively, Black males and females versus Indian males and females with p=0.00194334 and 0.01611047 respectively, as well as Black males and females versus White males and females with p=0.008856741 and 0.004850234 respectively. Group 3 produced ten correlations with p-values < 0.05, those of which are: Asian males and females versus Black males and females with p= 4.59625E-05 and 7.79214E-05 respectively, Black males and female versus Hispanic males and females with p=0.000361307 and 8.776E-06 respectively, Black males and females versus Indian males and females with p=0.000740486 and 0.037394689 respectively, Black males and females versus White males and females with p=0.028505327 and 0.016846764 respectively, and then amongst the females of Hispanic versus Indian and Hispanic versus White with p=0.037478645 and 0.016902132 respectively. Group 4 showed eleven correlations with p-values < 0.05, those of which are: Asian males and females versus Black males and females with p=5.07112E-07 and 5.2309E-05 respectively, Asian males and females versus White males and females with p=0.000817603 and 0.002805767 respectively, Black males and females versus Hispanic males and females with p=8.05814E-07 and 2.00083E-05 respectively, Black males and females versus Indian males and females with p=3.92325E-07 and 0.011913802 respectively, Hispanic males and females versus White males and females with p=0.00112812 and 0.001331138 respectively and the males of Indian versus White with p= 0.000683343.

Mortality

The mortality data looked at age divided into four categories; ages 20-49 (Group-1), ages 50-64 (Group-2), ages 65-74 (Group-3) and ages 75 and over (Group-4). Each of the age groups consisted of five

ethnicities (Asian, Black, Hispanic, Indian and White) which were further divided into gender. For each ethnicity and gender, there consisted a ten-year data collection from years 2000 to 2009 in which each year was averaged together to achieve a single ten-year average for each ethnicity according to gender. These ten-year averages were then used to find the statistical significance (p-value) of colorectal cancer mortality rates amongst males versus females, as well as each racial group being compared against all other racial group data in the study. Only p-values < 0.05 were considered statistically significant.

An overall trend could be seen when looking at males versus females with males having a higher mortality rate of colorectal cancer than do females with a p-value<0.05. However, it is important to mention that in Group 4, Asian males actually showed lower mortality rates of colorectal cancer amongst the male versus female comparison within this age category; p-value < 0.05.

Group 1 showed that there are no statistically significant correlations amongst colorectal cancer mortality rate when comparing the different racial groups amongst one another. When considering Group 2 however, it is noted that there are seven correlations with a p-value<0.05, those of which are: Asian males and females versus Black males and females with p=0.000428264 and 0.037110699 respectively, Black males and females versus Hispanic males and females with p=0.00345158 and 0.020863648 respectively, Black males versus Indian males with p=0.001473241 respectively, as well as Black males and females versus White males and females with p=0.023153222 and 0.004087861 respectively. Group 3 showed that there are twelve correlations with p-values<0.05, those of which are: Asian males and females versus Black males and females with p=7.91806E-08 and 2.63763E-05 respectively, Asian males and female versus Indian males and females with p=0.01096064 and 0.003614931 respectively, Asian males and females versus White males and females with p=0.007138688 and 0.046256033 respectively, Black males and females versus Hispanic males and females with p= 3.61654E-05 and 0.000172276 respectively, and then amongst the males of Black versus Indian with p= 0.003544328, Black males and females versus White males and females with p=0.005615388 and 0.022717892 respectively, and Hispanic versus Indian females with p=0.01432623.

Group 4 noted that there are fourteen correlations with p-values<0.05, those of which are: Asian males and females versus Black males and females with p= 8.27852E-31 and 1.74092E-07 respectively, Asian males versus Hispanic males with p=2.47413E-10, Asian males versus Indian males with p= 4.90845E-13, Asian males and females versus White males and females with p=1.33412E-18 and 0.002022325 respectively, Black males and females versus Hispanic males and females with p=1.31605E-06 and 7.21379E-09 respectively, Black males and females versus Indian males and female with p= 1.30567E-06 and 0.00088318 respectively, Black males and females versus White males and females with p=0.00179612 and 0.028554712 respectively, and Hispanic males and females versus White males and females with p= 0.006660185 and 0.007174944.

Our data shows as age increased so does incidence rate across all ethnicities and genders. Although there seems to be an increased interest in the increase in colorectal cancer in the younger population [5], our data proves otherwise.

Comparison of our data to other countries in Asia and Europe show some similarities and some key differences. Previous studies have shown increases in incidence across the continent of Asia in both male and females [6]. The largest increase in the Asian population is reported in the country of Japan. Reports indicate an increase as high as 28.2% in that country in the male population as well as an increase of 10.4% in the female population. While our data shows some differences, we show similar trends in the lower incidence of the female population when comparing it to the males within that ethnicity.

Countries of the European Union also show a dramatic increase in incidence rates throughout the entire continent with the largest increase shown in Eastern Europe [6]. Of the countries in Eastern Europe, the Czech Republic showed the largest increase in both male and female incidence rates with increases as high as 19% and 6% respectively. The countries that make up Eastern Europe have a higher percentage of Caucasians compared to other ethnicities. With this in mind, our data shows similar increases across the board in both sexes.

Although this project obtained information through a nationally accepted database there are some limitations that must be discussed. First, this database does not obtain information regarding family or personal medical history [7]. These histories are key aspects in both cancer of the colon and rectum. Due to this limitation, roles of illnesses such as inflammatory bowel disease and genetic cancer syndromes cannot be properly addressed.

Additional shortcomings include the potential over representation of certain ethnic populations including but not limited to Native Americans, Hispanics and Asians. Only African Americans have been published as being at higher risk for colorectal cancer [1-3]. The SEER database in itself is representative of 26% of the total African American population compared to 28% of the total population. It is important to understand that the exact role of race in colorectal cancer cannot be properly addressed through our data.

The data we obtained is limited to incidence and mortality rates. Although the SEER database represents a large sample of the United States population, the actual raw numbers of population and new cancer diagnoses are unavailable through this source. Taking this into consideration, there is a limited amount of statistical manipulation that can be completed for analysis. This limits this project to a descriptive study, which demonstrates incidence and mortality rates of a large population.

Conclusion

Colorectal Cancer continues to be a growing concern among physicians [8]. Although this study has several limitations, as listed above, our data once again proves the Black population is at overall highest risk of colorectal cancer, while Hispanics appear to be at lowest risk [9]. This trend carries over into the mortality rate discussion as the Black population was shown to have the highest mortality rate and Asians appear to have the lowest mortality rate. Increased awareness among the Black population should take place with regular diagnostic testing including but not limited to colonoscopy [10].

The results from this project are strictly observational so definitive conclusions would be difficult to make. Our data does show that our healthcare system needs to broaden its outlook for consideration of colorectal cancer screenings at an earlier age specifically in the ethnicities that have demonstrated a higher incidence rate. Previous studies looking at age and ethnicities have shown that the young populations are more likely to present with advanced disease than their older counterparts [11]. With that in mind, it makes clear sense that the earlier lesions are discovered, the better the patient outcome normally is.

This data gives evidence that we will need to be more aggressive with our screening. This screening should be via colonoscope, as this examination is more in-depth than fecal occult blood testing (FOBT)

and sigmoidoscopy. As mentioned previously, the American Cancer Society (ACS) gives recommendations for screening to being at the age of 50. The ACS developed this conclusion from research showing colorectal cancers do not present until the patient is around 60 years of age [12]. This recommendation is not gender or race specific as it should be. A generic [6] approach to this disease takes it from being treatable and beatable to less favorable outcomes for all parties involved.

Using this study as representation of the United States and the facts known from other countries, listed above, it is safe to say incidence rates on colorectal cancer continue to increase across the globe. While no scientific data can prove the exact cause, it is widely speculated the increased incidence of colorectal cancer can be contributed to adaption of the western lifestyle throughout the world. Aspects dangerous of the western lifestyle include but are not limited to diets high in fats, physical inactivity and smoking.

New studies are now being published making the former belief of the ACS age requirement for colorectal screening void. These studies are showing the paradigm may need to be shifted. The exact age, gender and ethnicity for colorectal cancer screening is still unknown, however; as the SEER database continues to grow and new data slowly becomes available it will be important to examine the population of the United States to closely observe the results seen in this study. We believe at this point, screening recommendations and indications for colorectal cancer screenings will need to be adjusted.

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