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Black-White Disparities in Colorectal Cancer Incidence, Screening, and Outcomes

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Black-White Disparities in Colorectal Cancer Incidence, Screening, and Outcomes

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Health Policy and Management

by

Folasade Popoola May

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ABSTRACT OF THE DISSERTATION

Black-White Disparities in Colorectal Cancer Incidence, Screening, and Outcomes

by

Folasade Popoola May

Doctor of Philosophy in Health Policy and Management

University of California, Los Angeles, 2012

Professor Roshan Bastani, Chair

African Americans are disproportionately impacted by colorectal cancer (CRC) with higher incidence of disease, higher mortality from disease, and poorer disease survival. These disparities are likely the result of multiple factors, including a high prevalence of CRC risk factors, unfavorable tumor biology, and poor access to medical services among blacks. In addition, while national guidelines promote universal screening for CRC in all Americans, African Americans are less likely than white Americans to pursue screening. There is increasing emphasis in health services research to understand why CRC screening is underutilized in African Americans and to develop interventions that improve screening uptake in the racial subgroup.

This dissertation consists of three distinct but related studies that explore black-white disparities in CRC incidence, screening, and outcomes in the United States. The first study evaluates trends in black-white disparities in CRC incidence and stage at diagnosis over the past four decades using the Surveillance, Epidemiology, & End Results (SEER) cancer registry

database. Study two is a systematic review of the literature evaluating barriers to colonoscopic CRC screening in African Americans. Study three is a retrospective analysis to compare rates of colonoscopic screening in African Americans and non-African Americans and to identify patient-level, provider-level, and system-level factors associated with receipt and non-receipt of screening in a large Veteran Affairs Healthcare Network.

The dissertation demonstrates that while disparities in both CRC incidence and late stage presentation have narrowed over the past four decades, an incidence gap persists. The findings highlight the success of CRC prevention and early detection tools that have come into use over the past three decades and emphasize a continued need for strategies to improve uptake of CRC screening in African Americans. In addition, the dissertation identifies several patient-, provider-, and system-level factors that hinder colonoscopic screening in blacks and contribute to the incidence disparity. While future efforts to address disparities in CRC incidence should focus on increasing the use of screening endoscopy among African Americans to reduce disease incidence, we must not rely on colonoscopic screening alone to decrease the overall burden of CRC on blacks. By determining programs, policy, and interventions to reduce lifestyle risk factors for CRC and optimize use of both preventive and early detection screening methods in varied clinical settings, we can further reduce black-white disparities in CRC incidence, screening, and outcomes.

The dissertation of Folasade Popoola May is approved.

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2015

For my dearest grandfather,

the late Chief Joseph Inaolaji Popoola of Ilora, Nigeria.

You have always been my inspiration and will forever be my guiding light.

I carry you with me.

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Popoola, FA[#]. Increase in obesity and health-care use, from the Health Survey for England, ages 50 to 69. Obes Surg. 2004 Oct;14(9):1258-62. [#]Maiden Name

Oken E, Taveras EM, **Popoola FA#**, Rich-Edwards JW, Gillman MW. Television, walking, and diet: Associations with postpartum weight retention, Am J Prev Med. 2007 Apr;32(4):305-11.

May FP, Bromley EG, Baek M, Yoon J, Cohen E, Lee A, Reid MW, van Oijen MG, Spiegel BM. Low Uptake of Colorectal Cancer Screening Among African-Americans in an Integrated Veterans Affairs Healthcare Network. Gastrointest Endosc. 2014 Aug; 80(2):291-8.

Sundaram V, **May FP**, Manne V, Saab S. Clostridium Difficile infection and acute alcoholic hepatitis: The associated risk, mortality, and health care utilization. Clin Gastroenterol Hepatol. 2014 Oct;12(10):1745-1752.

May FP*, Bromley EG*, Federer L, Spiegel BM, van Oijen MG. Explaining persistent under-use of colonoscopic cancer screening in African Americans: A systematic review. Prev Med. 2015 Feb;71:40-8. *co-first authorship

Almario CV, **May FP**, Ponce NA, Spiegel BM. Racial and Ethnic Disparities in Colonoscopic Examination of Individuals with a Family history of Colorectal Cancer. Clin Gastroenterol Hepatol. 2015 Feb [Epub ahead of print]

May FP, Whitman CB, Varlyguina K, Bromlwy EG, Spiegel BM. Addressing Low Colorectal Cancer Screening In African Americans: Focus Groups Reveal A Framework For Developing An Effective Intervention. Journal Cancer Education (Accepted)

May FP, Almario C, Ponce N, Spiegel BM. Racial Minorities are More Likely Than Whites to Report Lack of Provider Recommendation for Colon Cancer Screening. Am J Gastroenterol. 2015 May [Epub ahead of print]

PRESENTATIONS:

May FP, Bromley EG, Baek M, Yoon J, Cohen E, Lee A, Reid MW, van Oijen MG, Spiegel Bm. Low Uptake of Colorectal Cancer Screening Among African-Americans in an Integrated Veterans Affairs Healthcare Network. Gastroenterology, Volume 144, Issue 5, S-573-S-574. Poster presentation at Digestive Diseases Week; Orlando, Fl; May, 2013.

Bromley EG, **May FP**, Federer L, van Oijen MG, Spiegel BM. A systematic review of patient, provider, and system barriers to colorectal cancer screening with colonoscopy in African Americans. Gastroenterology, Volume 144, Issue 5, S-581. Poster presentation at Digestive Diseases Week; Orlando, Fl; May, 2013.

May FP, Whitman CB, Varlyguina K, Bromley EG, Martinez BM, Spiegel BM. Addressing Low Colorectal Cancer Screening in African Americans: Focus Groups Reveal Insights for Developing an Effective Intervention. Gastroenterology, Volume 146, Issue 5, S-548. Poster presentation at Digestive Diseases Week; Chicago, IL; May, 2014.

Chapter 1:

Introduction to the Dissertation

1.1 Dissertation Overview

This dissertation includes three independent but related studies that explore black-white disparities in colorectal cancer (CRC) incidence, screening, and outcomes in the United States (U.S.). The research investigates disparities in different aspects of CRC prevention and care and aims to address several factors: 1) whether disparities in CRC incidence and stage at presentation have improved over time in the U.S.; 2) the barriers to colonoscopic CRC screening among African Americans; and 3) whether screening disparities exist when there is minimal variation in access to healthcare services. This chapter provides an overview of health equity research in the U.S., racial disparities in health and healthcare, and black-white disparities in CRC incidence, outcomes, and screening. The chapter also includes a summary of the dissertation aims, a brief description of the three dissertation studies, and a description of the guiding conceptual framework for the dissertation. Chapters two, three, and four present the background, methods, findings, and implications for the three dissertation studies. Chapter five provides a summary of the work, including a discussion of the dissertation limitations and implications for future research. As a whole, the dissertation aims to explore various aspects of black-white disparities across the CRC care continuum. This research will serve as the foundation for future research in CRC disparities and for the development of interventions to improve screening uptake and CRC outcomes among African Americans.

1.2 Dissertation Terminology

Currently, there is no consensus in the literature for the use of the term "black" or "African American" to describe individuals with dark-colored skin, especially of African ancestry. While the term "black" has been commonly used in mainstream media in the U.S. since the 1950s, "African-American" and "African American" were terms popularized in the 1980s with the growing sentiment that Americans of African descent should have a label similar to those for other immigrant groups to the U.S. like "Italian-Americans" or "German-Americans."

In this dissertation, the terms "African American" and "black" should be considered synonymous. The exception is chapter 2 in which the term "black" can also refer to individuals of black-Hispanic descent to be consistent with the convention of the Surveillance, Epidemiology and End Results (SEER) Program database. The term "white" in the dissertation refers to individuals of European descent, not otherwise classified as African American, Hispanic, Asian, Native American, American Indian, Alaskan Native, Pacific Islander, or other non-white race. Again to remain consistent with the convention of the SEER Program database, chapter two is an exception. In chapter 2, the term "white" refers to individuals of either white-Hispanic or white-non-Hispanic descent.

1.3 Health Equity in the United States

There is strong evidence that health, healthcare utilization and healthcare outcomes in the U.S. are influenced by one's socio-demographic background (Bradley, Given, & Roberts, 2001; Harper, Rushani, & Kaufman, 2012; Trivedi et al., 2014; Virani et al., 2015). These inequalities are rooted in biologic, historic, and political etiologies but also reflect how poor distribution of

health services can result in grave disparities in utilization of care and healthcare outcomes. In the 2001 landmark report, *Crossing the Quality Chasm*, the Institute of Medicine (IOM) specified six strategies to improve the quality of healthcare systems in the U.S. (IOM, 2001). Healthcare equity was among these six aims, defined by the IOM as providing care that does not vary in quality because of personal characteristics such as gender, race, ethnicity, geographic location, or socioeconomic status (IOM, 2001).

The *Crossing the Quality Chasm* report, along with highly publicized disparities research and policy statements such as the Healthy People Program and AHRQ National Healthcare Disparities report have placed a national spotlight on health equity (IOM, 2010; Sondik, Huang, Klein, & Satcher, 2010). The most significant piece of healthcare reform since the passing of the Medicare and Medicaid legislations in the 1960s, the Affordable Care Act (ACA), recognizes the need for effective research and interventions to reduce health disparities. The reform includes provisions to decrease the number of uninsured Americans, improve mechanisms through which population data are collected, and support federal infrastructures to reduce health disparities (Bustamante, Morales, & Ortega, 2013). With this growing emphasis on health equity, health services researchers and implementation scientists aim to fully understand the mechanisms that drive each disparity in health and healthcare so that effective interventions can be developed and implemented to address health inequities.

1.4 Racial Disparities in Health and Healthcare

While disparities occur across many patient-level characteristics, this dissertation focuses on the relationship between race, health, and healthcare. There is a distinction in the medical literature between *disparities in health* and *disparities in healthcare*. Racial disparities in health

occur when there are differences in disease incidence, morbidity, and/or mortality between racial subgroups (Yancey, Bastani, & Glenn, 2013). African Americans, for example, are disproportionately affected by cancer with an all-cause cancer mortality rate 30% higher than non-Hispanic white Americans (ACS, 2014; Howlader et al., 2012). This disparity in health has been attributed to genetic predisposition to malignancies, a high prevalence of obesity, social barriers, discrimination, and disparities in the use of healthcare services among many other factors (ACS, 2014; Agrawal et al., 2005; Elk & Landrine, 2012; Yancey et al., 2013).

Racial *disparities in healthcare*, while related, refer to inequities in the quantity or quality of healthcare services received by different racial subgroups. In the most inclusive definition, disparities in healthcare include any difference in service use predicted by race or ethnicity (Bustamante et al., 2013; Elk & Landrine, 2012). In contrast, in the 2002 IOM report, *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*, disparities in healthcare refer only to differences in care that are not explained by inequities in patient preference or clinical need (Smedley, Stith, & Nelson, 2003). This definition specifies that a healthcare disparity between two groups is a difference in access or treatment that is not justified by larger differences in group preferences, clinical need, or health status (Smedley et al., 2003). While there is lack of consensus among health equity researchers regarding which definition is optimal, limitations in the available data about the role of organizational operation, access to care, discrimination, and bias in how healthcare is provided challenge the use of the IOM definition. The present dissertation addresses both racial disparities in health (CRC incidence and outcomes) and racial disparities in healthcare (CRC screening utilization). We define "disparity" as the absolute difference between whites and blacks in health status (CRC incidence and outcomes) or healthcare utilization (CRC screening uptake).

1.5 Black-White Disparities in Colorectal Cancer Incidence and Outcomes

CRC is the third most common malignancy and third most common cause of cancer-related mortality among men and women in the U.S. (Siegel, Desantis, & Jemal, 2014). Each year, the U.S. spends approximately $14 billion on CRC, and over fifty thousand Americans die from the disease (ACS, 2011, 2014; NCI, 2012). While CRC affects all racial and ethnic groups, blacks carry an excessive burden of disease with the highest overall incidence, highest incidence of advanced stage at disease presentation, highest incidence of advanced malignancy at age less than 50, highest mortality from disease, and lowest survival rates following diagnosis when compared to other racial and ethnic groups (ACS, 2014; Lieberman et al., 2008; Murphy et al., 2011; Rex et al., 2009; Rise, Eisner, & Kosary, 2003; Siegel et al., 2014; Tammana & Laiyemo, 2014). In 2011, the age-adjusted incidence of CRC was 55.0 per 100,000 African Americans, compared to 44.9 per 100,000 white Americans (USCSWG, 2014). The same year, mortality rates from CRC were 26.2 and 17.5 per 100,000, respectively, for blacks and whites (USCSWG, 2014). Five-year relative survival from CRC has improved from 46% to 57% in blacks over the past five decades, compared to an improvement from 51% to 65% in whites (Howlader et al., 2012) . At least some of the survival disparity is attributed to late stage at CRC presentation, which is significantly more common in blacks than in whites (ACS, 2014; Howlader, Noone, & Krapcho, 2011; Polite, Dignam, & Olopade, 2006; Soneji, Iyer, Armstrong, & Asch, 2010; Wallace et al., 2013).

The disparities in CRC incidence and outcomes between black Americans and white Americans are not fully understood. CRC is associated with several lifestyle factors such as cigarette use, high animal fat diet, low fiber diet, low physical activity and obesity, all of which are also associated with black race (Bolen, Rhodes, Powell-Griner, Bland, & Holtzman, 2000;

Ford, 1999; Huxley et al., 2009; NCI, 2012; Willett, Stampfer, Colditz, Rosner, & Speizer, 1990). In addition, diets low in vitamin E, vitamin C, calcium and beta-carotene micronutrients have been implicated in CRC pathogenesis (O'Keefe et al., 2009; Patterson, White, Kristal, Neuhouser, & Potter, 1997; Satia-Abouta et al., 2003). African Americans may be less likely to take vitamin supplements and to have diets high in these nutrients (Satia-Abouta et al., 2003). Increased CRC incidence and poorer outcomes in blacks may also reflect unfavorable tumor biology, lack of access to healthcare services, poorer quality of health services, and a high prevalence of barriers to screening services (Agrawal et al., 2005; Ashktorab et al., 2009; Berkowitz, Hawkins, Peipins, White, & Nadel, 2008; Dimou, Syrigos, & Saif, 2009; James, Daley, & Greiner, 2011; Palmer, Chhabra, & McKinney, 2011; Palmer, Midgette, & Dankwa, 2008; Palmer, Midgette, & Mullan, 2010; Tammana & Laiyemo, 2014). In particular, low uptake of CRC screening among African Americans has been the focus of considerable research (Ananthakrishnan, Schellhase, Sparapani, Laud, & Neuner, 2007; Benarroch-Gampel et al., 2012; CDC, 2010; Doubeni et al., 2010; Johnson-Jennings, Tarraf, Xavier Hill, & Gonzalez, 2014; Wilkins et al., 2012).

1.6 Low Uptake of Colorectal Cancer Screening among Blacks

Despite strong data supporting CRC screening and national guidelines for universal screening, less than two-thirds of eligible Americans are up-to-date with CRC screening. In National Health Interview Survey (NHIS) and Behavioral Risk Factor Surveillance Survey (BRFSS) data, the overall CRC screening rates in the U.S. in 2010 were 59% and 65%, respectively (CDC, 2011; Klabunde et al., 2012). Among racial/ethnic minorities and those who are uninsured, uneducated, or poor, screening uptake was even lower (Ananthakrishnan et al.,

2007; CDC, 2010, 2011; Shapiro et al., 2008). Blacks, in particular, have lower CRC screening rates when compared to white Americans (Ananthakrishnan et al., 2007; Benarroch-Gampel et al., 2012; CDC, 2010; Doubeni et al., 2010; Johnson-Jennings et al., 2014; Wilkins et al., 2012). CRC screening uptake in white Medicare beneficiaries was 49% in 2000 compared to 41% in blacks (Doubeni et al., 2010). In a 2007 analysis of average-risk Medicare beneficiaries, the CRC screening rate in blacks was 10% lower than for whites (Ananthakrishnan et al., 2007). Similarly, NHIS data from 2010 demonstrated a CRC screening rate of 60% in blacks compared to 66% in whites (Klabunde et al., 2012).

More recent data suggest some convergence in black and white CRC screening rates (CDC, 2013; Johnson-Jennings et al., 2014). However, while the disparity may be decreasing, significant differences persist in most studies (ACS, 2014; Johnson-Jennings et al., 2014). Further, as African Americans are disproportionately affected by CRC, these poor screening rates are especially concerning. In a 2012 microsimulation model to estimate CRC incidence and mortality rates in African Americans, 42% of the black-white disparity in CRC incidence and 19% of the disparities in mortality were attributed to black-white differences in CRC screening uptake (Lansdorp-Vogelaar et al., 2012).

1.7 Methods for Colorectal Cancer Screening

Screening guidelines for CRC were first introduced in the late 1990s by a consortium of five medical and surgical gastrointestinal societies and the American Cancer Society (ACS) (ACS, 2014). There are two broad categories of FDA-approved CRC screening tests for the average-risk population, which is defined as individuals over age 50 without a familial history of CRC or other predisposing conditions: 1) tests that perform structural examination of the colon;

and 2) stool-based studies (USPSTF, 2008). Structural examination of the colon is effective for CRC prevention through the identification of pre-cancerous adenomatous polyps (colonic adenomas) as well as for CRC detection (**Table 1.1**) (He & Efron, 2011; Pignone, Rich, Teutsch, Berg, & Lohr, 2002; USPSTF, 2008; Whitlock, Lin, Liles, Beil, & Fu, 2008). Colon adenomas are common in adults over age 50 years (Conteduca, Sansonno, Russi, & Dammacco, 2013). Over time, some adenomas undergo malignant transformation into adenocarcinomas or CRC (Conteduca et al., 2013). Structural screening tests are capable of preventing CRC incidence by identifying pre-cancerous adenomas and of detecting early CRC by identifying malignant adenocarcinomas. They include two radiographic studies and two endoscopic studies: double-contrast barium enema, computed tomography colonography, colonoscopy, and flexible sigmoidoscopy (**Table 1.1**). Whereas double-contrast barium enema and computer tomography colonography require follow-up diagnostic colonoscopy in the setting of a positive result, colonoscopy and flexible sigmoidoscopy can be used as both screening and diagnostic tools.

Stool-based tests are effective for the detection of malignant adenocarcinomas. They include fecal occult blood testing (FOBT), fecal immunochemistry testing (FIT), and the newly FDA-approved stool DNA test (sDNA). These studies require the user to place a small amount of fecal material onto a reactive surface capable of detecting blood (FOBT or FIT) or into a receptacle for cancer DNA testing (sDNA). If the test is positive, a colonoscopy is required to determine the source of blood loss or cancer cells. While FOBT, FIT, and sDNA can be up to 98% sensitive for CRC, they are at best 20-50% sensitive for pre-cancerous lesions like adenomas and advanced adenomas (Hundt, Haug, & Brenner, 2009; Imperiale et al., 2014; Lee, Liles, Bent, Levin, & Corley, 2014; Miutescu et al., 2013). Given these test characteristics, the

primary goal of stool-based screening methods is early detection over primary prevention (Rex et al., 2009; USPSTF, 2008).

1.8 Evidence for Colorectal Cancer Screening

Several studies have supported the use of screening programs for CRC. The evidence includes both observational data as well as randomized controlled trials that demonstrate that screening for CRC with colonoscopy, flexible sigmoidoscopy, or stool-based studies can effectively identify and remove premalignant lesions, reduce incidence of CRC, and decrease CRC mortality (Atkin et al., 2010; Faivre et al., 2004; Hardcastle et al., 1996; Kronborg, Fenger, Olsen, Jorgensen, & Sondergaard, 1996; Lieberman et al., 2012; Mandel, Church, Ederer, & Bond, 1999; Nishihara et al., 2013; Schoen et al., 2012; Segnan et al., 2011; Shaukat et al., 2013; USPSTF, 2008). Several randomized studies demonstrate that FOBT screening is effective in reducing CRC-related mortality (Faivre et al., 2004; Hardcastle et al., 1996; Jorgensen, Kronborg, & Fenger, 2002; Kronborg et al., 1996; Mandel et al., 1999; Shaukat et al., 2013). There are also randomized trial data supporting flexible sigmoidoscopy for CRC prevention (Atkin et al., 2010; Schoen et al., 2012; Segnan et al., 2011). Randomized trial data does not yet exist for colonoscopic screening; however, several observational studies suggest a mortality benefit (Lieberman et al., 2012; Nishihara et al., 2013; USPSTF, 2008).

1.8 Colorectal Cancer Screening Guidelines

While most society and national guidelines promote screening by any of the seven FDA-approved screening strategies, there are a few exceptions. For example, the 2008 USPSTF guidelines recommend only three of these studies for average-risk Americans beginning at age

50 and continuing until age 75: 1) high-sensitivity FOBT every year, 2) flexible sigmoidoscopy every five years with FOBT every three years, or 3) colonoscopy every ten years (grade A) (USPSTF, 2008). The American College of Gastroenterology (ACG) recommends any one of the seven FDA-approved methods but specifies earlier screening at age 45 with colonoscopy for African Americans (Rex et al., 2009).

1.10 Dissertation Aims

The dissertation investigates black-white disparities in CRC through three distinct but related studies. The primary aim in study one is to evaluate trends in black-white disparities in CRC incidence and stage at diagnosis in the U.S. over the past four decades using the Surveillance, Epidemiology, & End Results (SEER) cancer registry database. Study two aims to systematically review the literature evaluating barriers to colonoscopic CRC screening in African Americans. In study three, the objective is to conduct a large retrospective database analysis within the West Los Angeles Veteran Affairs Healthcare Network to: 1) describe rates of colonoscopic screening among African Americans; 2) compare rates of colonoscopic screening in African Americans and non-African Americans; and 3) identify patient-level, provider-level, and system-level factors associated with receipt and non-receipt of screening in general, and among African Americans in particular.

1.11 Conceptual Framework

The conceptual model underlying the three studies in this dissertation is based on two highly publicized conceptual frameworks:1) the IOM Source of Disparities in Care model (**Figure 1.1**) and 2) the IOM Cancer Control Continuum model (**Figure 1.2**). In the 2002 IOM

Unequal Treatment report, the Source of Disparities in Care Model divided concepts contributing to racial and ethnic disparities into patient-, provider-, and healthcare system-level factors (Smedley et al., 2003). Patient-level factors are the patient preferences and demographic factors that determine whether a patient utilizes a specific healthcare service. Provider-related characteristics are those features specific to the provider's practice techniques that affect whether a patient receives a healthcare service. System-level contributors are the aspects of the healthcare system that affect a patient's ability to access a healthcare service. The IOM Disparities in Care Model is not specific to a particular disease state or medical service, however, is a hypothesis-generating framework that can guide the exploration of any disparity. The second model, the IOM Cancer Control Continuum, depicts the various steps and transition points in cancer care, from prevention of disease to survivorship (**Figure 1.2**) (IOM, 2013). The framework has been used since the 1970s to describe the potential failure points in the management of cancer and to highlight areas where resources and interventions are needed to improve cancer outcomes and the quality of cancer care (Zapka, Taplin, Solberg, & Manos, 2003).

The *Conceptual Model for Black-White Disparities in Colorectal Cancer Incidence, Screening, and Outcomes* is a framework based on these two IOM models to provide an overlying framework for the dissertation (**Figure 1.3**). The patient-, provider-, and system-level domains in the model correspond to the IOM Disparities in Care Model and interact with one another to influence patient and provider behavior and patient care. For example, an individual's financial status (patient-level factor) may impact the healthcare system (system-level factor) he has access to, which, in turn, may determine availability of CRC preventive and diagnostic services. Alternatively, a provider's inclination to recommend a screening test to an eligible

individual (provider-level factor) might be influenced by system-level features like clinical reminders or provider benchmark reports (system-level factors) (Baron et al., 2010).

The prevention, detection, and diagnosis domains in the dissertation framework are borrowed from the left side of the IOM Cancer Control Continuum Model. As the dissertation studies only explore CRC prevention, detection, and diagnosis, our model is specific to CRC disparities in these three domains rather than the entire CRC cancer care continuum. Study one draws inferences from the prevention, detection, and diagnosis domains while studies two and three focus specifically on barriers to CRC prevention and early detection.

1.12 Overview of Dissertation Studies

1.12.1 Black-White Trends in Colorectal Cancer Incidence and Outcomes (Study One)

While the literature provides cross-sectional data about disparities in CRC incidence and outcomes in the U.S., there is limited information on how these disparities have varied in direction and magnitude over time. Study one employs a large national cancer registry database to determine trends in black-white disparities in CRC incidence and stage at diagnosis from 1975 to 2011. Both outcomes are important indicators of CRC— they represent the impact of CRC on the U.S. population and may reflect the impact of programs and policy aimed at improving CRC prevention through screening. Study one compares trends in these two outcomes over time in whites and blacks and examines disparity trends in the context of historical events in CRC advocacy, policy, and screening.

1.12.2 Systematic Review of Barriers to Colonoscopic Colorectal Cancer Screening in African Americans (Study Two)

In light of disparities in CRC screening and outcomes between blacks and whites, study two is a systematic review of the literature on barriers to colonoscopic screening in African Americans. We conducted a search of the MEDLINE and the Cochrane Central Register of Controlled Trials (CENTRAL) databases with the guidance of an experienced biomedical librarian to find quantitative and qualitative research identifying barriers to screening with colonoscopy. For each study that met inclusion and exclusion criteria, we summarize the identified patient-, provider-, and system-level barriers to colonoscopic screening among African Americans. We also suggest strategies to address these barriers.

1.12.3 Low Uptake of Colorectal Cancer Screening in an Integrated Veterans Affairs Healthcare Network (Study Three)

The final study is a cross-sectional retrospective cohort study that aimed to determine screening rates and predictors of screening among African Americans and non-African Americans in an integrated network of 12 Veterans Affairs (VA) healthcare network sites serving a racially- and ethnically-diverse population in Southern California. As access inequalities are minimized in the VA health system, it is an ideal model to test whether patient-level and provider-level factors impact CRC screening after controlling for system-level factors. We aimed to determine rates of uptake of any CRC screening method in both African Americans and non-African Americans, rates of colonoscopic screening, and predictors of CRC screening by any method and by colonoscopy. In addition, the study included cox proportional hazard regression analyses to examine the effect of each predictor on time-to-screening uptake and

Kaplan-Meier survival analyses with log-rank testing to examine differences in time-to-screening between African American and non-African Americans.

1.13 Contribution to the Field of Health Policy and Management

The literature suggests that disparities in care across the CRC cancer care continuum are the result of multiple, interacting patient-level, provider-level, and system-level factors. The overall purpose of this dissertation is to characterize the impact of these factors on the uptake of CRC screening, CRC incidence and CRC clinical outcomes over time. In doing so, the dissertation will contribute three novel studies to the health equity literature and lay the foundation for future research into interventions to improve CRC outcomes in blacks.

CRC is one of few largely preventable malignancies. A better understanding of the extent of and contributors to CRC disparities will ultimately lead us towards the long-term goal to develop interventions that will decrease the incidence of and mortality and morbidity from CRC in African Americans. Reducing CRC outcomes in African Americans will, in turn, lessen the overall burden of colorectal malignancies.

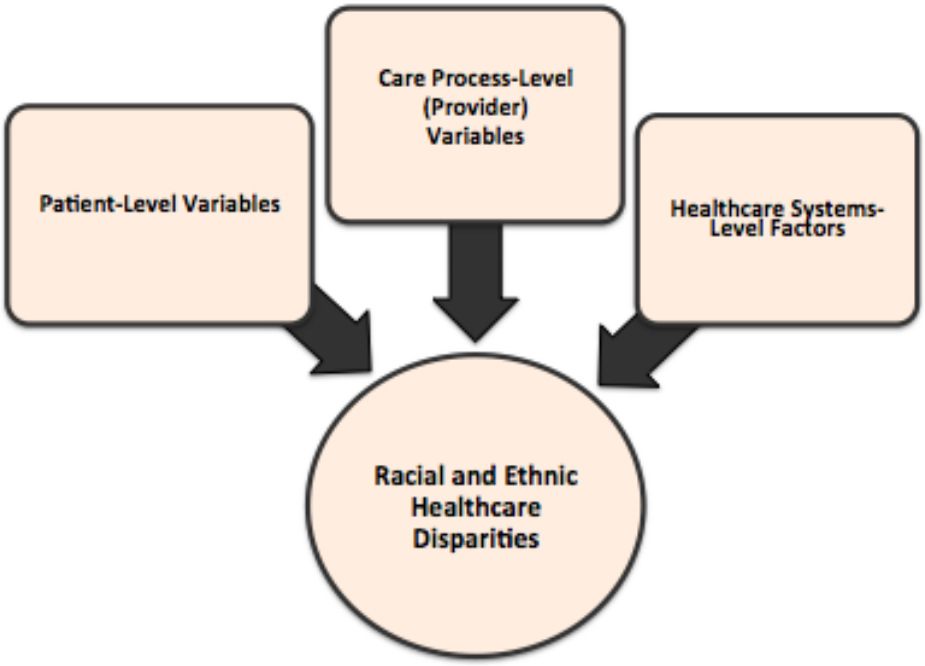
1.14 Tables and Figures

Table 1.1: Available colorectal cancer screening tests (Rex et al., 2009; USPSTF, 2008)

Stool-Based Early Detection Tests for Colorectal Cancer	**Test Frequency***
1. Fecal occult blood testing (FOBT)	Annual
2. Fecal immunochemistry testing (FIT)	Annual
3. Stool DNA test (sDNA)	Every 3 years
Structural Examination of the Colon for Pre-Cancerous and Cancerous Lesions	**Test Frequency***
Radiographic Tests:	
4. Double-contrast barium enema	Every 5 years
5. Computed tomography colonography	Every 5 years
Endoscopic Tests:	
6. Flexible sigmoidoscopy (with FOBT every 3 years)	Every 5 years
7. Colonoscopy	Every 10 years

* Recommended frequency of repeat testing in the setting that previous test was normal

Figure 1.1: Sources of Disparities in Care Model, IOM (Smedley et al., 2003)*



* Adapted from Smedley et al., 2003

Figure 1.2: The Cancer Care Continuum Model, IOM (IOM, 2013)

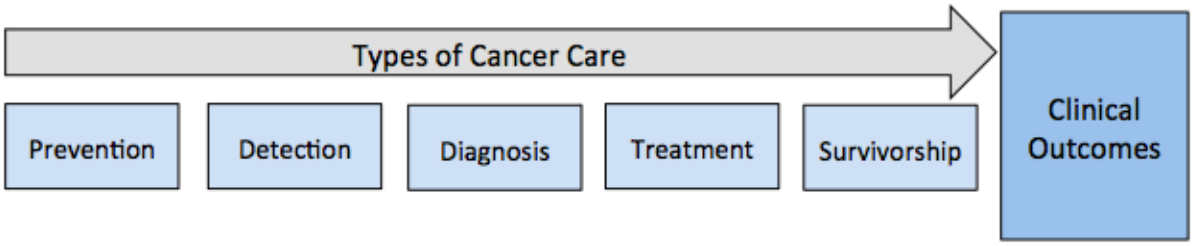
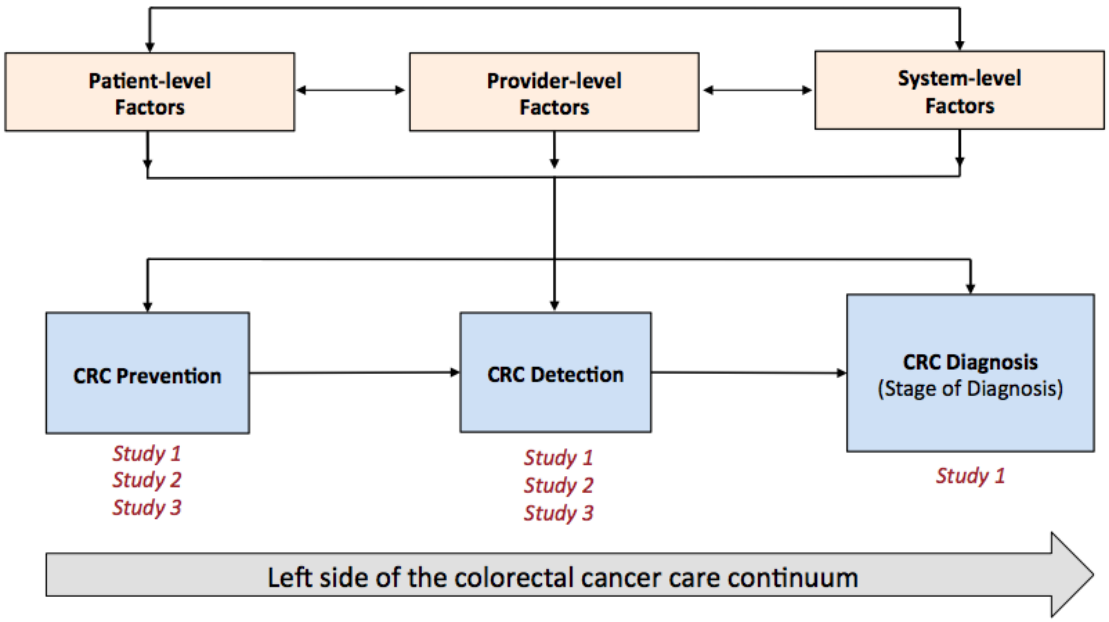


Figure 1.3: A Conceptual Model for Black-White Disparities in Colorectal Cancer Incidence, Screening, and Outcomes*



*Only the domains from left side of the Cancer Care Continuum Model are included in this conceptual model. These are the domains relevant to the dissertation.

1.15 References

ACS. (2011). American Cancer Society: Colorectal Cancer Facts & Figures 2011-2013. Atlanta: American Cancer Society.

ACS. (2014). American Cancer Society: Colorectal Cancer Facts & Figures 2014-2016. Atlanta: American Cancer Society.

Agrawal, S., Bhupinderjit, A., Bhutani, M. S., Boardman, L., Nguyen, C., Romero, Y., . . . Figueroa-Moseley, C. (2005). Colorectal cancer in African Americans. *Am J Gastroenterol, 100*(3), 515-523; discussion 514. doi: 10.1111/j.1572-0241.2005.41829.x

Ananthakrishnan, A. N., Schellhase, K. G., Sparapani, R. A., Laud, P. W., & Neuner, J. M. (2007). Disparities in colon cancer screening in the Medicare population. *Arch Intern Med, 167*(3), 258-264. doi: 10.1001/archinte.167.3.258

Ashktorab, H., Nouraie, M., Hosseinkhah, F., Lee, E., Rotimi, C., & Smoot, D. (2009). A 50-year review of colorectal cancer in African Americans: implications for prevention and treatment. *Dig Dis Sci, 54*(9), 1985-1990. doi: 10.1007/s10620-009-0866-5

Atkin, W. S., Edwards, R., Kralj-Hans, I., Wooldrage, K., Hart, A. R., Northover, J. M., . . . Cuzick, J. (2010). Once-only flexible sigmoidoscopy screening in prevention of colorectal cancer: a multicentre randomised controlled trial. *Lancet, 375*(9726), 1624-1633. doi: 10.1016/s0140-6736(10)60551-x

Baron, R. C., Melillo, S., Rimer, B. K., Coates, R. J., Kerner, J., Habarta, N., . . . Leeks, K. J. (2010). Intervention to increase recommendation and delivery of screening for breast, cervical, and colorectal cancers by healthcare providers a systematic review of provider reminders. *Am J Prev Med, 38*(1), 110-117. doi: 10.1016/j.amepre.2009.09.031

Benarroch-Gampel, J., Sheffield, K. M., Lin, Y. L., Kuo, Y. F., Goodwin, J. S., & Riall, T. S. (2012). Colonoscopist and primary care physician supply and disparities in colorectal cancer screening. *Health Serv Res, 47*(3 Pt 1), 1137-1157. doi: 10.1111/j.1475-6773.2011.01355.x

Berkowitz, Z., Hawkins, N. A., Peipins, L. A., White, M. C., & Nadel, M. R. (2008). Beliefs, risk perceptions, and gaps in knowledge as barriers to colorectal cancer screening in older adults. *J Am Geriatr Soc, 56*(2), 307-314. doi: 10.1111/j.1532-5415.2007.01547.x

Bolen, J. C., Rhodes, L., Powell-Griner, E. E., Bland, S. D., & Holtzman, D. (2000). State-specific prevalence of selected health behaviors, by race and ethnicity--Behavioral Risk Factor Surveillance System, 1997. *MMWR CDC Surveill Summ, 49*(2), 1-60.

Bradley, C. J., Given, C. W., & Roberts, C. (2001). Disparities in cancer diagnosis and survival. *Cancer, 91*(1), 178-188.

Bustamante, AV., Morales, LS. , & Ortega, AN. (2013). Racial and Ethnic Disparities in Health Care. In Andersen RM, Rice TH, Kominski GF. Changing the U.S. Health Care System:

Key Issues in Health Services Policy and Management. 4th edition. San Francisco (CA): Jossey-Bass; 2013.

CDC. (2010). Centers For Disease Control and Prevention: Vital signs: colorectal cancer screening among adults aged 50-75 years - United States, 2008. *MMWR Morb Mortal Wkly Rep, 59*(26), 808-812.

CDC. (2011). Centers For Disease Control and Prevention. Vital signs: Colorectal cancer screening, incidence, and mortality--United States, 2002-2010. *MMWR Morb Mortal Wkly Rep, 60*(26), 884-889.

CDC. (2013). Centers For Disease Control and Prevention: Vital signs: colorectal cancer screening test use--United States, 2012. *MMWR Morb Mortal Wkly Rep, 62*(44), 881-888.

Conteduca, V., Sansonno, D., Russi, S., & Dammacco, F. (2013). Precancerous colorectal lesions (Review). *Int J Oncol, 43*(4), 973-984. doi: 10.3892/ijo.2013.2041

Dimou, A., Syrigos, K. N., & Saif, M. W. (2009). Disparities in colorectal cancer in African-Americans vs Whites: before and after diagnosis. *World J Gastroenterol, 15*(30), 3734-3743.

Doubeni, C. A., Laiyemo, A. O., Klabunde, C. N., Young, A. C., Field, T. S., & Fletcher, R. H. (2010). Racial and ethnic trends of colorectal cancer screening among Medicare enrollees. *Am J Prev Med, 38*(2), 184-191. doi: 10.1016/j.amepre.2009.10.037

Elk, R., & Landrine, H. (2012). *Cancer Disparities*. New York, NY: Springer.

Faivre, J., Dancourt, V., Lejeune, C., Tazi, M. A., Lamour, J., Gerard, D., . . . Bonithon-Kopp, C. (2004). Reduction in colorectal cancer mortality by fecal occult blood screening in a French controlled study. *Gastroenterology, 126*(7), 1674-1680.

Ford, E. S. (1999). Body mass index and colon cancer in a national sample of adult US men and women. *Am J Epidemiol, 150*(4), 390-398.

Hardcastle, J. D., Chamberlain, J. O., Robinson, M. H., Moss, S. M., Amar, S. S., Balfour, T. W., . . . Mangham, C. M. (1996). Randomised controlled trial of faecal-occult-blood screening for colorectal cancer. *Lancet, 348*(9040), 1472-1477. doi: 10.1016/s0140-6736(96)03386-7

Harper, S., Rushani, D., & Kaufman, J. S. (2012). Trends in the black-white life expectancy gap, 2003-2008. *JAMA, 307*(21), 2257-2259. doi: 10.1001/jama.2012.5059

He, J., & Efron, J. E. (2011). Screening for colorectal cancer. *Adv Surg, 45*, 31-44.

Howlader, N. , Noone, A.M., Krapcho, M., Neyman, N., Aminou, R., Waldron, W., . . . Cronin, K.A. (2012). SEER Cancer Statistics Review, 1975-2009.

Howlader, N. , Noone, AM. , & Krapcho, M. (2011). SEER Cancer Statistics Review, 1975-2008. Bethesda, MD: National Cancer Institute.

Hundt, S., Haug, U., & Brenner, H. (2009). Comparative evaluation of immunochemical fecal occult blood tests for colorectal adenoma detection. *Ann Intern Med, 150*(3), 162-169.

Huxley, R. R., Ansary-Moghaddam, A., Clifton, P., Czernichow, S., Parr, C. L., & Woodward, M. (2009). The impact of dietary and lifestyle risk factors on risk of colorectal cancer: a quantitative overview of the epidemiological evidence. *Int J Cancer, 125*(1), 171-180. doi: 10.1002/ijc.24343

Imperiale, T. F., Ransohoff, D. F., Itzkowitz, S. H., Levin, T. R., Lavin, P., Lidgard, G. P., . . . Berger, B. M. (2014). Multitarget stool DNA testing for colorectal-cancer screening. *N Engl J Med, 370*(14), 1287-1297. doi: 10.1056/NEJMoa1311194

IOM. (2001) *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington DC: 2001 by the National Academy of Sciences.

IOM. (2010). In C. Ulmer, M. Bruno & S. Burke (Eds.), *Future Directions for the National Healthcare Quality and Disparities Reports*. Washington DC: 2010 by the National Academy of Sciences.

IOM. (2013). Institute of Medicine: Delivering High-Quality Cancer Care: Charting a New Course for a System in Crisis. Washington, D.C.: The National Academies Press.

James, A. S., Daley, C. M., & Greiner, K. A. (2011). Knowledge and attitudes about colon cancer screening among African Americans. *Am J Health Behav, 35*(4), 393-401.

Johnson-Jennings, M. D., Tarraf, W., Xavier Hill, K., & Gonzalez, H. M. (2014). United States colorectal cancer screening practices among American Indians/Alaska Natives, blacks, and non-Hispanic whites in the new millennium (2001 to 2010). *Cancer, 120*(20), 3192-3299. doi: 10.1002/cncr.28855

Jorgensen, O. D., Kronborg, O., & Fenger, C. (2002). A randomised study of screening for colorectal cancer using faecal occult blood testing: results after 13 years and seven biennial screening rounds. *Gut, 50*(1), 29-32.

Klabunde, C.N, Brown, M, Ballard-Barbash, R, White, M.C, Thompson, T, Plescia, M , & King, S.C. (2012). Cancer Screening — United States, 2010. *MMWR, 61(03);41-45*.

Kronborg, O., Fenger, C., Olsen, J., Jorgensen, O. D., & Sondergaard, O. (1996). Randomised study of screening for colorectal cancer with faecal-occult-blood test. *Lancet, 348*(9040), 1467-1471. doi: 10.1016/s0140-6736(96)03430-7

Lansdorp-Vogelaar, I., Kuntz, K. M., Knudsen, A. B., van Ballegooijen, M., Zauber, A. G., & Jemal, A. (2012). Contribution of screening and survival differences to racial disparities in colorectal cancer rates. *Cancer Epidemiol Biomarkers Prev, 21*(5), 728-736. doi: 10.1158/1055-9965.epi-12-0023

Lee, J. K., Liles, E. G., Bent, S., Levin, T. R., & Corley, D. A. (2014). Accuracy of fecal immunochemical tests for colorectal cancer: systematic review and meta-analysis. *Ann Intern Med, 160*(3), 171. doi: 10.7326/m13-1484

Lieberman, D. A., Holub, J. L., Moravec, M. D., Eisen, G. M., Peters, D., & Morris, C. D. (2008). Prevalence of colon polyps detected by colonoscopy screening in asymptomatic black and white patients. *JAMA, 300*(12), 1417-1422. doi: 10.1001/jama.300.12.1417

Lieberman, D. A., Rex, D. K., Winawer, S. J., Giardiello, F. M., Johnson, D. A., & Levin, T. R. (2012). Guidelines for colonoscopy surveillance after screening and polypectomy: a consensus update by the US Multi-Society Task Force on Colorectal Cancer. *Gastroenterology, 143*(3), 844-857. doi: 10.1053/j.gastro.2012.06.001

Mandel, J. S., Church, T. R., Ederer, F., & Bond, J. H. (1999). Colorectal cancer mortality: effectiveness of biennial screening for fecal occult blood. *J Natl Cancer Inst, 91*(5), 434-437.

Miutescu, B., Sporea, I., Popescu, A., Bota, S., Iovanescu, D., Burlea, A., . . . Miutescu, E. (2013). Effectiveness of the immunochemical fecal test (FIT) for detection of advanced adenomas in colorectal carcinoma screening in an asymptomatic population. *Rev Med Chir Soc Med Nat Iasi, 117*(2), 302-307.

Murphy, G., Devesa, S. S., Cross, A. J., Inskip, P. D., McGlynn, K. A., & Cook, M. B. (2011). Sex disparities in colorectal cancer incidence by anatomic subsite, race and age. *Int J Cancer, 128*(7), 1668-1675. doi: 10.1002/ijc.25481

NCI. (2012). National Cancer Institute: Cancer Trends Progress Report 2011-2012. . Retrieved February 10, 2015, from http//progressreport.cancer.gov/doc.asp?

Nishihara, R., Wu, K., Lochhead, P., Morikawa, T., Liao, X., Qian, Z. R., . . . Chan, A. T. (2013). Long-term colorectal-cancer incidence and mortality after lower endoscopy. *N Engl J Med, 369*(12), 1095-1105. doi: 10.1056/NEJMoa1301969

O'Keefe, S. J., Ou, J., Aufreiter, S., O'Connor, D., Sharma, S., Sepulveda, J., . . . Mawhinney, T. (2009). Products of the colonic microbiota mediate the effects of diet on colon cancer risk. *J Nutr, 139*(11), 2044-2048. doi: 10.3945/jn.109.104380

Palmer, R. C., Chhabra, D., & McKinney, S. (2011). Colorectal cancer screening adherence in African-American men and women 50 years of age and older living in Maryland. *J Community Health, 36*(4), 517-524. doi: 10.1007/s10900-010-9336-4

Palmer, R. C., Midgette, L. A., & Dankwa, I. (2008). Colorectal cancer screening and African Americans: findings from a qualitative study. *Cancer Control, 15*(1), 72-79.

Palmer, R. C., Midgette, L. A., & Mullan, I. D. (2010). Colorectal cancer screening preferences among African Americans: which screening test is preferred? *J Cancer Educ, 25*(4), 577-581. doi: 10.1007/s13187-010-0081-2

Patterson, R. E., White, E., Kristal, A. R., Neuhouser, M. L., & Potter, J. D. (1997). Vitamin supplements and cancer risk: the epidemiologic evidence. *Cancer Causes Control, 8*(5), 786-802.

Pignone, M., Rich, M., Teutsch, S. M., Berg, A. O., & Lohr, K. N. (2002). Screening for colorectal cancer in adults at average risk: a summary of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med, 137*(2), 132-141.

Polite, B. N., Dignam, J. J., & Olopade, O. I. (2006). Colorectal cancer model of health disparities: understanding mortality differences in minority populations. *J Clin Oncol, 24*(14), 2179-2187. doi: 10.1200/jco.2005.05.4775

Rex, D. K., Johnson, D. A., Anderson, J. C., Schoenfeld, P. S., Burke, C. A., & Inadomi, J. M. (2009). American College of Gastroenterology guidelines for colorectal cancer screening 2009 [corrected]. *Am J Gastroenterol, 104*(3), 739-750. doi: 10.1038/ajg.2009.104

Rise, LA, Eisner, MP, & Kosary, CL. (2003). *SEER cancer statistic review 1975-2000*. Bethesda, MD: National Cancer Institute.

Satia-Abouta, J., Galanko, J. A., Martin, C. F., Potter, J. D., Ammerman, A., & Sandler, R. S. (2003). Associations of micronutrients with colon cancer risk in African Americans and whites: results from the North Carolina Colon Cancer Study. *Cancer Epidemiol Biomarkers Prev, 12*(8), 747-754.

Schoen, R. E., Pinsky, P. F., Weissfeld, J. L., Yokochi, L. A., Church, T., Laiyemo, A. O., . . . Berg, C. D. (2012). Colorectal-cancer incidence and mortality with screening flexible sigmoidoscopy. *N Engl J Med, 366*(25), 2345-2357. doi: 10.1056/NEJMoa1114635

Segnan, N., Armaroli, P., Bonelli, L., Risio, M., Sciallero, S., Zappa, M., . . . Senore, C. (2011). Once-only sigmoidoscopy in colorectal cancer screening: follow-up findings of the Italian Randomized Controlled Trial--SCORE. *J Natl Cancer Inst, 103*(17), 1310-1322. doi: 10.1093/jnci/djr284

Shapiro, J. A., Seeff, L. C., Thompson, T. D., Nadel, M. R., Klabunde, C. N., & Vernon, S. W. (2008). Colorectal cancer test use from the 2005 National Health Interview Survey. *Cancer Epidemiol Biomarkers Prev, 17*(7), 1623-1630. doi: 10.1158/1055-9965.epi-07-2838

Shaukat, A., Mongin, S. J., Geisser, M. S., Lederle, F. A., Bond, J. H., Mandel, J. S., & Church, T. R. (2013). Long-term mortality after screening for colorectal cancer. *N Engl J Med, 369*(12), 1106-1114. doi: 10.1056/NEJMoa1300720

Siegel, R., Desantis, C., & Jemal, A. (2014). Colorectal cancer statistics, 2014. *CA Cancer J Clin, 64*(2), 104-117. doi: 10.3322/caac.21220

Smedley, BD, Stith, AY, & Nelson, AR. (2003). Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care. In I. o. Medicine (Ed.). Washington, DC.

Sondik, E. J., Huang, D. T., Klein, R. J., & Satcher, D. (2010). Progress toward the healthy people 2010 goals and objectives. *Annu Rev Public Health, 31*, 271-281 274 p folliwng 281. doi: 10.1146/annurev.publhealth.012809.103613

Soneji, S., Iyer, S. S., Armstrong, K., & Asch, D. A. (2010). Racial disparities in stage-specific colorectal cancer mortality: 1960-2005. *Am J Public Health, 100*(10), 1912-1916. doi: 10.2105/ajph.2009.184192

Tammana, V. S., & Laiyemo, A. O. (2014). Colorectal cancer disparities: issues, controversies and solutions. *World J Gastroenterol, 20*(4), 869-876. doi: 10.3748/wjg.v20.i4.869

Trivedi, A. N., Nsa, W., Hausmann, L. R., Lee, J. S., Ma, A., Bratzler, D. W., . . . Fine, M. J. (2014). Quality and equity of care in U.S. hospitals. *N Engl J Med, 371*(24), 2298-2308. doi: 10.1056/NEJMsa1405003

USCSWG. (2014). U.S. Cancer Statistics Working Group. United States Cancer Statistics: 1999–2011 Incidence and Mortality Web-based Report. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention and National Cancer Institute.

USPSTF. (2008). Screening for colorectal cancer: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med, 149*(9), 627-637.

Virani, S. S., Woodard, L. D., Ramsey, D. J., Urech, T. H., Akeroyd, J. M., Shah, T., . . . Petersen, L. A. (2015). Gender disparities in evidence-based statin therapy in patients with cardiovascular disease. *Am J Cardiol, 115*(1), 21-26. doi: 10.1016/j.amjcard.2014.09.041

Wallace, K., Sterba, K. R., Gore, E., Lewin, D. N., Ford, M. E., Thomas, M. B., & Alberg, A. J. (2013). Prognostic factors in relation to racial disparity in advanced colorectal cancer survival. *Clin Colorectal Cancer, 12*(4), 287-293. doi: 10.1016/j.clcc.2013.08.001

Whitlock, E. P., Lin, J. S., Liles, E., Beil, T. L., & Fu, R. (2008). Screening for colorectal cancer: a targeted, updated systematic review for the U.S. Preventive Services Task Force. *Ann Intern Med, 149*(9), 638-658.

Wilkins, T., Gillies, R. A., Harbuck, S., Garren, J., Looney, S. W., & Schade, R. R. (2012). Racial disparities and barriers to colorectal cancer screening in rural areas. *J Am Board Fam Med, 25*(3), 308-317. doi: 10.3122/jabfm.2012.03.100307

Willett, W. C., Stampfer, M. J., Colditz, G. A., Rosner, B. A., & Speizer, F. E. (1990). Relation of meat, fat, and fiber intake to the risk of colon cancer in a prospective study among women. *N Engl J Med, 323*(24), 1664-1672. doi: 10.1056/nejm199012133232404

Yancey, AK, Bastani, R, & Glenn, BA. (2013). Racial and Ethnic disparities in health status. In: Andersen RM, Rice TH, Kominski GF, Afifi AA, editors. Changing the US health care system: key issues in health services policy and management. 4th edition. San Francisco: Jossey-Bass;.

Zapka, J. G., Taplin, S. H., Solberg, L. I., & Manos, M. M. (2003). A framework for improving the quality of cancer care: the case of breast and cervical cancer screening. *Cancer Epidemiol Biomarkers Prev, 12*(1), 4-13.

Chapter 2:

Long-term Black-White Disparity Trends in Colorectal Cancer Incidence and Stage at Presentation in the United States

2.1 Abstract

Introduction: Black Americans face considerable burden of disease from colorectal cancer (CRC). Cross-sectional data have repeatedly shown that blacks are more likely to be diagnosed with CRC than whites and to present at late stages of disease. Incidence and stage at diagnosis are important CRC indicators that reflect the impact of CRC on the United States (U.S.) population and may reflect the efforts over the past several decades to improve CRC prevention through screening. As little is known about black-white differences in these two indicators over time, the purpose of this study was to evaluate trends in black-white disparities in CRC incidence and stage at diagnosis in the U.S. over the past four decades.

Methods: We used data from the Surveillance, Epidemiology, & End Results (SEER) program, a large national cancer database, to identify whites and blacks with histologically confirmed CRC from January 1, 1975 through December 31, 2011 in the U.S. We calculated annual age-adjusted CRC incidence rates for whites and blacks and the proportion of CRC cases presenting in late stages in each racial group for each year. We determined significant changes in trends for incidence and late stage for each racial group, the annual percent change (APC) for each trend period, the average annual percentage change (AAPC) for each SEER study period, and the absolute difference ("disparity") between whites and blacks in incidence for each SEER year. Statistical tests were then performed to compare trends in white and blacks and to determine

statistically significant changes in disparities from 1975 to 2011.

Results: The overall incidence of CRC decreased significantly for whites (AAPC=-1.33, $p<0.001$) and marginally for blacks (AAPC=-0.4, $p=0.05$) from 1975 to 2011. While the disparity in CRC incidence increased from 1986 to 2004 (APC=5.71, $p<0.001$), it declined significantly each year from 2004 to 2011 (APC=-4.20, $p=0.04$). Despite the recent decline in the incidence disparity, CRC incidence was higher in blacks than in whites in 2011. Late stage cancers decreased by an AAPC of -0.31 ($p=0.02$) in whites and by -0.44 ($p<0.001$) in blacks over the study period. The proportion of blacks presenting with late stage CRC exceeded the proportion of whites with late stage disease from 1975 to 2010. In 2010 and 2011, the proportion of cases presenting in late stage was similar in both groups. The results support a stable to improving disparity in incidence and a dramatic improvement in the black-white disparity in stage at presentation since 1975.

Conclusion: Despite well-recognized black-white disparities in CRC incidence and outcomes in the U.S., inequities in CRC incidence and stage at presentation have narrowed significantly over the past four decades. The incidence of CRC, while still higher in blacks, has been decreasing at similar rates in both racial groups over the past eleven years. In addition, the large black-white disparity in the proportion of CRCs presenting in late stages appears to have resolved. While both are notable achievements, a CRC incidence gap persists. Public health interventions to date are necessary but not sufficient to accelerate progress and eliminate CRC inequities.

2.2 Introduction

The overall burden of colorectal cancer (CRC) in the United States (U.S.) has improved substantially over the past several decades. CRC incidence has dropped from 60 per 100,000 men and women in 1975 to 39 per 100,000 in 2011 (ACS, 2014; Chu, Tarone, Chow, Hankey, & Ries, 1994; Howlader, Noone, & Krapcho, 2011). Likewise, mortality has decreased from 28 to 15 per 100,000 Americans over the same period (Howlader et al., 2011). While CRC remains the third most common type of malignancy, these improvements are notable and are attributed to an emphasis on primary and secondary CRC prevention and the implementation of screening programs to detect premalignant and early stage malignant lesions (ACS, 2014; Nelson, Persky, & Turyk, 1999).

Despite overall improvements in the incidence of and mortality from CRC in the U.S., there are broad inequities in CRC incidence and outcomes between white Americans and black Americans (ACS, 2014; Chu, Tarone, Chow, & Alexander, 1995; Chu et al., 1994; Henschke et al., 1973; Irby, Anderson, Henson, & Devesa, 2006; NCI, 2012; Nelson et al., 1999; Siegel et al., 2012). Incidence of CRC in blacks has exceeded incidence in whites since the mid-1980s (ACS, 2014). In addition, late stage at diagnosis, an important indicator for CRC outcomes, also varies by race. Blacks are more likely to be diagnosed with CRC at advanced stages than whites, limiting options for treatment and promoting poor survival and mortality outcomes (ACS, 2014; Mehrkhani, Nasiri, Donboli, Meysamie, & Hedayat, 2009; Rex et al., 2009; Siegel, Desantis, & Jemal, 2014).

Many have attributed these disparities to a genetic predisposition to CRC, a high prevalence of CRC risk factors, and inequities in access to preventive healthcare among blacks (Agrawal et al., 2005; Ashktorab et al., 2009; Berkowitz, Hawkins, Peipins, White, & Nadel,

2008; Bolen, Rhodes, Powell-Griner, Bland, & Holtzman, 2000; Dimou, Syrigos, & Saif, 2009; Ford, 1999; Huxley et al., 2009; James, Daley, & Greiner, 2011; NCI, 2012; O'Keefe et al., 2009; Palmer, Chhabra, & McKinney, 2011; Palmer, Midgette, & Dankwa, 2008; Palmer, Midgette, & Mullan, 2010; Patterson, White, Kristal, Neuhouser, & Potter, 1997; Satia-Abouta et al., 2003; Tammana & Laiyemo, 2014; Willett, Stampfer, Colditz, Rosner, & Speizer, 1990). Race-based differences have led to a myriad of targeted efforts to improve CRC screening uptake and outcomes in black Americans. While the Centers for Disease Control (CDC) National Program of Cancer Registries (NPCR) data suggest decreasing rates of age-adjusted incidence in blacks from 1999 to 2011, we know little about long-term changes in black-white disparities over time (CDC, 2014)[1].

The aim of this paper is to examine trends in black-white disparities in CRC incidence and stage at diagnosis in the U.S. from 1975 to 2011. Both of these CRC indicators are amenable to clinical and public health intervention, and thus, provide insight into the impact of screening guidelines, national insurance policy changes, and other historic events on disparities in CRC outcomes. We describe trends in CRC incidence and stage at diagnosis from 1975 to 2011, calculate the disparity (difference) for incidence for each year, and perform statistical tests to determine statistically significant changes in trends for each racial group and in the disparity between groups. An understanding of how inequities in CRC incidence and stage at diagnosis have changed over time is critical. As we seek to develop the most effective interventions to address poor CRC outcomes in blacks, knowledge about how disparities have responded to previous national events will inform research, implementation strategy, and policy to address

[1] NPCR is a nationally representative cancer registry that covers approximately 91-99% of the U.S. population from 1999 to 2011 (CDC, 2014).

inequities in CRC outcomes.

2.3 Methods

2.3.1 Data Source

We used the Surveillance, Epidemiology, & End Results (SEER) database to determine CRC incidence and stage at diagnosis in whites and blacks from 1975 to 2011. SEER is a publicly available database made accessible by the National Cancer Institute (NCI) (NCI, 2012). The database includes information from various cancer registries throughout the U.S. and links these data to information from the Social Security Administration, state vital records departments, National Death Index, and Centers for Medicare & Medicaid Services (NCI, 2014b). SEER is the only national source of population-based data on cancer stage at diagnosis and survival.

The SEER database began with nine regional cancer registries in 1973 and currently includes data from eighteen registries (**Table 2.1**). These first nine regions constitute the SEER 9 database which consist of data from 1975 to 2011 and represents 9.4% of the U.S. population (NCI, 2014b)[2]. SEER 13 includes data from 1992 to 2011 from thirteen regions and covers 13.4% of the U.S. population. SEER 18 has the largest geographic coverage with eighteen regions covering 27.8% of the U.S. population from the years 2000 to 2011 (NCI, 2014b)[3].

2.3.2 Study Period

[2] SEER 9 includes data from 1973 to 2011. However, the convention is to use years 1975-2011 so that cases from Atlanta (added in 1974) and Seattle-Puget Sound (added in 1975) are included.

[3] SEER 13 and 18 include the Alaska Native tumor registry. This registry contains data for only the American Indian/Alaska Native population within Alaska. Thus, as is the NCI convention for studies that compare only blacks and whites, the Alaska Native tumor registry was excluded from SEER 13 and SEER 18. In the present analyses, SEER 13 and 18, in actuality, have twelve and seventeen registries, respectively.

Use of three SEER program databases allowed us to examine both long-term and recent black-white disparity trends. While SEER 9 allowed us to study disparity trends over the full spectrum of SEER program years, it is limited in its inclusion of only nine U.S. regions. SEER 13 and 18, on the other hand, provide only recent trends and limit the ability to draw inferences about changes in disparities over long periods of time. A major benefit of these more recent databases, however, is that they include a greater number of U.S. regions and, thus, provide a cohort of individuals more representative of the U.S. population.

In order to account for differences in the number of registries included, maximize the use of SEER data, and examine long-term disparity trends, we conducted three sets of analyses: 1) trends in CRC indicators from 1975 to 2011 using only those registries included in SEER 9; 2) trends in CRC indicators from 1992 to 2011 using the thirteen regions in SEER 13; and 3) trends in CRC indicators from 2000 to 2011 using the eighteen SEER 18 regions. We present separate results from each set of analyses and compare interpretations of the SEER 9, SEER 13, and SEER 18 results.

2.3.3 Study Population

The study cohort includes individuals in the SEER program database with histologically confirmed colon or rectal cancer diagnosed between January 1, 1975 and December 31, 2011. Colorectal cancer is defined as a primary malignancy in at least one of the following locations: rectum, rectosigmoid junction, sigmoid colon, descending colon, splenic flexure, transverse colon, hepatic flexure, ascending colon, or cecum, as classified by the *International Classification of Diseases for Oncology*, 3RD edition (Fritz et al., 2000).

The SEER 9 database provides the following classifications for race: white, black, other

(American Indian/Alaska native, Asian/pacific islander) and unknown and does not specify Hispanic ethnicity. Thus, while analyses were limited to U.S. blacks and whites, the "white" cohort included both whites and white Hispanics and the "black" cohort included both blacks and black Hispanics. This is a limitation of all analyses that use the SEER 9 program database (NCI, 2014b).

The SEER population is comparable to the U.S. population with respect to income level (14.1% v. 14.3% below poverty level) and level of education (16% v. 14.6% with less than high school diploma) (NCI, 2012). Minority racial and ethnic groups, foreign-born, and urban populations are purposely overrepresented in the SEER database to ensure adequate representation of groups that are of special interest to the SEER program (**Table 2.1**) (IOM, 1999; NCI, 2014b).

2.3.4 Colorectal Cancer Indicators

This study evaluates trends in two CRC indicators over time: incidence and stage at diagnosis. For incidence, we used age-adjusted CRC incidence rates by race expressed per 100,000 persons as provided in the SEER*Stat software version 8.1.5 (NCI, 2014c). The population data used in calculating SEER cancer rates are obtained from the Census Bureau and are based on the 2000 U.S. standard population (NCI, 2014b).

Two categories were used for stage at disease presentation: 1) "early stage" and 2) "late stage." Categories were based on SEER Historic Stage A, which has the advantage of being the only stage variable in the SEER dataset that has been recorded consistently for all years for CRC. In the case of CRC, localized disease is invasive but confined to the colon/rectum or with intraluminal extension but no lymph node involvement. Regional disease extends beyond the

colon/rectum directly into surrounding tissue or organs and/or into regional lymph nodes by way of the lymphatic system. Distant colon/rectal cancer has extended to parts of the body remote to the colon/rectum by direct extension or metastasis. Individuals with localized disease at the time of diagnosis were categorized as "early stage" presentations. Those presenting with CRC in regional or distant stages were categorized as "late stage" presentations. We excluded patients in the unstaged disease category.

2.3.5 Statistical Analyses

All analyses were performed using three statistical software programs: 1) SEER*Stat 8.1.5, 2) the Health Disparities Calculator (HD*Calc 1.2.4), and 3) Joinpoint 4.1.1.3 (NCI, 2013, 2014a, 2014c, 2014d, 2014e). All three statistical packages are produced by the Surveillance Research Program of the Division of Cancer Control and Population Sciences at NCI and are recommended by the NCI for analysis of SEER program data (NCI, 2014b).

2.3.5.1 SEER*Stat

SEER*Stat is a query-based program that allows users to specify a patient cohort within the SEER program database for which to report cancer indicators (SEER, 2014). SEER*Stat capabilities include frequencies, incidence rates, mortality rates, trends, and survival statistics with standard errors.

2.3.5.2 The Health Disparities Calculator (HD*Calc)

The Health Disparities Calculator (HD*Calc) program is an extension of SEER*Stat that allows researchers to import SEER data and calculate several disparity measures for cancer

indicators of interest (NCI, 2013). We defined "disparity" as the range difference (RD) or absolute difference between two health status indicators:

RD= $r_1 - r_2$ where r_1 and r_2 are the rates for the health indicator in the two groups compared—white and blacks in the present study.

HD*Calc also provides range ratios (RR) as a measure of relative disparity:

RR= r_1/r_2 where r_2 is the reference group—whites in the present study.

At each time point, the RR represents the relative difference in indicator rates between whites and blacks. RRs are useful in interpreting disparities as they express the difference in rates in the two compared groups multiplicatively. We used HD*Calc to calculate the RD and RR comparing CRC incidence in whites and blacks.

2.3.5.3 Joinpoint

Joinpoint is a statistical software package that can assess SEER program data for linear trends and test whether a change in trend is statistically significant (NCI, 2014a). For a given set of data, a sequence of permutation tests determine the optimal number of points in time in which the trend changes in direction and/or magnitude. The slope of the line segment between joinpoints is the annual percent change (APC) and represents the change in rate over a one-year period for that segment of the data. The average annual percent change (AAPC) is the weighted average of APCs where weights are proportional to the length of the each APC interval; it provides a single value to describe the change in trend over the entire SEER study period (Clegg, Hankey, Tiwari, Feuer, & Edwards, 2009). For both APC and AAPC, a p-value less than 0.05 signifies that the change (in APC or AAPC) is significantly different from zero.

We used Joinpoint for four purposes in this study: 1) to determine significant trends in

incidence and proportion of late stage presentations for whites and for blacks over each SEER study period; 2) to evaluate for trends in the disparity in incidence as calculated from HD*Calc; 3) to perform comparability tests to examine whether joinpoint trends whose mean functions are represented by joinpoint regression were statistically identical in the white and black cohorts ($p<0.05$ signifies significantly different trends); and 4) to test the null hypothesis that two regression mean functions were parallel ($p<0.05$ signifies non-parallel trends).

2.4 Results

2.4.1 Colorectal Cancer Incidence by SEER Database, Race and Stage

2.4.1.1 SEER 9

From 1975 to 2011, the incidence of CRC in whites and blacks was 55.1 per 100,000 and 60.6 per 100,000, respectively (**Table 2.2**). These rates amounted to 389,114 cases of CRC in whites and 40,157 cases in blacks. In whites, 59% of cases had late stage CRC at the time of presentation. For blacks, 62% presented with late stage over the SEER 9 study period. For stage at diagnosis analyses, we excluded 27,952 (6.5%) individuals with unstaged disease in SEER 9.

2.4.1.2 SEER 13

The incidence of CRC was 49.1 per 100,000 in whites and 59.7 per 100,000 in blacks in the thirteen SEER regions from 1992 to 2011. In all, 57% of whites and 60% of blacks in SEER 13 presented with late stage disease (**Table 2.3**). For trends in stage at diagnosis, we excluded 18,376 (5.7%) individuals with no stage for disease in the SEER 13 database.

2.4.1.3 SEER 18

In the eighteen regions that comprise the SEER 18 database, incidence was 47.2 per 100,000 in whites and 58.0 per 100,000 in blacks from 2000 to 2011. In all, 56% of whites and 59% blacks were diagnosed with late stage disease at presentation over the study period (**Table 2.4**). For stage at diagnosis analyses, we excluded 24,478 (5.8%) SEER 18 cases.

2.4.2 Black-White Disparities in Colorectal Cancer Incidence

2.4.2.1 Long-term Incidence Trends in U.S. Whites and Blacks

Figure 2.1 depicts CRC incidence in white Americans and black Americans in the nine SEER 9 regions from 1975 to 2011. The results for significant linear trends are presented in **Figure 2.2** and **Table 2.5**. When investigating CRC incidence over the entire range of SEER data, we observed that CRC incidence in whites exceeded incidence in blacks when data collection began in 1975. Both racial groups had similar incidence rates in the early 1980s before rates in blacks exceeded rates in whites in 1987. Whites experienced a significant increase in CRC incidence from 1975 to 1985 (APC=0.79, $p<0.001$) before experiencing declining rates at an APC of -1.98 ($p<0.001$) in 1985 (**Table 2.5**). Rates for whites declined steadily from 1985 to 1995 (APC= -1.98, $p<0.001$), from 1998 to 2008 (APC= -2.50; $p<0.001$) and more dramatically from 2008 to 2011 (APC= -5.06; $p<0.001$).

Incidence in blacks in the SEER 9 regions, on the other hand, climbed at a rate higher than in whites from 1975 to 1980 (APC= 3.30, $p=0.01$) and then remained stable over a prolonged period from 1980 to 2004 (APC= -0.17, $p=0.08$). Blacks did not see improvements in CRC incidence until twenty years after whites in 2004 (APC of -7.71, $p<0.001$). From 2004 onward, the incidence gap between whites and blacks narrowed. Despite this steep incidence

decrease in blacks from 2004 to 2011, incidence in blacks remained higher than incidence in whites at the end of the study period in 2011 (46.8 per 100,000 in blacks versus 38.1 per 100,0000 in whites).

For whites, the AAPC for the 1975 to 2011 study period was -1.33 ($p<0.001$) (**Table 2.5**). For blacks, however, the AAPC was smaller in magnitude and only marginally significant at -0.41 ($p=0.05$). Consequently, the comparability test and test for parallelism for incidence trends from 1975 to 2011 revealed that the incidence trends in whites and blacks were not statistically similar when directly compared across the entire study period ($p<0.001$). In addition, the test for parallelism rejected the null hypothesis that the two lines were parallel when directly compared across the entire study period ($p<0.001$).

Of note, when the trend analysis for SEER 9 is limited to the last eleven years of data (2000-2011), the AAPC in whites is not significantly different than the AAPC in blacks ($p=0.06$). This finding suggests that while the trend in whites is not similar to the trend in blacks in the SEER 9 regions over the entire study period, there is a similar downward trend in the two groups when looking at only the past eleven years.

2.4.2.2 Recent Incidence Trends in U.S. Whites and Blacks

We next investigated incidence trends in SEER 13 and 18, databases that sample larger proportions of the U.S. population and more geographic regions. The findings from these analyses also suggest notable improvements in CRC incidence in both racial groups in recent years (**Figures 2.3 & 2.4; Tables 2.6 & 2.7**). From 1992 to 2011 in the SEER 13 regions, CRC incidence in whites decreased at an AAPC of -2.10 ($p<0.001$), compared to an AAPC of -1.56 ($p<0.001$) for blacks. For one particular segment in the SEER 13 data (2009 to 2011), the black

cohort experienced a steeper decline in incidence than whites experienced in the same period (APC, blacks= -6.98, $p<0.001$ v. APC, whites= -4.79, $p<0.001$). Overall, white and black trends were not significantly different ($p=0.18$) but were not parallel ($p<0.001$) from 1992 to 2011.

For the larger SEER 18 sample, the AAPCs for whites and blacks were quite similar from 2000 to 2011: -2.94 ($p<0.001$) and -2.41 ($p<0.001$), respectively (**Table 2.7**). The downward trends in incidence in whites and in blacks were not statistically different ($p=0.12$), but were also not parallel ($p=0.02$). These finding are consistent with the results from the SEER 9 limited range data that demonstrated statistically similar incidence trends in blacks and whites for the last eleven years of the SEER 9 study period (**Table 2.5**). Overall, all three series support that while incidence in blacks exceeded incidence in whites overall, both racial groups saw improvements in CRC incidence at similar rates over the past eleven years.

2.4.2.3 The Colorectal Cancer Incidence Disparity Over Time

After evaluating the SEER program data for significant trends in incidence across the study period, we examined the absolute difference between incidence rates in whites and blacks and how that disparity changed over time. **Figure 2.5** shows the RD and RR for white and black incidence of CRC from 1975 to 2011 as calculated from the SEER 9 database. **Figure 2.6** is the joinpoint graph demonstrating significant changes in the disparity trend over the same period.

As shown in **Figure 2.6**, the disparity remained statistically stable from 1975 to 1983 (APC= -5.96, $p=0.39$). During this period, incidence rates in blacks were increasing and then exceeded rates in whites (**Figure 2.1**). Thus, the downward slope in the incidence disparity graph from 1975 to 1983 (**Figure 2.6**) demonstrates the crossover from higher CRC rates in whites to higher rates in blacks rather than improving disparities. In the early 1980s, when whites had a

higher incidence than blacks, the incidence disparity was least (RD= 2.12; 95% CI=6.97- -2.72) (**Table 2.8**). Due to the dramatic decrease in incidence in whites, thereafter, the disparity then increased significantly from 1983 to 2004 (APC= 5.7; $p<0.01$). The year 2004 marked the maximal difference in incidence in whites and blacks in the SEER 9 regions: RD=13.08 (95% CI=16.58 – 9.58). In that year, the rate ratio was 1.27 (95% CI=1.20-1.34), suggesting that incidence in whites was 1.27 times or 27% higher than the incidence in blacks. Since 2004, the incidence disparity has been significantly improving (APC= -4.20, p=0.04).

Data from the larger SEER 13 and SEER 18 samples led to somewhat different conclusions about the recent incidence disparity trend. (**Figures 2.7 & 2.8; Tables 2.9 & 2.10**). Like SEER 9, data from SEER 13 demonstrated a significant increase in the incidence disparity from 1992 to 2004 (APC= 5.02, $p<0.001$). However, the downward disparity trend from 2004 to 2011 was only marginally significant in SEER 13 (APC= -3.36, p=0.05) (**Table 2.9**). For SEER 18, results suggest a stable disparity in CRC incidence between whites and blacks from 2000 to 2011 rather than the significant or marginally significant decline seen in the SEER 9 and SEER 13 data (**Table 2.10**).

2.4.3 Black-White Trends in Late Stage at Colorectal Cancer Presentation

2.4.3.1 Long-term Trends in Late Stage at Presentation in U.S. Whites and Blacks

In the SEER 9 regions, the proportion of blacks presenting with late stage CRC was higher than the proportion of whites presenting with late stage disease in 1975. Blacks maintained a higher proportion of late stage disease throughout the SEER 9 study period with the exception of 2010 when whites had a higher proportion of late stage presenting disease than blacks (**Figure 2.9**). As demonstrated in the Joinpoint output (**Figure 2.10**), whites saw no

significant change in the proportion of late stage presenting tumors for several intervals. In fact, the proportion of whites presenting with late stage tumors was statistically stable in the SEER 9 population for all of the SEER 9 study period except years 1995 to 2003 when there was a significant downward trend in late stage presentation in whites (APC= -0.93, $p<0.001$). In blacks, on the other hand, there was a significant and steady decrease in late stage presentation over the entire SEER 9 study period (APC= -0.44; $p<0.001$) (**Table 2.11**). Consequently, the trends converge in the last two years of data, with the proportion of late stage presenting disease in blacks matching the proportion of whites with late stage disease.

Over the SEER 9 study period, the overall AAPC was -0.31 ($p=0.02$) in whites and -0.44 ($p<0.001$) in blacks. Despite the gradual merging of the trend lines, the trend in proportion of whites presenting with late stage CRC was not statistically different than the trend in blacks ($p=0.36$). The parallelism hypothesis was rejected (**Table 2.11**).

2.4.3.2 Recent Trends in Late Stage at Presentation in U.S. Whites and Blacks

The SEER 13 and 18 data offer similar findings for proportion of late stage CRC at diagnosis in larger samples of the U.S. population. From 1992 to 2011 (SEER 13), whites had non-uniform change in incidence of late stage presentation (**Figure 2.11**). While late presentation declined significantly from 2003 to 2011 in whites (APC -1.15, $p<0.001$), there was actually a rising proportion of late stage diagnoses in whites from 2008 to 2011 in the SEER 13 cohort (APC=1.10, $p=0.01$). This rise in late stage CRCs in whites is in contrast to a significant decline in blacks from 2003 to 2011 (APC= -1.15, $p<0.001$) (**Table 2.12**).

Data from the SEER 18 regions also support a significant downward trend in late stage CRC in blacks from 2000 to 2011 (APC -0.72, $p<0.001$) (**Figure 2.12**). In whites, the proportion

of late stage malignancies was relatively stable from 2000 to 2011 and, like in the SEER 13 data, rose from 2008 to 2011 (APC = 1.01, $p<0.001$). In the SEER 18 regions, there was a significant difference in the trends between whites and blacks from 2000 to 2011 ($p<0.001$), highlighting the changes leading to convergence of the two trend lines in 2010 (**Table 2.13**). This finding somewhat contrasts with the finding that the trend lines were not significantly different in the SEER 9 regions. However, when the SEER 9 is limited to the last eleven years, we again see consensus between the two databases; both suggest statistically different trends for whites and blacks in the last decade of data (**Table 2.11**).

2.5 Discussion

2.5.1 Summary of Key Findings

We found that despite well-documented black-white disparities in CRC incidence and a high proportion of late stage presenting CRCs among blacks, black-white disparities in CRC incidence and stage at diagnosis have narrowed since 1975. Long-term and recent data from the SEER program database support an overall significant decrease in CRC incidence in both racial groups since 1975 with a disproportionate downward trend in blacks compared to whites in recent years. Our findings are consistent with the improving incidence disparities seen in the 1999-2011 CDC NPCR data, however, expand on the CDC findings, as they also provide information on long-term trends that the CDC database is not capable of measuring (CDC, 2014). In addition to incidence, we found that disparities in late stage at diagnosis have improved substantially since 1975. In fact, data from all three SEER databases suggest that this gap has closed.

2.5.2 Historic Factors Influencing Incidence

The overall decline in CRC incidence in the past several years is likely a result of several factors, including lifestyle and risk modification, advances in medical technology, public awareness about CRC, and CRC prevention efforts. CRC is largely preventable with identification and removal of premalignant colonic polyps. However, primary prevention and incidence reduction require access to health information and healthcare services. Black-white disparities in incidence began to increase in the mid-1980s, after the introduction of CRC screening at the population level. Although use of endoscopy and other structural screening tests (double-contrast barium enema and computed tomography colonography) was low before 1985,

there were great disparities in access to healthcare services at the time and whites were more likely to have had access to endoscopy than blacks (Byrd, 1990; Hiatt, Klabunde, Breen, Swan, & Ballard-Barbash, 2002; McMahon et al., 1999; Waidmann & Rajan, 2000). Greater rates of identification and removal of colonic polyps in whites may have contributed to the significant decline in CRC incidence in whites compared to blacks in the mid-1980s.

Blacks did not see declines in incidence until 2004, which may reflect a lag in the use of colonoscopy and flexible sigmoidoscopy to identify precancerous lesions in the racial group (ACS, 2014; Edwards et al., 2010; Irby et al., 2006). As black Americans gained improved access to healthcare services and as interventions and policies to improve CRC prevention in the underserved emerged, there was likely a diffusion of technology and information to minority communities. Over time, increased CRC education and use of endoscopy may have contributed to the reduction in incidence blacks saw in the early 2000s and, thus, to the decrease in the incidence disparity.

Public awareness about CRC risk may have also played a role in the overall reduction of CRC incidence and disparities in incidence. There was increased public awareness of CRC following President Ronald Reagan's diagnosis in July 1985. Further, the formal introduction of CRC screening guidelines and provisions to include CRC screening as a Medicare benefit in the late 1990s placed a public spotlight on CRC prevention. The televised broadcast of Katie Couric's colonoscopy in 2000 also influenced CRC risk awareness and education. Often referred to at the "Katie Couric Effect," this event was associated with a significant increase in colonoscopy (Cram et al., 2003; He & Efron, 2011). These events likely impacted both whites and blacks but may have had more influence on white Americans in the 1980s to early 2000s,

thus contributing to the persistent disparities in CRC incidence in the years that followed (James et al., 2011).

2.5.3 Historic Factors Influencing Stage at Presentation

The proportion of both whites and blacks presenting with late stage CRC has improved over time. In blacks, this improvement has been more notable than in whites, to the effect that the proportion of whites and blacks presenting with late stage CRC were comparable in 2010 and 2011. While it is essential to see how these trends continue in the next several years, the implication is that blacks may have benefited disproportionately from collective CRC screening efforts in recent years.

Like incidence, trends in stage of CRC diagnosis may reflect key events in CRC prevention and detection. While CRC incidence is more directly influenced by radiographic and endoscopic procedures that identify colonic polyps before malignant transformation, stage of CRC diagnosis is also impacted by early detection CRC screening tests like fecal occult blood testing (FOBT), fecal immunochemical testing (FIT), and stool DNA (sDNA) (Fazio, Cotterchio, Manno, McLaughlin, & Gallinger, 2005). These less invasive screening examinations function mainly as early detection tools by identifying malignant colonic lesions before regional or distant spread (Fisher et al., 2004; Heinzerling, Anthony, Livingston, & Huerta, 2007; Mehrkhani et al., 2009; Tsikitis, Larson, Huebner, Lohse, & Thompson, 2014). While they are capable of detecting colonic adenomas before malignant transformation, they are limited in their ability to prevent disease incidence (Imperiale et al., 2014; Miutescu et al., 2013).

Blacks are more likely to pursue non-endoscopic CRC screening modalities that whites (McMahon et al., 1999; Zimmerman, Tabbarah, Trauth, Nowalk, & Ricci, 2006). Thus, strong

recommendations for CRC screening from the United States Preventive Service Task Force (USPSTF) in 2002, improvements in access to care over the past decade, public attention to disparities in CRC outcomes, and improving rates of CRC screening among blacks may be shifting the diagnosis of CRC to earlier stages in the disease continuum more so in blacks than in whites.

2.5.4 Study Strengths

There are several strengths to the present analysis. First, we used a large, national cancer registry database to determine trends in CRC indicators. The SEER program provides access to a large cohort of individuals with CRC, allowing for stratified analysis by race, year and stage. In addition, national data better reflect the influence of national programs and interventions to improve CRC outcomes. Second, we examined CRC indicator trends over a prolonged period of time. While there are examples in the literature of analyses of recent trends in CRC incidence and outcomes, the present study is innovative in that it explores data over four decades to comment on long-term black-white disparity trends and what might be driving them. Third, we performed analyses using three different SEER program datasets. Given the potential for bias resulting from differences in the SEER regions included, years covered, and sample size in each SEER database, the hope was to bolster the opportunity for meaningful results by examining trends for three somewhat different yet complementary databases.

2.5.5 Study Limitations

Our study is not without limitations. Given limitations in the definitions used for race and ethnicity in the SEER 9 program database, we included individuals of Hispanic race in our

analyses. While the inclusion of Hispanic subjects occurs in both the white and black subgroups, it is likely that there are more white Hispanics than black Hispanics in the study sample. Hispanics have a lower incidence but later stage at diagnosis than whites, and the inclusion of this subgroup in the white sample may have biased our results away from the null hypothesis that incidence trends do not vary and/or towards the null hypothesis that stage at presentation trends do not vary between whites and blacks. As a result, our results may overestimate incidence disparities and underestimate stage disparities between whites and blacks. These biases were likely larger in the SEER 13 and SEER 18 analysis, given the addition of regions with large numbers of Hispanics like Los Angeles and Greater California for those years. The inability to exclude individuals with Hispanic race is a limitation of studies reporting long-term trends with SEER program data as Hispanic persons may be of any race in the SEER 9 database.

A second limitation of our study is that while the SEER 9, SEER 13, and SEER 18 databases are subsets of each other, they contain different cancer registry regions and populations. Thus, results may not be consistent across registries, and we may be limited in our ability to directly compare results across databases. For example, data from the SEER 9 regions support a significantly improving incidence disparity from 2004 to 2011 while SEER 13 and 18 suggest a stable disparity during the same interval. As the SEER 13 and 18 databases include more U.S. regions, results from these databases may be more generalizable to the U.S. as a whole. It is not possible, however, to say this for certain. While inconsistencies in SEER year and registries pose hypothetical interpretation challenges, SEER is the best available source for long-term national data. It is reassuring that our findings were for the most part consistent and not at all contradictory across SEER databases.

Lastly, while we made several inferences about associations between key events in CRC

prevention and management, we were not able to demonstrate a causal effect of historic events on CRC outcomes. The present analyses do generate hypotheses for further quantitative evaluation of the impact of historical events on CRC outcomes. However, quantifying the effect of public attention to CRC, screening guidelines, and prevention policy requires alternative study methods.

2.5.6 Conclusions

In conclusion, our findings suggest that while inequities in CRC incidence and outcomes persist in the U.S., there is strong evidence for improvements in at least some CRC disparities over the past decade. In addition to genetic and environmental factors, CRC screening practices and other historical events have likely played a major role in the progression of CRC disparities over time in the U.S. Contrary to the body of literature demonstrating disparities at a cross-section of time, the present study suggests that longitudinal evaluation of CRC indicators points to at least some progress.

While recent improvements in CRC disparities are encouraging, our results do not suggest that the decades-long challenges of disparities in CRC have resolved. Efforts to improve CRC prevention and management may have halted the widening gap in CRC disparities; however, inequities in CRC incidence persist. The challenge now is to identify the factors that have been most effective in reducing disparities so that we can develop interventions that will continue to bend the incidence disparity curve. Despite the successes we have seen, disparities in CRC incidence will likely persist and CRC will continue to disproportionately affect black Americans unless there are more efforts to improve disease prevention.

2.6 Tables and Figures

Table 2.1: National Cancer Institute (NCI) Surveillance, Epidemiology, & End Results (SEER) registries and regions, 1975-2011 (NCI, 2014b)

Registry	Years	Regions	U.S. Population Represented (%)	% U.S. Whites Included*	% U.S. Blacks Included*
SEER 9^	1973 (1975) - 2011	Connecticut, Detroit, Hawaii, Iowa, New Mexico, San Francisco-Oakland, Utah, Atlanta (1974+), Seattle-Puget Sound (1975+)	9.4	8.7	8.8
SEER 13	1992 - 2011	Above + Los Angeles, San Jose-Monterey, Rural Georgia, Alaska Natives	13.4	11.5	11.3
SEER 18	2000 - 2011	Above + Greater California, Kentucky, Louisiana, New Jersey, Greater Georgia	27.8	24.9	25.6

^ SEER 9 includes data from 1973 to 2011. However, the convention is to use years 1975-2011 so that cases from Atlanta (added in 1974) and Seattle-Puget Sound (added in 1975) are included.

* Denotes percent of entire population of U.S. whites/blacks that are included in the database

Table 2.2: Colorectal cancer (CRC) incidence by race and stage; SEER 9 regions (1975-2011)

Incidence	Whites			Blacks			Total		
	N	Rate	SE	N	Rate	SE	N	Rate	SE
	389,114	55.05	0.09	40,157	60.63	0.31	429,271	55.65	0.09
Histologic Stage, N (%)									
Early	150,722 (41.40)			14,217 (38.20)			164,939 (41.10)		
Late	213,382 (58.60)			22,998 (61.80)			236,380 (58.90)		
Total	364,104			37,215			401,319		

Rates are per 100,000 and age-adjusted to the 2000 U.S. standard population

Table 2.3: CRC incidence by race and stage; SEER 13 regions (1992-2011)

Incidence	Whites			Blacks			Total		
	N	Rate	SE	N	Rate	SE	N	Rate	SE
	284,522	49.08	0.09	36,631	59.67	0.32	321,153	50.18	0.09
Histologic Stage, N (%)									
Early	115,190 (42.87)			13,636 (40.00)			128,826 (42.56)		
Late	153,504 (57.13)			20,447 (60.00)			173,951 (57.45)		
Total	268,694			34,083			302,777		

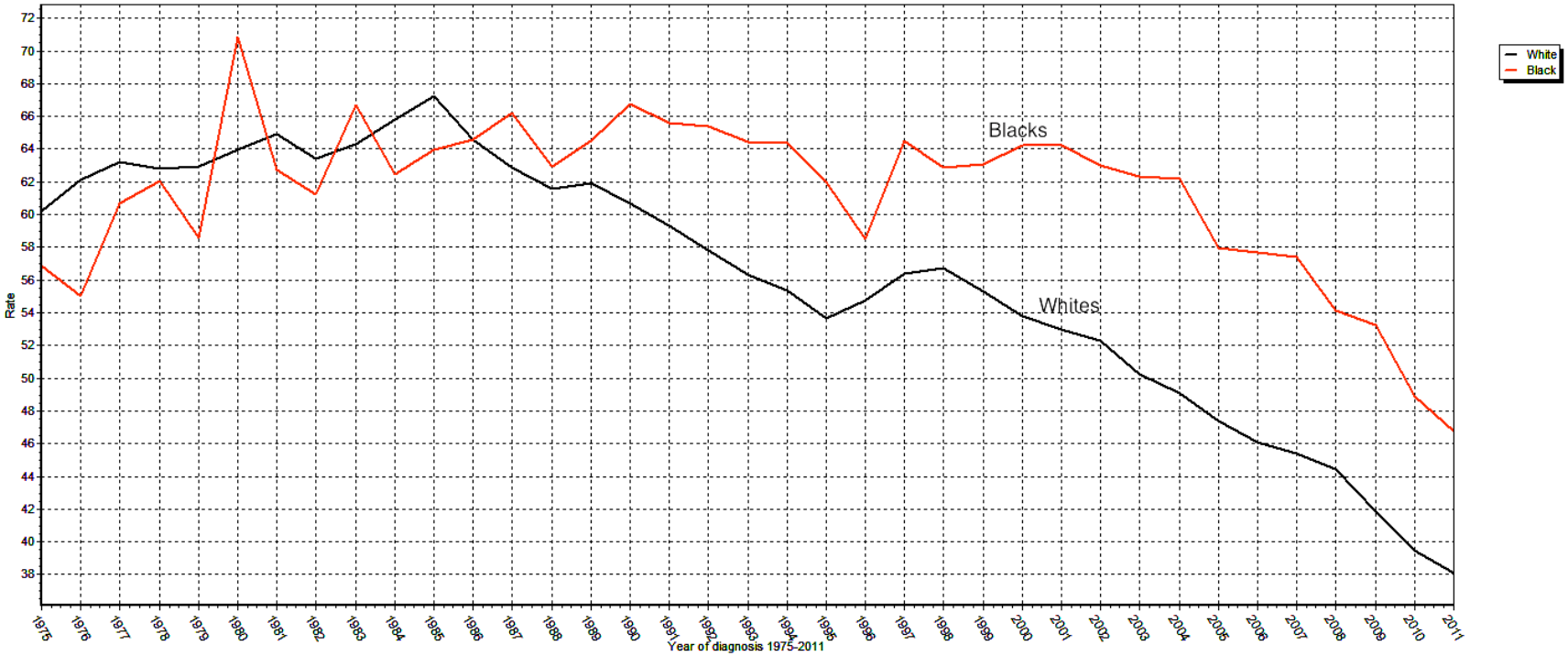
Rates are per 100,000 and age-adjusted to the 2000 U.S. standard population

Table 2.4: CRC incidence by race and stage; SEER 18 regions (2000-2011)

Incidence	Whites			Blacks			Total		
	N	**Rate**	**SE**	**N**	**Rate**	**SE**	**N**	**Rate**	**SE**
	372,043	47.18	0.08	52,045	58.00	0.26	424,088	48.35	0.07
Histologic Stage, N (%)									
Early	154,549 (44.02)			20,003 (41.23)			174,552 (43.68)		
Late	196,551 (56.00)			28,507 (58.77)			225,058 (56.32)		
Total	351,100			48,510			399,610		

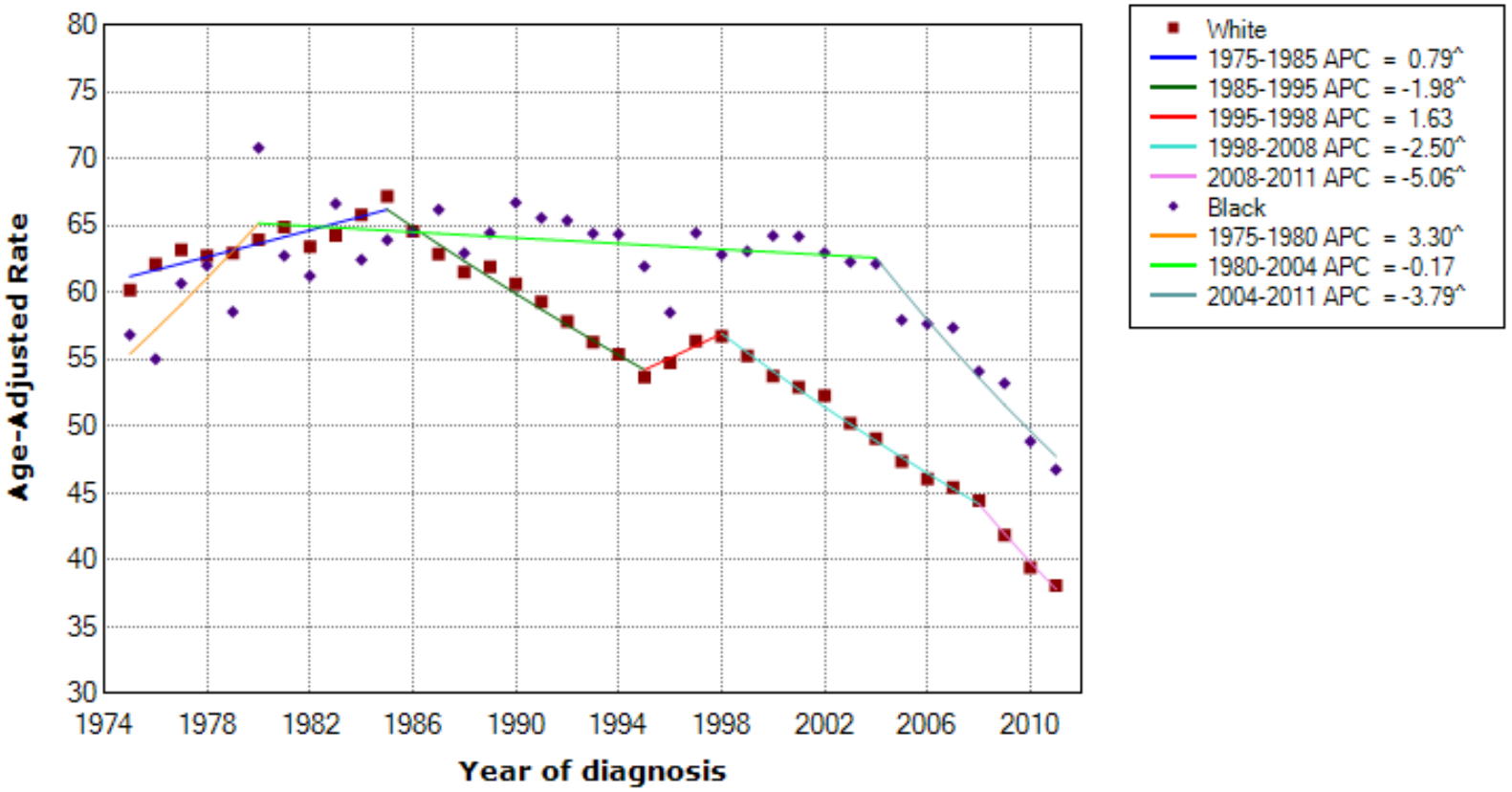
Rates are per 100,000 and age-adjusted to the 2000 U.S. standard populatio

Figure 2.1: Trends in CRC incidence in whites and blacks; SEER 9 regions (1975-2011)



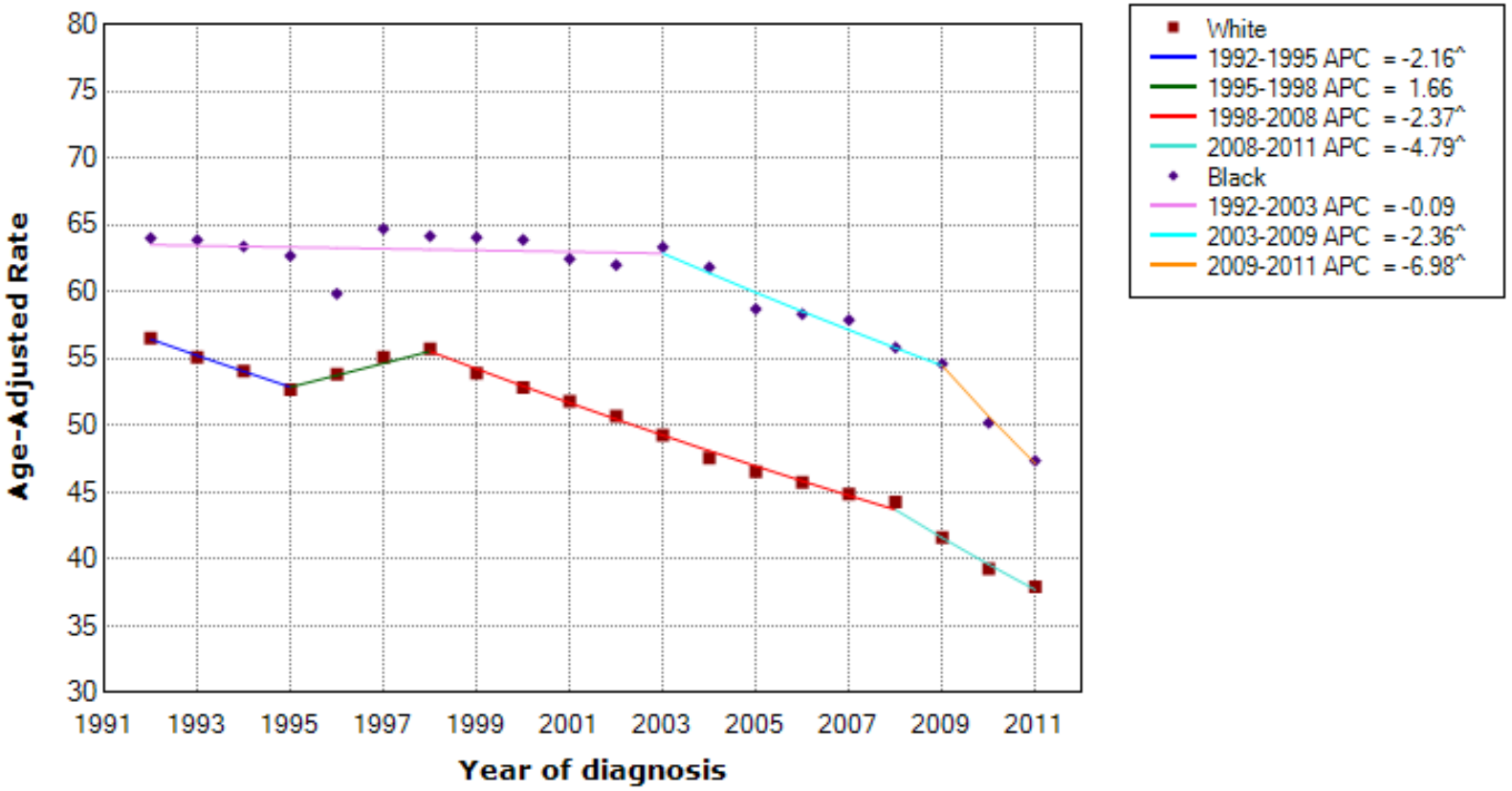
Rates are per 100,000 and age-adjusted to the 2000 U.S. standard population

Figure 2.2: Evaluation for significant linear trends in CRC incidence in whites and blacks, SEER 9 (1975-2011)



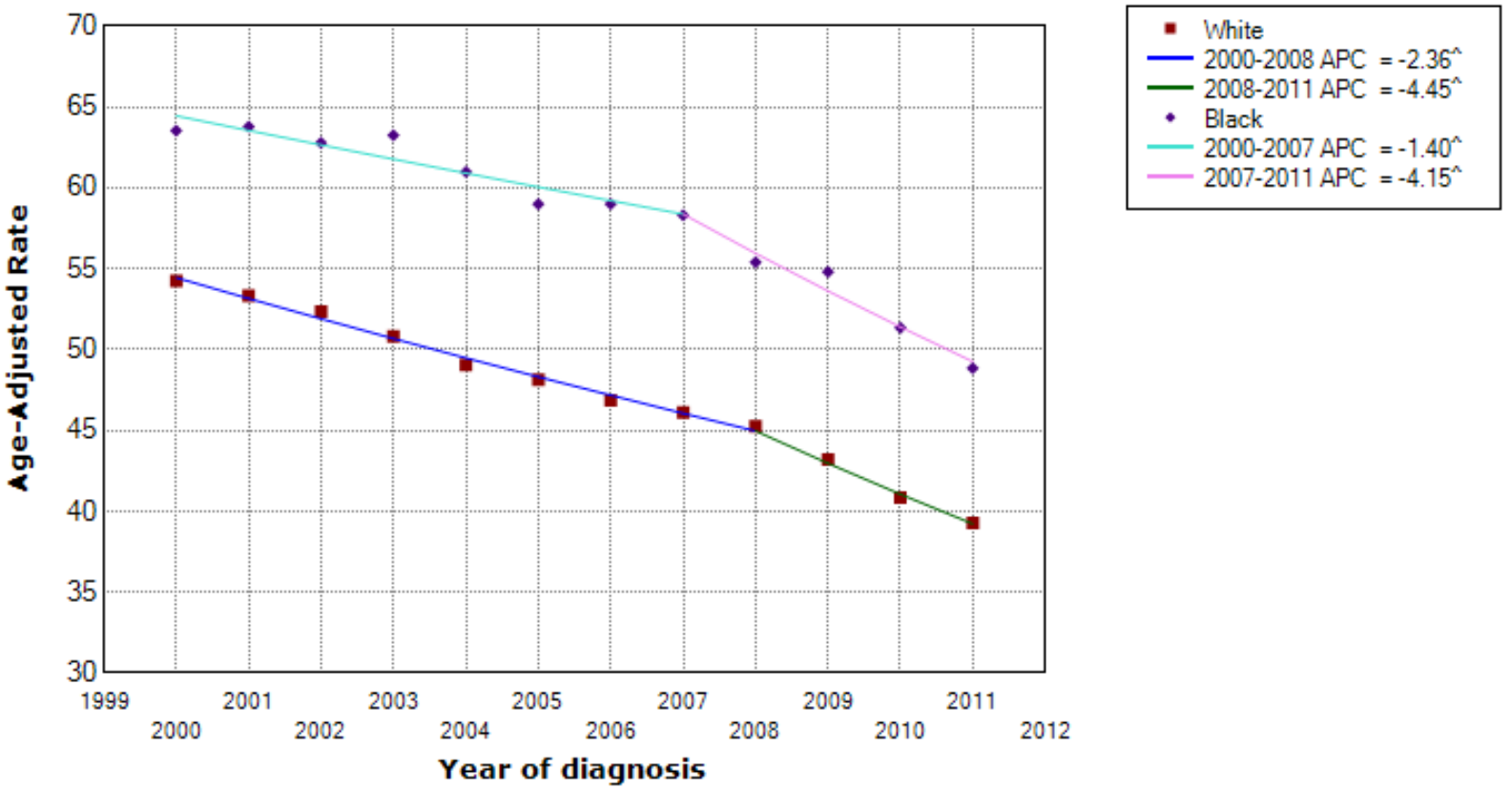
Rates are per 100,000 and age-adjusted to the 2000 U.S. standard population. APC indicates annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Figure 2.3: Evaluation for significant linear trends in CRC incidence in whites and blacks, SEER 13 (1992-2011)



Rates are per 100,000 and age-adjusted to the 2000 U.S. standard population. APC indicates annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Figure 2.4: Evaluation for significant linear trends in CRC incidence in whites and blacks, SEER 18 (2000-2011)



Rates are per 100,000 and age-adjusted to the 2000 U.S. standard population. APC indicates annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.5: Annual percent change, average annual percent change, average annual percent change comparisons, and test of parallelism for CRC incidence in whites and blacks; SEER 9 regions (1975-2011)

Annual Percent Change (APC)								
Cohort	**Segment**	**Lower EndPoint**	**Upper Endpoint**	**APC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
White	1	1975	1985	0.79^	0.54	1.03	6.67	0.00
White	2	1985	1995	-1.98^	-2.24	-1.71	-15.38	0.00
White	3	1995	1998	1.63	-1.26	4.61	1.16	0.25
White	4	1998	2008	-2.50^	-2.76	-2.24	-19.52	0.00
White	5	2008	2011	-5.06^	-6.54	-3.55	-6.80	0.00
Black	1	1975	1980	3.30^	0.60	6.07	2.51	0.01
Black	2	1980	2004	-0.17	-0.36	0.03	-1.75	0.08
Black	3	2004	2011	-3.79^	-4.78	-2.80	-7.71	0.00
Average Annual Percent Change (AAPC)								
Cohort	**Range**	**Lower EndPoint**	**Upper Endpoint**	**AAPC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
White	Full Range	1975	2011	-1.33^	-1.61	-1.05	-9.17	0.00
White	2000-2011	2000	2011	-3.20^	-3.64	-2.77	-14.26	0.00
Black	Full Range	1975	2011	-0.41	-0.83	0.01	-1.93	0.05
Black	2000-2011	2000	2011	-2.49^	-3.10	-1.88	-7.85	0.00

APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.5: continued

Average Annual Percent Change (AAPC) Comparison								
Cohort	**Range**	**Lower Endpoint**	**Upper Endpoint**	**AAPC Difference**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
Comparison	Full Range	1975	2011	-0.92^	-1.43^	-0.42^	-3.57^	0.00^
Comparison	2000-2011	2000	2011	-0.71^	-1.51^	0.04^	-1.86^	0.06^

Test For Parallelism					
Number of Joinpoints	**Degrees of Freedom**	**Degrees of Freedom**	**Number of Permutations**	**P-Value**	**Significance Level**
4 Joinpoint(s)	9	54	4500	0.00	0.05
Final Selected Model: Rejected Parallelism					

APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.6: Annual percent change, average annual percent change, average annual percent change comparisons, and test of parallelism for CRC incidence in whites and blacks; SEER 13 regions (1992-2011)

Annual Percent Change (APC)								
Cohort	**Segment**	**Lower EndPoint**	**Upper Endpoint**	**APC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
White	1	1992	1995	-2.16^	-3.09	-1.22	-5.17	0.00
White	2	1995	1998	1.66	-0.23	3.59	1.98	0.05
White	3	1998	2008	-2.37^	-2.54	-2.20	-31.26	0.00
White	4	2008	2011	-4.79^	-5.75	-3.82	-10.95	0.00
Black	1	1992	2003	-0.09	-0.53	0.35	-0.45	0.65
Black	2	2003	2009	-2.36^	-3.68	-1.03	-3.83	0.00
Black	3	2009	2011	-6.98^	-12.55	-1.04	-2.55	0.01
Average Annual Percent Change (AAPC)								
Cohort	**Range**	**Lower EndPoint**	**Upper Endpoint**	**AAPC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
White	Full Range	1992	2011	-2.10^	-2.42	-1.78	-12.63	0.00
Black	Full Range	1992	2011	-1.56^	-2.28	-0.83	-4.17	0.00
Average Annual Percent Change (AAPC) Comparison								
Cohort	**Range**	**Lower Endpoint**	**Upper Endpoint**	**AAPC Difference**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
Comparison	Full Range	1992	2011	-0.54^	-1.36^	0.25^	-1.35^	0.18^

APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.6: Continued

Test For Parallelism					
Number of Joinpoints	**Degrees of Freedom**	**Degrees of Freedom**	**Number of Permutations**	**P-Value**	**Significance Level**
3 Joinpoint(s)	7	24	4500	0.00	0.05
Final Selected Model: Rejected Parallelism					

APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.7: Annual percent change, average annual percent change, average annual percent change comparisons, and test of parallelism for CRC incidence in whites and blacks; SEER 18 regions (2000-2011)

Annual Percent Change (APC)								
Cohort	**Segment**	**Lower EndPoint**	**Upper Endpoint**	**APC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
White	1	2000	2008	-2.36^	-2.58	-2.14	-25.51	0.00
White	2	2008	2011	-4.45^	-5.47	-3.43	-10.07	0.00
Black	1	2000	2007	-1.40^	-2.10	-0.70	-4.73	0.00
Black	2	2007	2011	-4.15^	-5.73	-2.55	-6.06	0.00

Average Annual Percent Change (AAPC)								
Cohort	**Range**	**Lower EndPoint**	**Upper Endpoint**	**AAPC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
White	Full Range	2000	2011	-2.94^	-3.20	-2.67	-21.14	0.00
Black	Full Range	2000	2011	-2.41^	-3.02	-1.80	-7.68	0.00

Average Annual Percent Change (AAPC) Comparison								
Cohort	**Range**	**Lower Endpoint**	**Upper Endpoint**	**AAPC Difference**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
Comparison	Full Range	2000	2011	-0.52^	-1.22^	0.15^	-1.54^	0.12^

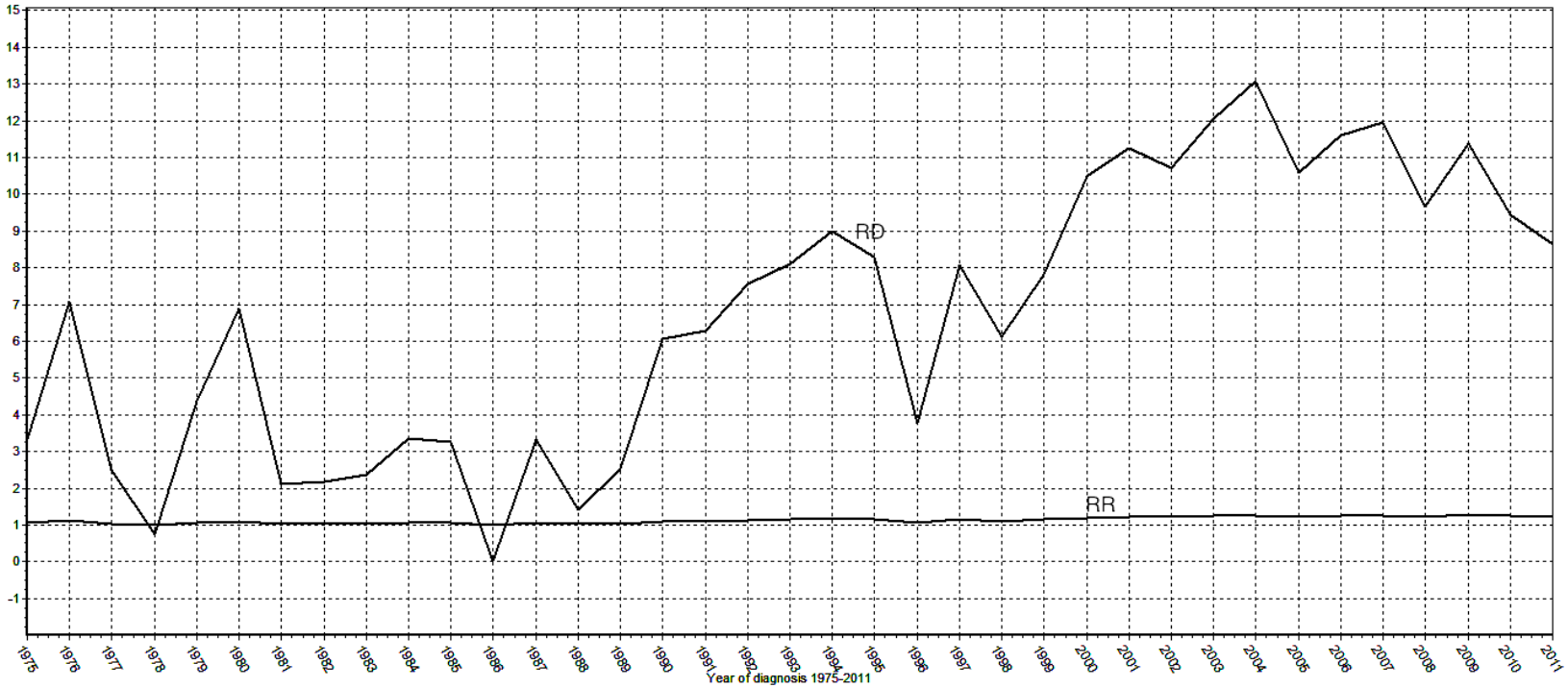
APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.7: Continued

Test For Parallelism					
Number of Joinpoints	**Degrees of Freedom**	**Degrees of Freedom**	**Number of Permutations**	**P-Value**	**Significance Level**
1 Joinpoint(s)	3	16	4500	0.02	0.05
Final Selected Model: Rejected Parallelism					

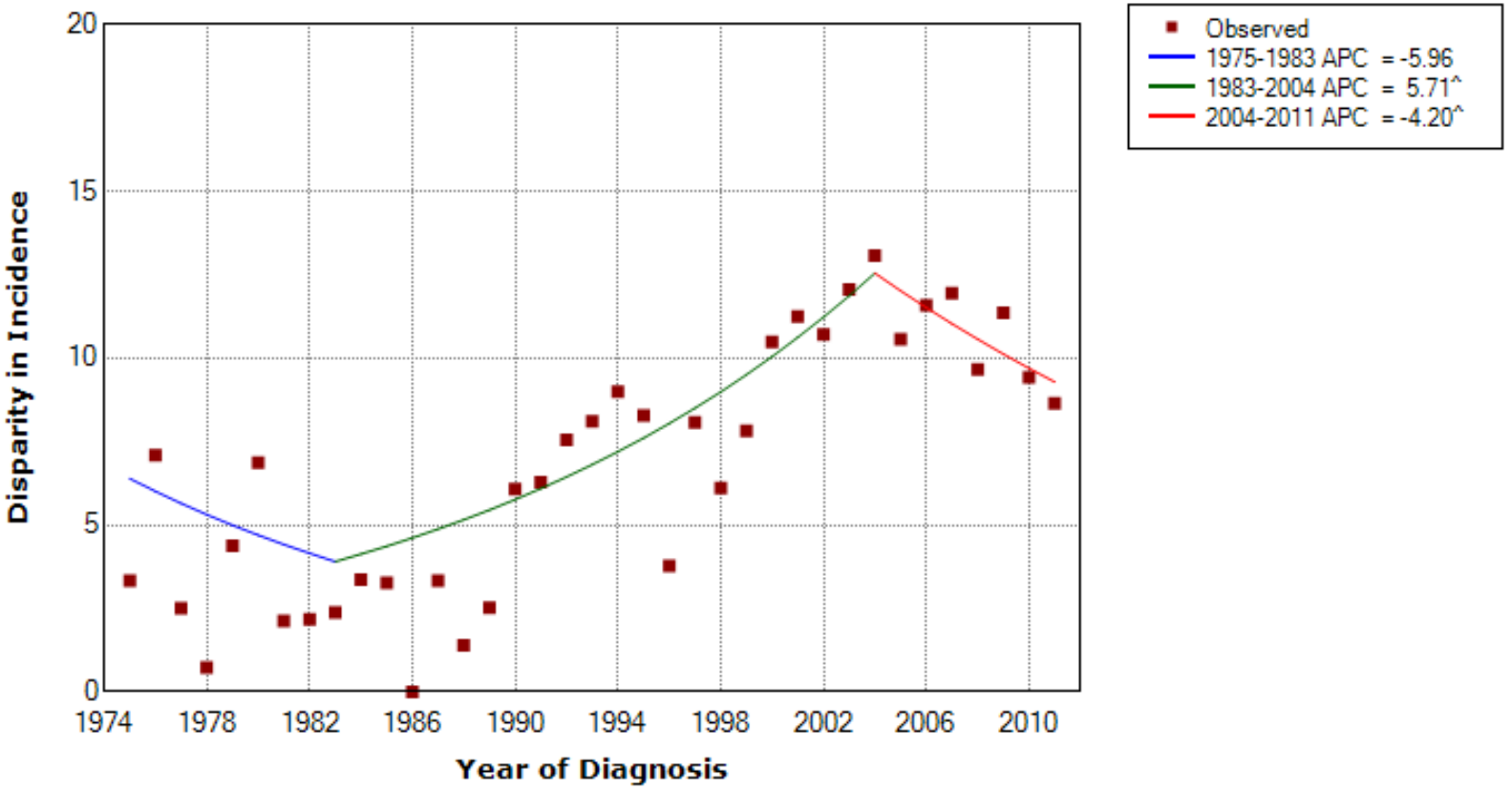
APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Figure 2.5: Range difference (RD) and rate ratio (RR) for the black-white disparity in CRC incidence; SEER 9 (1975-2011)



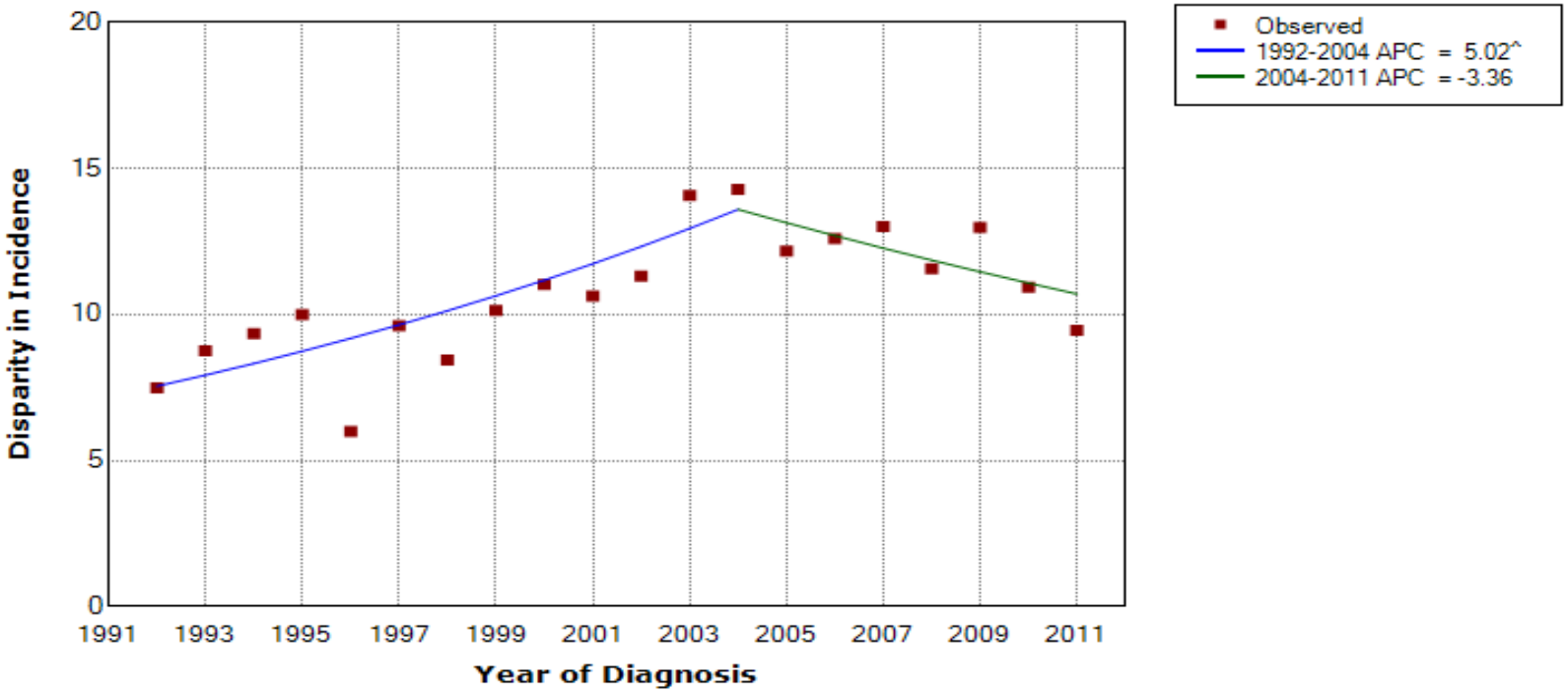
Rates are per 100,000 and age-adjusted to the 2000 U.S. standard population

Figure 2.6: Evaluation for significant disparity trends in CRC incidence in whites and blacks; SEER 9 (1975-2011)



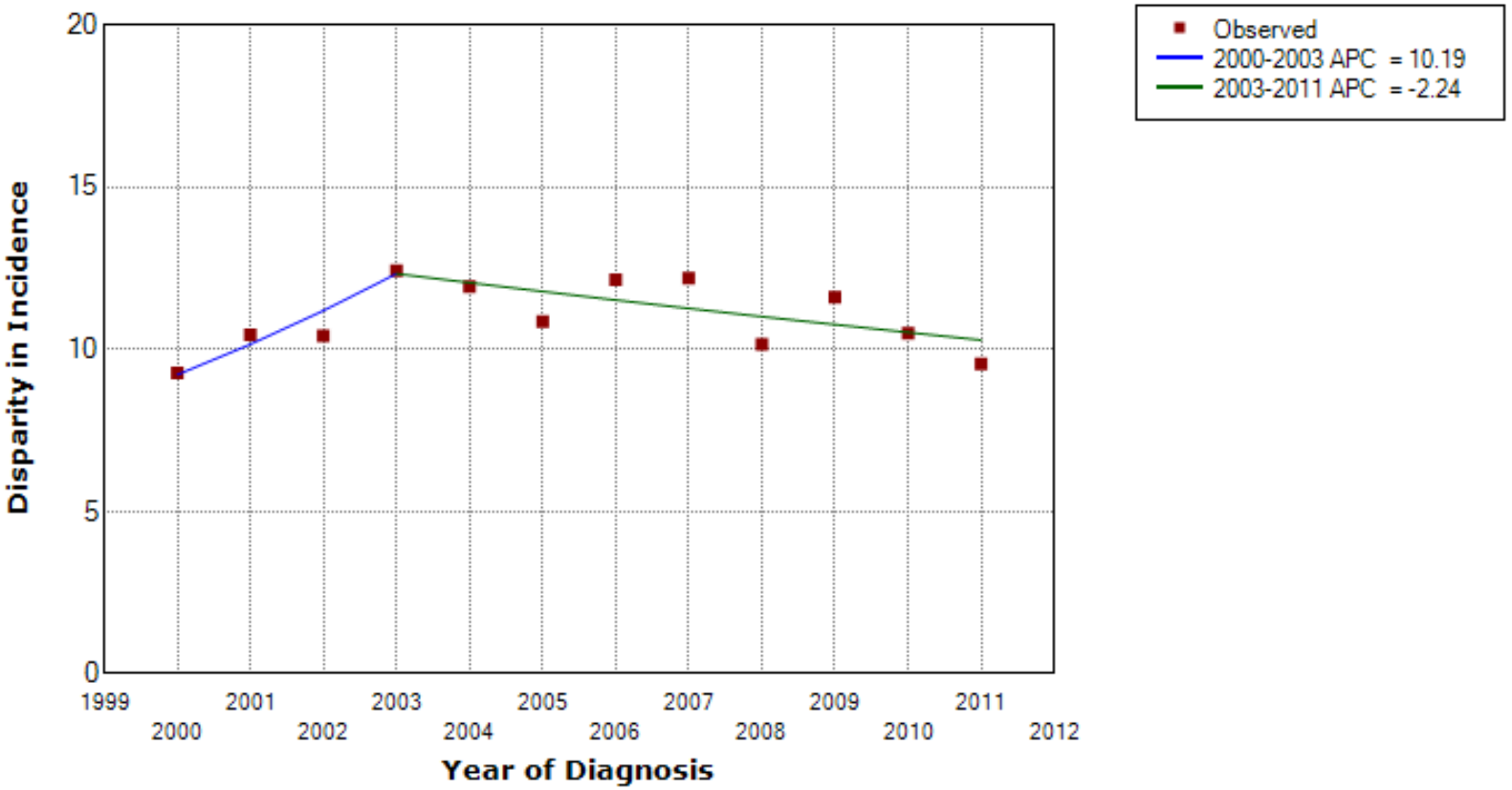
Disparity is defined as the absolute difference in the incidence in whites and the incidence in blacks for a given year
APC indicates annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Figure 2.7: Evaluation for significant disparity trends in CRC incidence in whites and blacks; SEER 13 (1992-2011)



Disparity is defined as the absolute difference in the incidence in whites and the incidence in blacks for a given year
APC indicates annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Figure 2.8: Evaluation for significant disparity trends in CRC incidence in whites and blacks; SEER 18 (2000-2011)



Disparity is defined as the absolute difference in the incidence in whites and the incidence in blacks for a given year
APC indicates annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.8: Annual percent change and average annual percent change for incidence disparity in whites and blacks; SEER 9 (1975-2011)

Annual Percent Change (APC)							
Segment	**Lower EndPoint**	**Upper Endpoint**	**APC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
1	1975	1983	-5.96	-18.86	8.98	-0.85	0.39
2	1983	2004	5.71^	3.68	7.78	5.87	0.00
3	2004	2011	-4.20^	-8.13	-0.11	-2.10	0.04

Average Annual Percent Change (AAPC)							
Range	**Lower EndPoint**	**Upper Endpoint**	**AAPC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
Full Range	1975	2011	1.04	-2.35	4.55	0.60	0.55

APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.9: Annual percent change and average annual percent change for incidence disparity in whites and blacks; SEER 13 (1992-2011)

Annual Percent Change (APC)							
Segment	**Lower EndPoint**	**Upper Endpoint**	**APC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
1	1992	2004	5.02^	2.68	7.42	4.62	0.00
2	2004	2011	-3.36	-6.90	0.32	-1.95	0.05
Average Annual Percent Change (AAPC)							
Range	**Lower EndPoint**	**Upper Endpoint**	**AAPC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
Full Range	1992	2011	1.86^	0.02	3.73	1.98	0.05

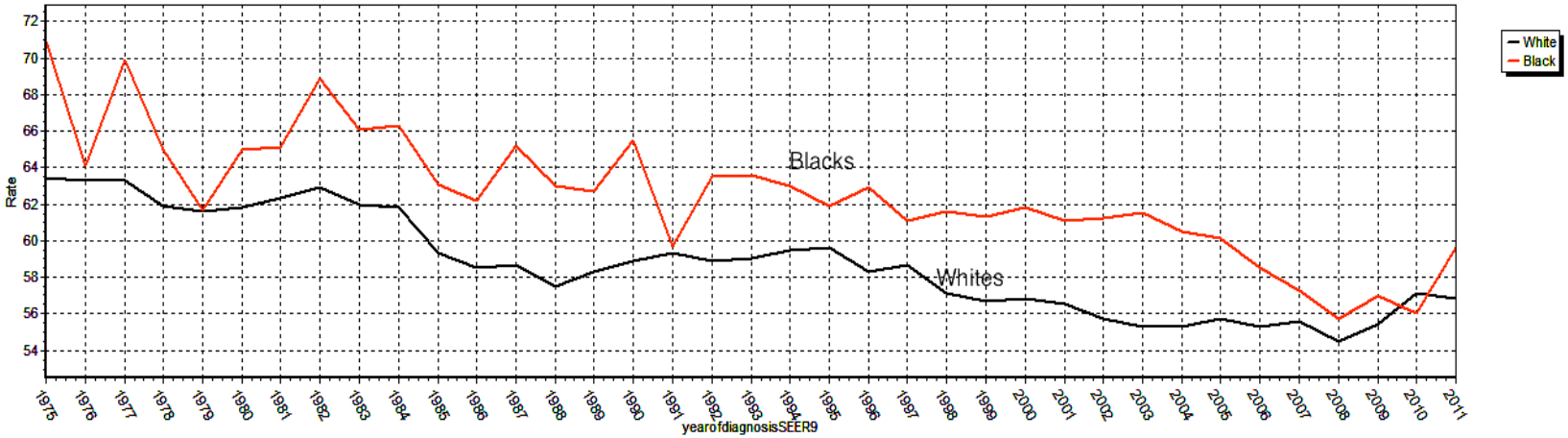
APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.10: Annual percent change and average annual percent change for incidence disparity in whites and blacks; SEER 18 (2000-2011)

Annual Percent Change (APC)							
Segment	**Lower EndPoint**	**Upper Endpoint**	**APC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
1	2000	2003	10.19	-5.38	28.33	1.51	0.13
2	2003	2011	-2.24	-4.76	0.34	-2.06	0.04
Average Annual Percent Change (AAPC)							
Range	**Lower EndPoint**	**Upper Endpoint**	**AAPC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
Full Range	2000	2011	1.00	-2.75	4.90	0.52	0.61

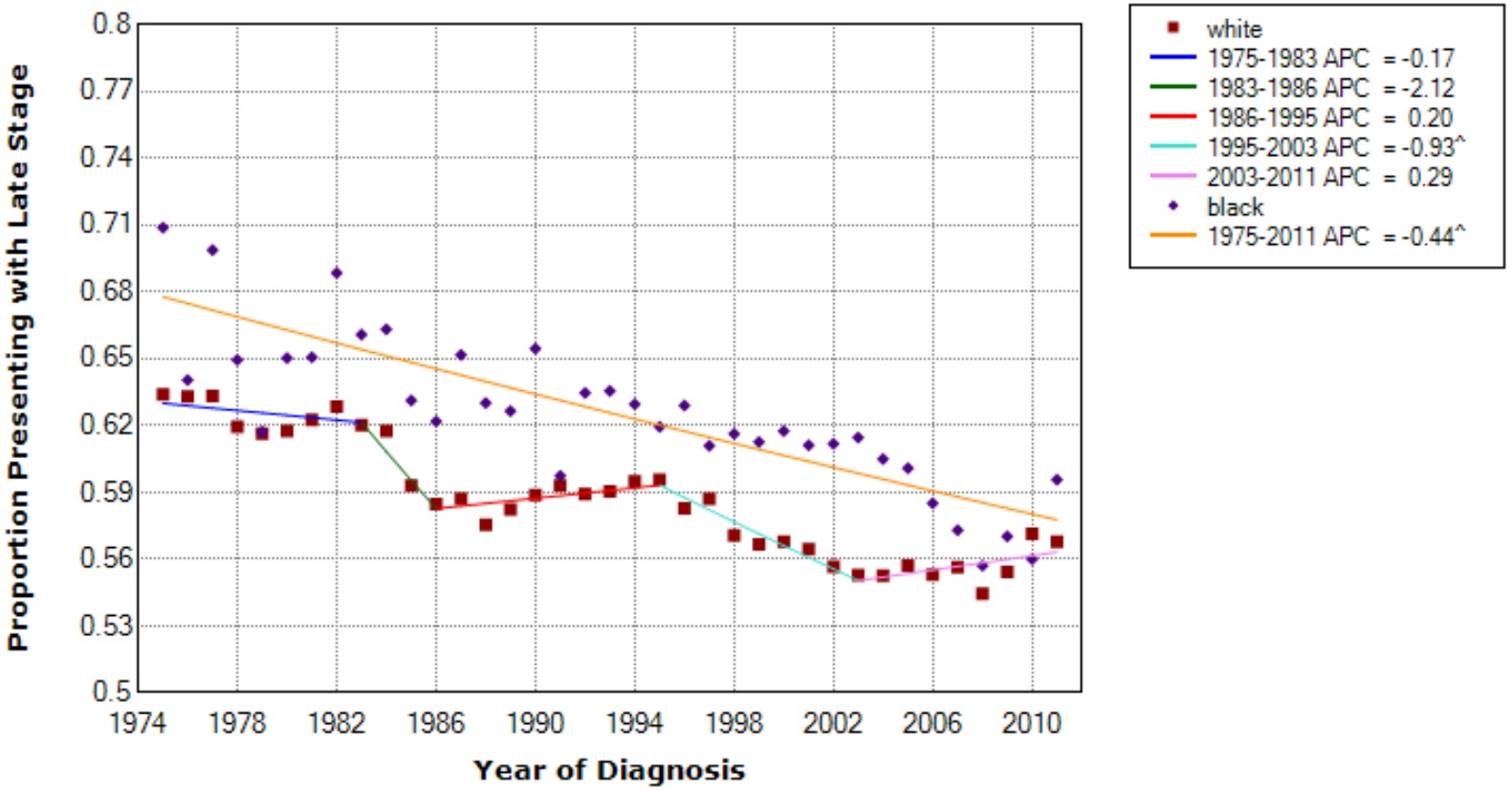
APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Figure 2.9: Rate of CRC late stage presentation in whites and blacks; SEER 9 (1975 to 2011)



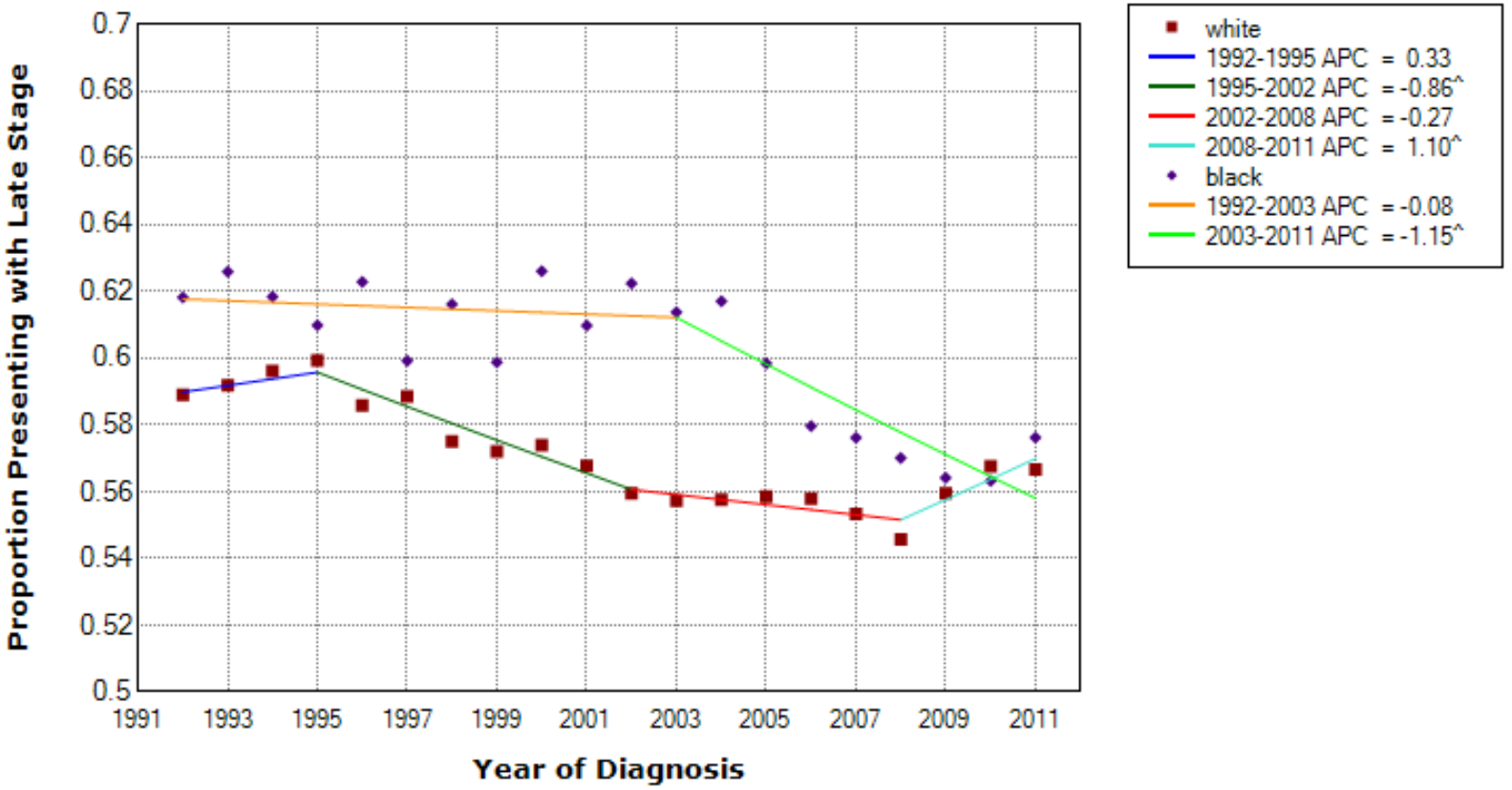
Rates are per 100,000 and age-adjusted to the 2000 U.S. standard population

Figure 2.10: Evaluation for significant linear trends in late stage CRC presentation in whites and blacks; SEER 9 (1975-2011)



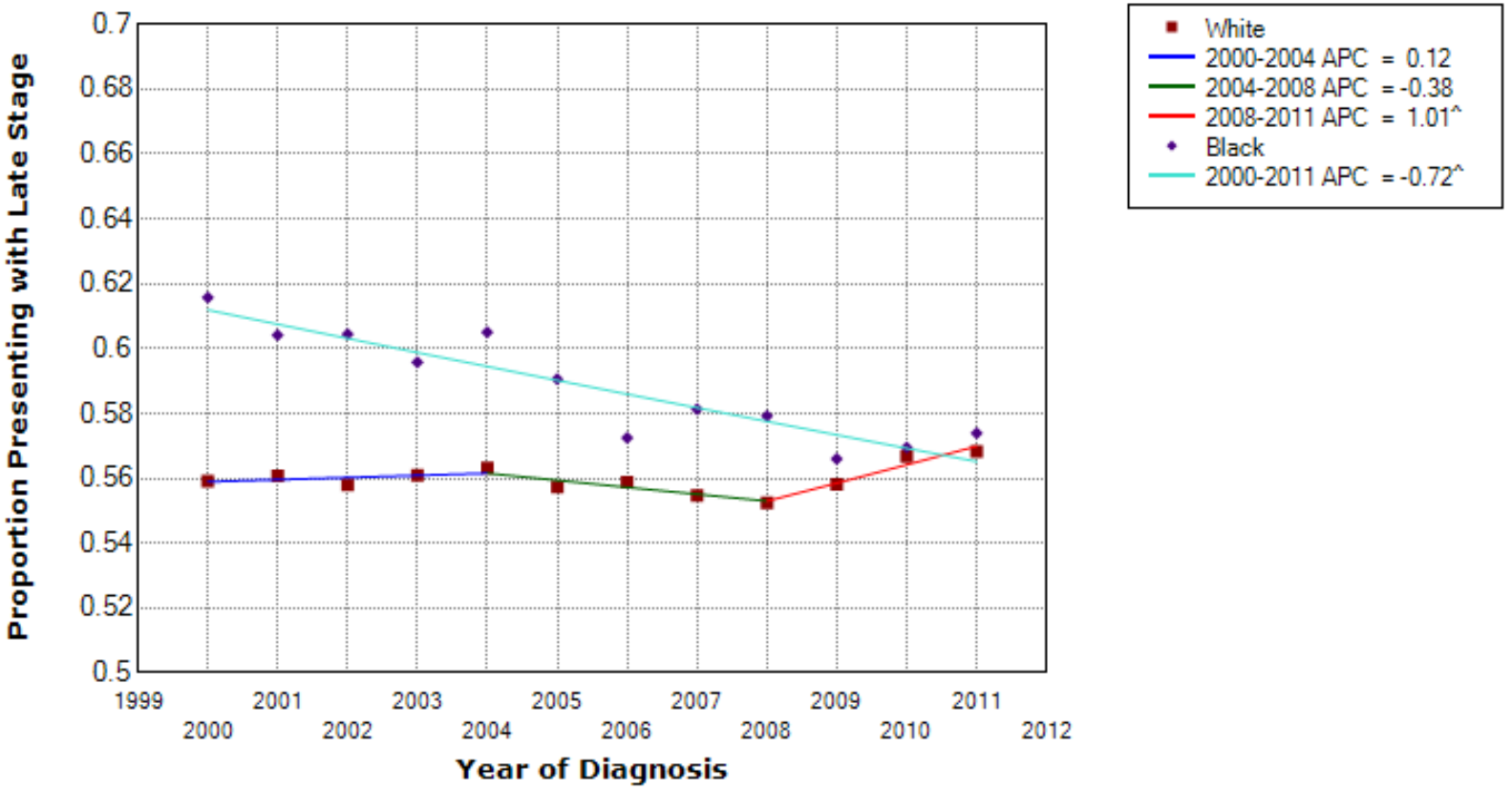
APC indicates annual percentage change
^ indicates the APC is significantly different from zero at p = 0.05

Figure 2.11: Evaluation for significant linear trends in late stage CRC presentation in whites and blacks; SEER 13 (1992-2011)



APC indicates annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Figure 2.12: Evaluation for significant linear trends in late stage CRC presentation in whites and blacks; SEER 18 (2000-2011)



APC indicates annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.11: Annual percent change, average annual percent change, average annual percent change comparisons, and test of parallelism for CRC late stage at presentation in whites and blacks; SEER 9 (1975-2011)

Annual Percent Change (APC)								
Cohort	**Segment**	**Lower EndPoint**	**Upper Endpoint**	**APC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
white	1	1975	1983	-0.17	-0.49	0.15	-1.12	0.26
white	2	1983	1986	-2.12	-4.83	0.67	-1.58	0.11
white	3	1986	1995	0.20	-0.12	0.52	1.27	0.20
white	4	1995	2003	-0.93^	-1.33	-0.53	-4.83	0.00
white	5	2003	2011	0.29	-0.06	0.64	1.69	0.09
black	1	1975	2011	-0.44^	-0.53	-0.35	-10.00	0.00
Average Annual Percent Change (AAPC)								
Cohort	**Range**	**Lower EndPoint**	**Upper Endpoint**	**AAPC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
white	Full Range	1975	2011	-0.31^	-0.58	-0.04	-2.27	0.02
white	2000-2011	2000	2011	-0.05	-0.31	0.22	-0.35	0.73
black	Full Range	1975	2011	-0.44^	-0.53	-0.35	-10.00	0.00
black	2000-2011	2000	2011	-0.44^	-0.53	-0.35	-10.00	0.00

APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.11: Continued

Average Annual Percent Change (AAPC) Comparison								
Cohort	**Range**	**Lower Endpoint**	**Upper Endpoint**	**AAPC Difference**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
Comparison	Full Range	1975	2011	0.13^	-0.15^	0.41^	0.92^	0.36^
Comparison	2000-2011	2000	2011	0.40^	0.12^	0.67^	2.81^	0.00^

Test For Parallelism					
Number of Joinpoints	**Degrees of Freedom**	**Degrees of Freedom**	**Number of Permutations**	**P-Value**	**Significance Level**
5 Joinpoint(s)	11	50	4500	0.00	0.05
Final Selected Model: Rejected Parallelism					

APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.12: Annual percent change, average annual percent change, average annual percent change comparisons, and test of parallelism for CRC late stage at presentation in whites and blacks; SEER 13 (1992-2011)

Annual Percent Change (APC)								
Cohort	**Segment**	**Lower EndPoint**	**Upper Endpoint**	**APC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
white	1	1992	1995	0.33	-0.53	1.20	0.87	0.39
white	2	1995	2002	-0.86^	-1.16	-0.57	-6.63	0.00
white	3	2002	2008	-0.27	-0.69	0.14	-1.47	0.14
white	4	2008	2011	1.10^	0.13	2.07	2.57	0.01
black	1	1992	2003	-0.08	-0.44	0.28	-0.48	0.63
black	2	2003	2011	-1.15^	-1.72	-0.58	-4.26	0.00

Average Annual Percent Change (AAPC)								
Cohort	**Range**	**Lower EndPoint**	**Upper Endpoint**	**AAPC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
white	Full Range	1992	2011	-0.18	-0.41	0.05	-1.54	0.12
black	Full Range	1992	2011	-0.53^	-0.83	-0.24	-3.54	0.00

Average Annual Percent Change (AAPC) Comparison								
Cohort	**Range**	**Lower Endpoint**	**Upper Endpoint**	**AAPC Difference**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
Comparison	Full Range	1992	2011	0.35^	-0.02^	0.73^	1.85^	0.06^

APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.12: continued

Test For Parallelism					
Number of Joinpoints	**Degrees of Freedom**	**Degrees of Freedom**	**Number of Permutations**	**P-Value**	**Significance Level**
3 Joinpoint(s)	7	24	4500	0.00	0.05
Final Selected Model: Rejected Parallelism					

APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

Table 2.13: Annual percent change, average annual percent change, average annual percent change comparisons, and test of parallelism for CRC late stage at presentation in whites and blacks; SEER 18 (2000-2011)

Annual Percent Change (APC)								
Cohort	**Segment**	**Lower EndPoint**	**Upper Endpoint**	**APC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
White	1	2000	2004	0.12	-0.35	0.59	0.69	0.49
White	2	2004	2008	-0.38	-1.14	0.38	-1.40	0.16
White	3	2008	2011	1.01^	0.23	1.80	3.61	0.00
Black	1	2000	2011	-0.72^	-0.93	-0.50	-7.42	0.00
Average Annual Percent Change (AAPC)								
Cohort	**Range**	**Lower EndPoint**	**Upper Endpoint**	**AAPC**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
White	Full Range	2000	2011	0.18	-0.10	0.45	1.26	0.21
Black	Full Range	2000	2011	-0.72^	-0.93	-0.50	-7.42	0.00
Average Annual Percent Change (AAPC) Comparison								
Cohort	**Range**	**Lower Endpoint**	**Upper Endpoint**	**AAPC Difference**	**Lower CI**	**Upper CI**	**Test Statistic**	**P-Value**
Comparison	Full Range	2000	2011	0.90^	0.56^	1.23^	5.27^	0.00^

Table 2.13: Continued

Test For Parallelism					
Number of Joinpoints	**Degrees of Freedom**	**Degrees of Freedom**	**Number of Permutations**	**P-Value**	**Significance Level**
2 Joinpoint(s)	5	12	4500	0.00	0.05
Final Selected Model: Rejected Parallelism					

APC indicates annual percentage change.
AAPC indicates average annual percentage change.
^ indicates the APC is significantly different from zero at p = 0.05

2.7 References

ACS. (2014). American Cancer Society: Colorectal Cancer Facts & Figures 2014-2016. Atlanta: American Cancer Society.

Agrawal, S., Bhupinderjit, A., Bhutani, M. S., Boardman, L., Nguyen, C., Romero, Y., . . . Figueroa-Moseley, C. (2005). Colorectal cancer in African Americans. *Am J Gastroenterol, 100*(3), 515-523; discussion 514. doi: 10.1111/j.1572-0241.2005.41829.x

Ashktorab, H., Nouraie, M., Hosseinkhah, F., Lee, E., Rotimi, C., & Smoot, D. (2009). A 50-year review of colorectal cancer in African Americans: implications for prevention and treatment. *Dig Dis Sci, 54*(9), 1985-1990. doi: 10.1007/s10620-009-0866-5

Berkowitz, Z., Hawkins, N. A., Peipins, L. A., White, M. C., & Nadel, M. R. (2008). Beliefs, risk perceptions, and gaps in knowledge as barriers to colorectal cancer screening in older adults. *J Am Geriatr Soc, 56*(2), 307-314. doi: 10.1111/j.1532-5415.2007.01547.x

Bolen, J. C., Rhodes, L., Powell-Griner, E. E., Bland, S. D., & Holtzman, D. (2000). State-specific prevalence of selected health behaviors, by race and ethnicity--Behavioral Risk Factor Surveillance System, 1997. *MMWR CDC Surveill Summ, 49*(2), 1-60.

Byrd, W. M. (1990). Race, biology, and health care: reassessing a relationship. *J Health Care Poor Underserved, 1*(3), 278-296.

CDC. (2014). U.S. Cancer Statistics Working Group. United States Cancer Statistics: 1999–2011 Incidence and Mortality Web-based Report. . Retrieved April 2, 2015, from http://www.cdc.gov/uscs.

Chu, K. C., Tarone, R. E., Chow, W. H., & Alexander, G. A. (1995). Colorectal cancer trends by race and anatomic subsites, 1975 to 1991. *Arch Fam Med, 4*(10), 849-856.

Chu, K. C., Tarone, R. E., Chow, W. H., Hankey, B. F., & Ries, L. A. (1994). Temporal patterns in colorectal cancer incidence, survival, and mortality from 1950 through 1990. *J Natl Cancer Inst, 86*(13), 997-1006.

Clegg, L. X., Hankey, B. F., Tiwari, R., Feuer, E. J., & Edwards, B. K. (2009). Estimating average annual per cent change in trend analysis. *Stat Med, 28*(29), 3670-3682. doi: 10.1002/sim.3733

Cram, P., Fendrick, A. M., Inadomi, J., Cowen, M. E., Carpenter, D., & Vijan, S. (2003). The impact of a celebrity promotional campaign on the use of colon cancer screening: the Katie Couric effect. *Arch Intern Med, 163*(13), 1601-1605. doi: 10.1001/archinte.163.13.1601

Dimou, A., Syrigos, K. N., & Saif, M. W. (2009). Disparities in colorectal cancer in African-Americans vs Whites: before and after diagnosis. *World J Gastroenterol, 15*(30), 3734-3743.

Edwards, B. K., Ward, E., Kohler, B. A., Eheman, C., Zauber, A. G., Anderson, R. N., . . . Ries, L. A. (2010). 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, 116*(3), 544-573. doi: 10.1002/cncr.24760

Fazio, L., Cotterchio, M., Manno, M., McLaughlin, J., & Gallinger, S. (2005). Association between colonic screening, subject characteristics, and stage of colorectal cancer. *Am J Gastroenterol, 100*(11), 2531-2539. doi: 10.1111/j.1572-0241.2005.00319.x

Fisher, D. A., Martin, C., Galanko, J., Sandler, R. S., Noble, M. D., & Provenzale, D. (2004). Risk factors for advanced disease in colorectal cancer. *Am J Gastroenterol, 99*(10), 2019-2024. doi: 10.1111/j.1572-0241.2004.40010.x

Ford, E. S. (1999). Body mass index and colon cancer in a national sample of adult US men and women. *Am J Epidemiol, 150*(4), 390-398.

Fritz, A., Percy, C., Jack, A., Shanmugaratnam, K., Sobin, L., Parkin, D., & Whelan, S. (Eds.). (2000). *International Classification of Diseases for Oncology* (Third ed.). Geneva: World Health Organization.

He, J., & Efron, J. E. (2011). Screening for colorectal cancer. *Adv Surg, 45*, 31-44.

Heinzerling, J. H., Anthony, T., Livingston, E. H., & Huerta, S. (2007). Predictors of distant metastasis and mortality in patients with stage II colorectal cancer. *Am Surg, 73*(3), 230-238.

Henschke, U. K., Leffall, L. D., Jr., Mason, C. H., Reinhold, A. W., Schneider, R. L., & White, J. E. (1973). Alarming increase of the cancer mortality in the U.S. black population (1950-1967). *Cancer, 31*(4), 763-768.

Hiatt, R. A., Klabunde, C., Breen, N., Swan, J., & Ballard-Barbash, R. (2002). Cancer screening practices from National Health Interview Surveys: past, present, and future. *J Natl Cancer Inst, 94*(24), 1837-1846.

Howlader, N., Noone, A., & Krapcho, M. (2011). SEER Cancer Statistics Review, 1975-2008. Bethesda, MD: National Cancer Institute.

Huxley, R. R., Ansary-Moghaddam, A., Clifton, P., Czernichow, S., Parr, C. L., & Woodward, M. (2009). The impact of dietary and lifestyle risk factors on risk of colorectal cancer: a quantitative overview of the epidemiological evidence. *Int J Cancer, 125*(1), 171-180. doi: 10.1002/ijc.24343

Imperiale, T. F., Ransohoff, D. F., Itzkowitz, S. H., Levin, T. R., Lavin, P., Lidgard, G. P., . . . Berger, B. M. (2014). Multitarget stool DNA testing for colorectal-cancer screening. *N Engl J Med, 370*(14), 1287-1297. doi: 10.1056/NEJMoa1311194

IOM. (1999). *The Unequal Burden of Cancer: An Assessment of NIH Research and Programs for Ethnic Minorities and the Medically Underserved*. Washington DC: National Academy of Sciences.

Irby, K., Anderson, W. F., Henson, D. E., & Devesa, S. S. (2006). Emerging and widening colorectal carcinoma disparities between Blacks and Whites in the United States (1975-2002). *Cancer Epidemiol Biomarkers Prev, 15*(4), 792-797. doi: 10.1158/1055-9965.epi-05-0879

James, A. S., Daley, C. M., & Greiner, K. A. (2011). Knowledge and attitudes about colon cancer screening among African Americans. *Am J Health Behav, 35*(4), 393-401.

McMahon, L. F., Jr., Wolfe, R. A., Huang, S., Tedeschi, P., Manning, W., Jr., & Edlund, M. J. (1999). Racial and gender variation in use of diagnostic colonic procedures in the Michigan Medicare population. *Med Care, 37*(7), 712-717.

Mehrkhani, F., Nasiri, S., Donboli, K., Meysamie, A., & Hedayat, A. (2009). Prognostic factors in survival of colorectal cancer patients after surgery. *Colorectal Dis, 11*(2), 157-161. doi: 10.1111/j.1463-1318.2008.01556.x

Miutescu, B., Sporea, I., Popescu, A., Bota, S., Iovanescu, D., Burlea, A., . . . Miutescu, E. (2013). Effectiveness of the immunochemical fecal test (FIT) for detection of advanced adenomas in colorectal carcinoma screening in an asymptomatic population. *Rev Med Chir Soc Med Nat Iasi, 117*(2), 302-307.

NCI. (2012). National Cancer Institute: Cancer Trends Progress Report 2011-2012. . Retrieved February 10, 2015, from http//progressreport.cancer.gov/doc.asp?

NCI. (2013). Health Disparities Calculator, Version 1.2.4 - October 29, 2013; Division of Cancer Control and Population Sciences, Surveillance Research Program and Applied Research Program, National Cancer Institute.

NCI. (2014a). Joinpoint Regression Program, Version 4.1.1 - August 2014; Statistical Methodology and Applications Branch, Surveillance Research Program, National Cancer Institute.

NCI. (2014b). National Cancer Institute. Cancer Incidence—Surveillance, Epidemiology, and End Results (SEER) Registries Research Data. Retrieved February 28, 2015., from http://seer.cancer.gov/data/seerstat/nov2011/.

NCI. (2014c). Surveillance, Epidemiology, and End Results (SEER) Program (http://www.seer.cancer.gov) SEER*Stat Database: Incidence - SEER 9 Regs Research Data, Nov 2013 Sub (1973-2011) <Katrina/Rita Population Adjustment> - Linked To County Attributes - Total U.S., 1969-2012 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Surveillance Systems Branch, released April 2014, based on the November 2013 submission.

NCI. (2014d). Surveillance, Epidemiology, and End Results (SEER) Program (http://www.seer.cancer.gov) SEER*Stat Database: Incidence - SEER 13 Regs Research Data, Nov 2013 Sub (1992-2011) <Katrina/Rita Population Adjustment> - Linked To County Attributes - Total U.S., 1969-2012 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Surveillance Systems Branch, released April 2014, based on the November 2013 submission.

NCI. (2014e). Surveillance, Epidemiology, and End Results (SEER) Program (http://www.seer.cancer.gov) SEER*Stat Database: Incidence - SEER 18 Regs Research Data, Nov 2013 Sub (2000-2011) <Katrina/Rita Population Adjustment> - Linked To County Attributes - Total U.S., 1969-2012 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Surveillance Systems Branch, released April 2014, based on the November 2013 submission.

Nelson, R. L., Persky, V., & Turyk, M. (1999). Determination of factors responsible for the declining incidence of colorectal cancer. *Dis Colon Rectum, 42*(6), 741-752.

O'Keefe, S. J., Ou, J., Aufreiter, S., O'Connor, D., Sharma, S., Sepulveda, J., . . . Mawhinney, T. (2009). Products of the colonic microbiota mediate the effects of diet on colon cancer risk. *J Nutr, 139*(11), 2044-2048. doi: 10.3945/jn.109.104380

Palmer, R. C., Chhabra, D., & McKinney, S. (2011). Colorectal cancer screening adherence in African-American men and women 50 years of age and older living in Maryland. *J Community Health, 36*(4), 517-524. doi: 10.1007/s10900-010-9336-4

Palmer, R. C., Midgette, L. A., & Dankwa, I. (2008). Colorectal cancer screening and African Americans: findings from a qualitative study. *Cancer Control, 15*(1), 72-79.

Palmer, R. C., Midgette, L. A., & Mullan, I. D. (2010). Colorectal cancer screening preferences among African Americans: which screening test is preferred? *J Cancer Educ, 25*(4), 577-581. doi: 10.1007/s13187-010-0081-2

Patterson, R. E., White, E., Kristal, A. R., Neuhouser, M. L., & Potter, J. D. (1997). Vitamin supplements and cancer risk: the epidemiologic evidence. *Cancer Causes Control, 8*(5), 786-802.

Rex, D. K., Johnson, D. A., Anderson, J. C., Schoenfeld, P. S., Burke, C. A., & Inadomi, J. M. (2009). American College of Gastroenterology guidelines for colorectal cancer screening 2009 [corrected]. *Am J Gastroenterol, 104*(3), 739-750. doi: 10.1038/ajg.2009.104

Satia-Abouta, J., Galanko, J. A., Martin, C. F., Potter, J. D., Ammerman, A., & Sandler, R. S. (2003). Associations of micronutrients with colon cancer risk in African Americans and whites: results from the North Carolina Colon Cancer Study. *Cancer Epidemiol Biomarkers Prev, 12*(8), 747-754.

SEER. (2014). *Surveillance, Epidemiology, and End Results (SEER) Program (*http://www.seer.cancer.gov*) SEER*Stat Database: Incidence - SEER 9 Regs Research Data, Nov 2013 Sub (1973-2011) <Katrina/Rita Population Adjustment> - Linked To County Attributes - Total U.S., 1969-2012 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Surveillance Systems Branch, released April 2014, based on the November 2013 submission.*

Siegel, R., Desantis, C., & Jemal, A. (2014). Colorectal cancer statistics, 2014. *CA Cancer J Clin, 64*(2), 104-117. doi: 10.3322/caac.21220

Siegel, R., DeSantis, C., Virgo, K., Stein, K., Mariotto, A., Smith, T., . . . Ward, E. (2012). Cancer treatment and survivorship statistics, 2012. *CA Cancer J Clin, 62*(4), 220-241. doi: 10.3322/caac.21149

Tammana, V. S., & Laiyemo, A. O. (2014). Colorectal cancer disparities: issues, controversies and solutions. *World J Gastroenterol, 20*(4), 869-876. doi: 10.3748/wjg.v20.i4.869

Tsikitis, V. L., Larson, D. W., Huebner, M., Lohse, C. M., & Thompson, P. A. (2014). Predictors of recurrence free survival for patients with stage II and III colon cancer. *BMC Cancer, 14*, 336. doi: 10.1186/1471-2407-14-336

Waidmann, T. A., & Rajan, S. (2000). Race and ethnic disparities in health care access and utilization: an examination of state variation. *Med Care Res Rev, 57 Suppl 1*, 55-84.

Willett, W. C., Stampfer, M. J., Colditz, G. A., Rosner, B. A., & Speizer, F. E. (1990). Relation of meat, fat, and fiber intake to the risk of colon cancer in a prospective study among women. *N Engl J Med, 323*(24), 1664-1672. doi: 10.1056/nejm199012133232404

Zimmerman, R. K., Tabbarah, M., Trauth, J., Nowalk, M. P., & Ricci, E. M. (2006). Predictors of lower endoscopy use among patients at three inner-city neighborhood health centers. *J Urban Health, 83*(2), 221-230. doi: 10.1007/s11524-005-9028-z

Chapter 3:

Explaining Under-Use of Colonoscopic Cancer Screening in African Americans: A Systematic Review

3.1 Abstract

Introduction: Although African Americans have a higher incidence of and mortality from colorectal cancer (CRC) than white Americans, they are less likely to undergo CRC screening. In light of poor CRC outcomes among blacks, there has been some emphasis on colonoscopic screening in this racial subgroup to help reduce CRC incidence and improve CRC outcomes. One major national gastrointestinal society has published guidelines recommending colonoscopy over other screening modalities in African Americans. As we consider the feasibility of modality-specific screening recommendations for black Americans, this systematic review aims to synthesize the available information about contributing factors to low uptake of screening colonoscopy among African Americans.

Methods: We conducted a systematic review to evaluate barriers to colonoscopic CRC screening in African Americans. We defined barriers as influences hindering age-appropriate CRC screening by colonoscopy and categorized these into patient-, provider-, and system-related factors. All studies resulting from the literature search were classified as either quantitative or qualitative and evaluated for quality with the Consolidated Criteria for Reporting Qualitative Research (COREQ) or Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Results: Nineteen studies met inclusion criteria. A total of 17 studies evaluated patient-level factors, 11 studies evaluated provider-level factors, and 7 studies evaluated system-level barriers. Patient barriers to colonoscopic screening included fear, poor knowledge of CRC risk, and low perceived benefit of colonoscopy. Provider-level factors included failure to recommend screening and knowledge deficits about guidelines and barriers to screening. System barriers included financial obstacles, lack of insurance and access to care, and infrequent primary care visits. COREQ scores ranged from 16 to 25 out of 32 items, and STROBE scores ranged from 16 to 21 out of 22 items.

Conclusions: There are several barriers to colonoscopic CRC screening among African Americans. As national societies consider specific recommendations for colonoscopic screening in African Americans, we must consider these barriers to uptake. Future interventions should confront patient fear, patient and physician knowledge about barriers, and access to healthcare services. As the Affordable Care Act aims to improve uptake of preventive services, focused interventions to increase CRC screening in blacks are essential and timely.

3.2 Introduction

African Americans have a higher incidence of and greater mortality from colorectal cancer (CRC) than any other ethnic group in the United States (U.S.) (Howlader, Noone, & Krapcho, 2011). These disparities are at least in part attributed to poor screening uptake among blacks, despite compelling evidence that CRC screening results in early cancer diagnosis and decreased CRC-related mortality (Agrawal et al., 2005; Ananthakrishnan, Schellhase, Sparapani, Laud, & Neuner, 2007; Benarroch-Gampel et al., 2012; CDC, 2010; Doubeni et al., 2010; Johnson-Jennings, Tarraf, Xavier Hill, & Gonzalez, 2014; Pignone, Rich, Teutsch, Berg, & Lohr, 2002; Wilkins et al., 2012; Zauber et al., 2012). In recent national estimates, 60% of African Americans, compared to 66% of white Americans were compliant with CRC screening guidelines (Klabunde et al., 2012). Prompted by these disparities, as well as by data supporting a high prevalence of right-sided colonic lesions among blacks, the American College of Gastroenterology (ACG) began recommending in 2009 that CRC screening begin at age 45 for African Americans, with colonoscopy as the preferred screening method (Cress, Morris, & Wolfe, 2000; Nelson, Persky, & Turyk, 1999; Rex et al., 2009; Zauber et al., 2012).

In a 2002 report on racial and ethnic inequities in healthcare, the Institute of Medicine (IOM) conceptualized racial and ethnic disparities in healthcare as the result of factors in patient-level, provider-level, and healthcare system-level domains (Smedley, Stith, Nelson, & eds.). While prior studies have identified individual patient-, provider-, and system-level barriers to screening in blacks, the literature lacks a systematic and summative presentation of barriers to screening in this racial subgroup (Dimou, Syrigos, & Saif, 2009; McLachlan, Clements, & Austoker, 2012; O'Malley, Forrest, Feng, & Mandelblatt, 2005; Ward et al., 2010). Further, although recent ACG guidelines emphasize colonoscopy as the preferred screening tool in

African Americans, the barriers preventing African Americans from participating in this method of screening have not been fully characterized.

Given these gaps in the literature, we aimed in this study to provide a systematic review of peer-reviewed material pertaining to barriers to colonoscopic screening in blacks. We used the three domains proposed by the IOM to categorize barriers and assessed studies for quality of reporting. Our findings inform clinicians, researchers, and healthcare organizations in the design of interventions to address barriers to colonoscopic screening among African Americans and to reduce disparities in CRC outcomes.

3.3 Methods

We conducted a search of the Medical Literature Analysis and Retrieval System Online (MEDLINE) and Cochrane Central Register of Controlled Trials (CENTRAL) databases with the guidance of an experienced university biomedical librarian. To perform a comprehensive search, we used keywords and Medical Subject Heading (MeSH) terms to combine the concepts of "colorectal cancer," "colonic polyps," "colonoscopy," "preventive health services," "barriers to healthcare," "health care disparities," "African Americans," and "minority groups" (**Figure 3.1**). The search was restricted to English language articles published between January 1950 and November 2013.

Studies that met the following inclusion criteria were considered: 1) evaluated African Americans between 45 to 75 years old; 2) identified at least one patient-, provider-, or system-level barrier to uptake of screening colonoscopy in African Americans; and 3) conducted in the U.S. Exclusion criteria were: 1) reported barriers to non-colonoscopic screening methods only; 2) aggregated data and outcomes for multiple methods of screening; 2) did not report barrier results specific to African Americans; and 3) only included participants with conditions known to confer increased CRC risk.

Two independent reviewers evaluated abstracts from the initial query results, and a third party resolved any discrepancies between reviewers. Full manuscripts for all relevant abstracts were reviewed, and those papers meeting inclusion and exclusion criteria were included in the study. The reviewers then checked the references of the selected manuscripts by hand and considered any studies meeting inclusion criteria that had not been identified in the initial query.

After selecting the final sample of studies, the two reviewers independently read each chosen manuscript and used a uniform spreadsheet to record data regarding the study design,

sample characteristics, sample size, percentage of blacks, statistical methods, and barriers to colonoscopy identified.

We defined "barriers" as influences hindering age-appropriate CRC screening by colonoscopy. Patient-level barriers included patient preferences and demographic factors that influence whether CRC screening is performed. Provider-related items were those factors specific to a provider's behavior or practice that affect whether CRC screening is offered or performed. System-level barriers were factors related to access to healthcare services, organization of the healthcare system, and healthcare system financing (Smedley et al.).

Studies were classified as "quantitative" if numeric data were generated by empirical statistical tests, standardized instruments and/or predetermined response categories. Studies were classified as "qualitative" if data were text-based and/or obtained by open-ended discussions, questions, and observations (Curry, Nembhard, & Bradley, 2009). To assess the quality of the qualitative interview and focus group studies, reviewers used the Consolidated Criteria for Reporting Qualitative Research (COREQ). COREQ is a comprehensive 32-item checklist created to promote complete and accurate reporting of qualitative studies (Tong, Sainsbury, & Craig, 2007). For the included observational studies, reviewers used the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines, a checklist of 22 items considered essential for the accurate reporting of observational studies (von Elm et al., 2014).

3.4 Results

3.4.1 Literature Search Results

We identified 468 abstracts in our initial query. Of these, we selected 162 for full-text review and ultimately included 19 publications in the final manuscript (Figure 3.2). One study of the 19 was identified during the manual search. We were unable to locate the full text of one article through the access of two university libraries (Paskett, Rushing, D'Agostino, Tatum, & Velez, 1997). Tables 3.1 and 3.2 summarize the subject population, study design, and findings of the included studies. The majority of studies included low-income subjects from community-based health centers or primary care facilities in urban areas of the U.S. Study samples were mutually exclusive with the exception of the two Winterich et al studies.

For the 8 included qualitative studies, the range of reported COREQ items was 16 to 25 items out of 32 with a mean of 19 items. For the 11 observational studies, the range of completed STROBE checklist items was 16 to 21 items out of 22 with a mean of 17 items. A total of 17 studies evaluated patient-level factors, 11 studies evaluated provider-level factors, and 7 studies evaluated system-level factors (Figure 3.3).

Figure 3.4 synthesizes the several identified patient-, provider-, and system-level barriers to utilization of CRC screening colonoscopy in African Americans. While our systematic review of the literature identified many additional demographic barriers to screening such as patient income, education, and age, our model includes only barriers that are salient to blacks and to colonoscopy and that are most modifiable by public health or healthcare interventions. Below, we review the specific barriers identified within each of the patient-, provider-, and system-level domains.

3.4.2 Patient-Level Barriers

We identified several patient-level barriers among African Americans, including fear, poor knowledge of CRC risk, lack of knowledge about screening, low perceived benefit of colonoscopy, absence of symptoms, low education level, cancer fatalism, and others (Beeker, Kraft, Southwell, & Jorgensen, 2000; Benarroch-Gampel et al., 2012; Holt et al., 2009; James, Daley, & Greiner, 2011; Janz, Wren, Schottenfeld, & Guire, 2003; Palmer, Midgette, & Mullan, 2010; Ruggieri et al., 2013; Wilkins et al., 2012; Winterich et al., 2011).

3.4.2.1 Fear

Fear was cited in 11 studies and was the most prevalent barrier to colonoscopic screening among blacks. Studies identified several types of patient fear: 1) fear of pain during colonoscopy; 2) fear of feeling invaded during colonoscopy; 3) fear of the bowel preparation prior to the procedure; 4) fear of sedation or of the hospital setting; and 5) fear of receiving a cancer diagnosis (Bass et al., 2011; Beeker et al., 2000; Benarroch-Gampel et al., 2012; Consedine, Ladwig, Reddig, & Broadbent, 2011; Holt et al., 2009; James, Campbell, & Hudson, 2002; James et al., 2011; Janz et al., 2003; Palmer, Midgette, & Dankwa, 2008; Ruggieri et al., 2013; Wilkins et al., 2012; Winterich et al., 2009).

Fear of perceived "invasion" during colonoscopy was a common theme among African American males in particular (Bass et al., 2011; Beeker et al., 2000; Benarroch-Gampel et al., 2012; Holt et al., 2009; James et al., 2011; Palmer et al., 2008; Ruggieri et al., 2013; Winterich et al., 2009). Male participants in focus groups and cognitive interviews described colonoscopy as "offensive," "violating," and "treading on my masculinity" (Beeker et al., 2000; Ruggieri et al., 2013; Winterich et al., 2009). Another prevalent type of fear stemmed from concerns about being

diagnosed with CRC and of undergoing cancer treatment (Bass et al., 2011; Benarroch-Gampel et al., 2012; James et al., 2011; Palmer et al., 2008; Wilkins et al., 2012). In addition, qualitative study participants described fear of "prolonged illness" and an inability to be cured (Benarroch-Gampel et al., 2012). Nonetheless, those who believed that the benefits of cancer screening outweighed the risks of being diagnosed with cancer were more likely to undergo screening in studies (Bass et al., 2011; Palmer et al., 2008; Sabatino et al., 2012). Further, compared to patients who had never undergone colonoscopic screening, patients who had undergone colonoscopy were less fearful of repeating the procedure and were more likely to prefer colonoscopy to other methods of screening in the future (Bass et al., 2011; Holt et al., 2009).

3.4.2.2 Knowledge and Perceived Susceptibility

We identified several knowledge barriers to colonoscopic screening uptake: 1) low perceived CRC risk, 2) lack of understanding of the purpose of screening, and 3) low perceived benefit of CRC screening (Bass et al., 2011; Benarroch-Gampel et al., 2012; James et al., 2002; James et al., 2011; Janz et al., 2003; Palmer et al., 2008; Taylor et al., 2003; Winterich et al., 2011). In studies, blacks were often not aware of a high risk of CRC in their racial subgroup (James et al., 2011; Palmer et al., 2008; Taylor et al., 2003). For example, in one survey of 76 African American participants, only 16% believed that blacks had a higher risk of CRC than whites. Further, only 53% of black participants believed that CRC was preventable (Taylor et al., 2003). In one telephone interview study of 635 Georgia residents, African American participants reported absence of symptoms as the main reason that screening was "unnecessary" (James et al., 2002; James et al., 2011). A need for more public awareness about CRC risk and screening was also emphasized. Participants in qualitative studies expressed concerns that the benefits of CRC

screening were not publicized as widely as breast and prostate cancer in their communities (Bass et al., 2011; James et al., 2011).

3.4.2.3 Other Patient-Level Barriers

The existing literature demonstrates that competing factors such as personal or financial obligations, life stressors, an inability to find transportation to or from a procedure, and concerns about other more pressing illness or comorbidity also present barriers to colonoscopic screening among blacks (James et al., 2011; Lukin et al., 2012; Palmer et al., 2008; Tabbarah, Nowalk, Raymund, Jewell, & Zimmerman, 2005; Wilkins et al., 2012).

3.4.3 Provider-Level Barriers

Provider-level barriers to screening included lack of provider recommendation for colonoscopy, insufficient patient counseling about screening, poor knowledge of CRC screening guidelines in African Americans, lack of provider recognition of barriers, and long wait times at provider offices (Bass et al., 2011; Benarroch-Gampel et al., 2012; Dimou et al., 2009; James et al., 2002; James et al., 2011; Janz et al., 2003; Palmer et al., 2008; White, Sahu, Poles, & Francois, 2012; Wilkins et al., 2012; Winterich et al., 2011).

3.4.3.1 Provider Knowledge

There is continued controversy about the age to initiate CRC screening in blacks. In a cross-sectional survey of 512 physicians in 2012, 28% of physicians identified 45 years as the age to initiate colonoscopic screening in African Americans while the remaining suggested initiation at age 50 (White et al., 2012). African American physicians were more likely than their

non-African American counterparts to report the 45-year-old screening threshold (66.7% vs. 27.8%; p=0.01). In two surveys of internal medicine resident physicians at an urban, academic medical center, physicians were unaware of previously identified barriers to colonoscopic screening among blacks and barriers deemed important by their African American patients (Dimou et al., 2009; Wilkins et al., 2012). Moreover, resident trainees in one of these surveys did not recognize the importance of several facilitating factors that might motivate their African American patients to undergo screening, including receiving a physician's recommendation for colonoscopy, the ability to remove pre-cancerous growths, and believing that the benefit of colonoscopy was "worth the effort" (Wilkins et al., 2012).

3.4.3.2 Physician Counseling Practices

Lack of a physician recommendation is the most frequently reported provider barrier to colonoscopic screening, and several studies demonstrate the importance of provider recommendation (Bass et al., 2011; James et al., 2002; James et al., 2011; Palmer et al., 2008; Winterich et al., 2011). One study demonstrated that lack of a physician recommendation strongly predicted lack of screening uptake (James et al., 2002). Two studies demonstrated a positive association between physician recommendation and colonoscopy completion, with rates as high as 88-92% among those receiving a physician endorsement for the procedure (Tabbarah et al., 2005; Wilkins et al., 2012).

Another documented provider-level barrier was insufficient time for patient-provider communication to discuss colonoscopy during the patient encounter. In interviews of 635 rural participants, blacks were significantly more likely than whites to believe that insufficient provider contact time served as a barrier to screening (Janz et al., 2003).

3.4.4 System-Level Barriers

In our review, we identified several system-level barriers to screening colonoscopy in African Americans. These included the cost of the colonoscopy procedure, inadequate healthcare insurance coverage for the procedure, few specialist referrals, and limited interactions with a primary care physician (Benarroch-Gampel et al., 2012; James et al., 2011; Janz et al., 2003; Lukin et al., 2012; Palmer et al., 2008; Tabbarah et al., 2005).

3.4.4.1 Financial Barriers and Lack of Insurance

The direct financial costs of colonoscopy were widely expressed as barriers to screening in the studies we identified. Procedural costs were prohibitive not only for uninsured African Americans but as well for African Americans with insurance but without provisions that covered the procedure (Benarroch-Gampel et al., 2012; James et al., 2011; Janz et al., 2003; Palmer et al., 2008; Tabbarah et al., 2005). Cost was also a reported barrier for insured patients with high insurance copays (Palmer et al., 2008).

3.4.4.2 Primary Care Provider Visits

Infrequent interaction with a primary care provider (PCP) was a reported barrier to colonoscopic screening. As demonstrated in a cross-sectional study of 157 patients with a primary medical doctor at Mount Sinai Hospital in New York, a higher proportion of colonoscopies was completed in patients with three or more visits to their primary doctor within one year than in those with fewer than three visits (Lukin et al., 2012). This finding emphasizes

that how patients are seen within the healthcare system plays a role in the uptake of preventive practices.

3.5 Discussion

3.5.1 Key Findings and Implications

Disparities exist across the entire cancer control continuum in the U.S. Given its impact as the third most common malignancy in the U.S. and the potential for prevention, the American Cancer Society has identified increasing CRC screening as a priority for cancer prevention and control (ACS, 2014). Despite United States Preventive Service Task Force (USPSTF) recommendations that all Americans aged 50-75 undergo screening for CRC and more recent recommendations by the ACG to screen African Americans at age 45 with colonoscopy, blacks face poor screening uptake (Whitlock, Lin, Liles, Beil, & Fu, 2008). In effort to improve screening uptake, this systematic review identifies patient-, provider-, and system-level barriers to colonoscopic CRC screening in African Americans.

By systematically reviewing the existing literature on barriers to colonoscopic screening in blacks, we aimed to summarize the barriers in each domain of the IOM inequities in healthcare model, recognizing that each domain contributes individually to screening uptake while also interacting with the other domains. For example, an individual's knowledge about CRC risk or perceived susceptibility for disease may influence the number of primary care visits he attends. Further, poor access to gastroenterology specialists within a healthcare system may influence whether a provider recommends screening colonoscopy. It is the interaction between these patient, provider, and system contributors that underlie the complex nature of CRC screening disparities.

One of the key themes we identified is that unmitigated fear strongly undermines colonoscopic screening in blacks. This finding is consistent with the literature on barriers to screening for prostate and breast cancer. In prostate cancer, procedural fear and concerns of

invasion are more prevalent among African American men than non-African American men (Bass et al., 2011; Benarroch-Gampel et al., 2012; Ruggieri et al., 2013; Winterich et al., 2009). Black males are more likely to report an affront to their masculinity, fear of invasion, and/or discomfort with digital rectal examination than white males (Bloom et al., 2006; Consedine et al., 2007; Lee, Consedine, & Spencer, 2011). With regard to fear of a cancer diagnosis, the breast cancer literature supports that African American women are often deterred from mammographic screening because of concern for a breast cancer diagnosis (Peek, Sayad, & Markwardt, 2008). While an emphasis has been placed on colonoscopic screening in blacks, procedural resistance may imply a role of other screening modalities to overcome these fear barriers. Insistence on colonoscopy over other screening tests like FOBT, Fecal Immunochemical Testing (FIT), or stool DNA may only further promote disparities in screening.

Physician-level factors also negatively impact African Americans eligible for CRC screening. Failure of providers to recommend CRC screening remains prevalent and is likely driven by factors that undermine adherence to other practice guidelines in medicine like physician knowledge, lack of outcome expectancy, lack of time and resources, and lack of reimbursement (Cabana et al., 1999; Lomas et al., 1989; Woolf, 1993). With respect to recommending CRC screening in blacks specifically, these factors are compounded by a lack of consensus among medical societies about the appropriate age of and method for initiation of CRC screening in blacks.

Patient decisions also depend on how CRC screening is offered. In a cross-sectional study of over 13,000 patients, Jones and colleagues found that when two or more screening options are presented, there is increased confusion and decreased adherence to CRC screening by any method in both white and African American patients (Jones, Vernon, & Woolf, 2010). In a 2012

randomized trial investigating adherence to CRC screening, Inadomi and colleagues demonstrated that the highest rates of CRC screening among blacks were achieved when patients were counseled to undergo FOBT (56%) or were offered a choice between FOBT and colonoscopy (54%). Similar to the Jones et al study, the highest rates of colonoscopy, were achieved when the colonoscopy option was presented alone (34% in the colonoscopy arm vs. 20% in the choice arm) (Inadomi et al., 2012).

3.5.2 Suggested Directions for Future Research

Our findings inform future approaches to address barriers to screening colonoscopy in African Americans.

3.5.2.1 Patient-Level Barriers and Future Strategies

In light of the pervasive deterrent role of fear among black Americans considering cancer screening, future interventions should focus on strategies to understand and confront this barrier. Our findings encourage interventions that employ peer support and community education to help allay patient fears of screening with colonoscopy. This approach will involve the creation of evidence-based, tailored interventions to directly and responsibly address the maladaptive cognitions that undermine receipt of colonoscopy.

Poor patient knowledge about CRC risk and susceptibility suggests that enhancing patient knowledge about colonoscopy may improve uptake rates among African Americans. In one study, blacks who completed screening advocated for education strategies to implore others to do the same (Bass et al., 2011). These screened patients have suggested educating the African American community via wellness vans, empowering community organizations with knowledge,

and using influential individuals as advocates (Bass et al., 2011; May, Whitman, Varlyguina, Bromely, & Spiegel, 2014). While the data supporting community- and peer-based education are limited in CRC, the Community Preventive Services Task Force emphasizes the benefits of such methods for other malignancies and suggests further investigations in CRC (Sabatino et al., 2012).

3.5.2.2 Provider-Level Barriers and Future Strategies

Given the importance of patient-provider communication, future interventions should evaluate the most effective ways for providers to discuss screening with patients and increase provider knowledge of patient barriers to screening. In addition, we should develop models and tools that encourage shared decision-making about CRC screening between African American patients and their care providers. That patients encouraged by physicians to pursue colonoscopy are very likely to complete screening activities speaks to the powerful influence providers have concerning patient screening behaviors (Tabbarah et al., 2005; Wilkins et al., 2012). Lastly, future research must determine whether optimal physician counseling practices are to suggest colonoscopy alone or to provide a menu of screening options to black patients.

3.5.2.3 System-Level Barriers and Future Strategies

The prevailing system barriers to offering colonoscopy screening in African Americans are the direct costs of screening, inadequate health insurance coverage, fewer PCP visits, and poor access to specialists. The Affordable Care Act (ACA) may provide an opportunity to reduce barriers to screening by providing improved access to care and eliminating copays for preventive

services (NAS, 2014). However, there remain uncertainties about the ACA's potential to eliminate disparities in CRC screening for African Americans. First, as the ACA mandates coverage for CRC screening according to USPSTF guidelines, the reform will not apply to screening at age 45 in blacks, as recommended by the ACG. Second, insurance coverage alone may not be sufficient to improve screening uptake. As a proxy for predicting the response to the ACA, investigators studied the impact of fee waivers on colonoscopies for members of the University of Texas health plan starting in 2009 (Khatami et al., 2012). The study demonstrated a limited but significant increase in colonoscopies by 1.5%, concluding that measures beyond elimination of financial barriers are needed to impact rates of colonoscopic screening in the U.S. (Khatami et al., 2012). Third, the preventive medicine literature reveals that when previously uninsured patients gain coverage, there is usually a delay before they use services at rates equal to continuously insured patients (Sudano & Baker, 2003). Future studies should investigate the effect of the ACA and Medicaid expansion on CRC screening uptake specifically in African Americans not only immediately after the expansion, but also over time.

Also at the systems level, efforts should be made to standardize screening recommendations for blacks given the lack of consensus among the major medical societies on the recommended age of initiation and screening modality. If the ACG and other national societies recommend screening initiation at age 45 for blacks, we must evaluate the effect that earlier screening has on uptake of colonoscopy and CRC outcomes in African Americans. Likewise, there is a need for a better understanding of how a strong recommendation for colonoscopy over other screening methods influences screening uptake and CRC outcomes in blacks. Lastly, given the indirect costs and burden of pursuing colonoscopy, system-level

interventions might include assistance programs and ancillary provider liaison programs to reduce the logistical conflicts to obtaining colonoscopy.

3.5.3 Study Strengths

There were several strengths to this study. First, we focused on a high-risk and under-screened population with poor CRC outcomes. Second, we specified barriers to colonoscopic screening, which is highly promoted among blacks but understudied. As professional societies begin to consider tailored screening recommendations for African Americans, this information will help determine the feasibility of recommending colonoscopic screening over other modalities. Third, all of the studies included in our review reported a majority of the quality checklist criteria. Lastly, our findings inform physicians, investigators, and healthcare organizations as they design and test targeted interventions to address the many barriers to colonoscopic screening in blacks.

3.5.4 Study Limitations

The limitations of this study are similar to those of other systematic reviews. We relied on published literature only, which can result in publication bias. In addition, given that multiple studies did not address all of the IOM domains and that primary studies may not have reported outcomes that were facilitators to colonoscopy, the review may also be biased by selective reporting. The majority of studies included African American subjects from low- and middle-income settings. Thus, our findings may not be representative of blacks in higher socioeconomic standing. While our intentions were to review and summarize facilitators and barriers to colonoscopic screening in African Americans, several of the factors identified and depicted in our conceptual model may not be specific to blacks. Concepts like fear, susceptibility, cost, and

provider knowledge of clinical guidelines appear to affect blacks disproportionately in the literature, while factors like insurance and frequency of primary provider visits are also contributors in non-African Americans (Bloom et al., 2006; Consedine et al., 2007; Janz et al., 2003; Lee et al., 2011). Finally, while we make several suggestions for future interventions, it is difficult to prioritize these efforts or to be certain that the proposed solutions will ultimately mitigate disparities in CRC screening in African Americans. Further work in this area will be useful to determine which factors have the greatest impact on increasing the uptake of colonoscopy.

3.5.5 Conclusion

In conclusion, the findings of our study imply strategies for clinicians, researchers, and health systems to improve utilization of colonoscopic screening in black Americans. In this era of healthcare reform, it is now possible for physicians and patients to engage in an open dialogue about CRC screening without the shroud of financial impossibility that has previously stifled many patients' ability to receive appropriate care. The onus now falls upon patients and providers to utilize these services and on researchers and healthcare organizations to determine how to translate our knowledge about screening barriers into equitable delivery of CRC screening to all Americans.

3.6 Tables and Figures

Figure 3.1: Medline search terms

((colorectal cancer OR colorectal neoplasm OR colorectal tumor OR colorectal carcinoma OR CRC OR colorectal adenoma) OR Colorectal Neoplasms [MeSH] OR ((polyp OR polyps) AND (colon OR colonic)) OR Colonic Polyps [MeSH]) AND (colonoscop* OR Colonoscopy [MeSH] OR Colorectal Neoplasms/diagnosis [MeSH] OR Early Detection of Cancer [MeSH] OR screening OR prevention OR early detect* OR Diagnostic Tests, Routine [MeSH] OR Mass Screening [MeSH] OR Preventive Health Services [MeSH]) AND (African Americans [MeSH] OR ("African" AND American*) OR ("black" AND American*) OR minorit* OR Minority Groups [MeSH] OR Minority Health [MeSH]) AND (Patient Acceptance of Health Care [MeSH] OR (barrier* AND (screening OR testing)) OR Health Services Accessibility [MeSH] OR (disparity OR disparities) OR Health Education [MeSH] OR Healthcare Disparities [MeSH] OR health care seeking behavior OR attitude*) AND English [lang] AND ("1950/01/01"[PDAT]:"3000/12/31"[PDAT])

Figure 3.2: Results of literature search

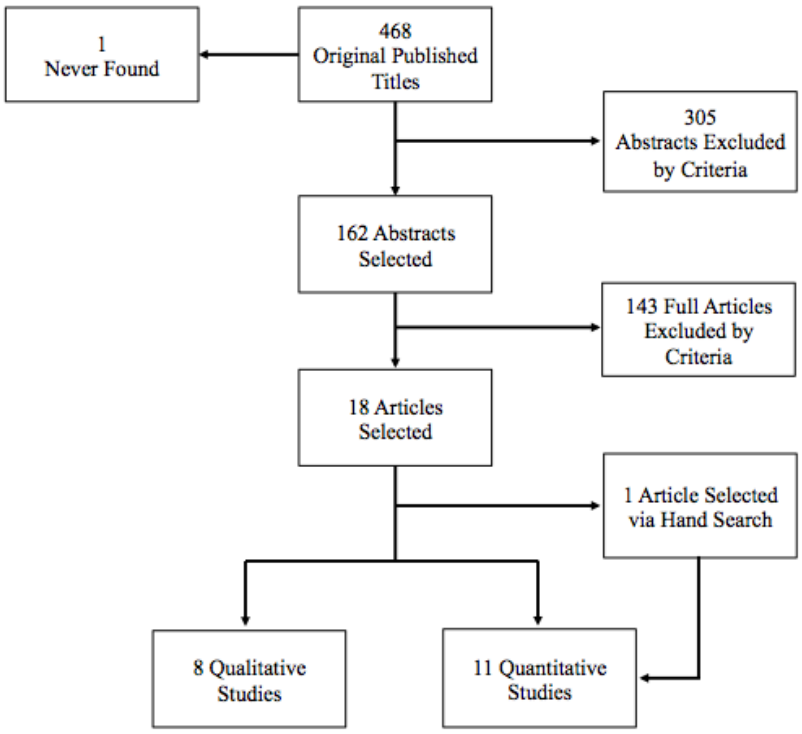


Table 3.1: Barriers to colonoscopic screening in African Americans: qualitative studies

Study	Subject Population	% AA	Study Design	Patient Barriers	Provider Barriers	System Barriers	Study Quality Assessment
James *et al*, 2011 (von Elm et al., 2014)	38 low-income adults at an urban community health center	100	Cross-sectional interviews and focus groups	Knowledge, fear (pain, invasion, cancer diagnosis and treatment), colonoscopy bowel preparation, cost, mistrust of provider and system	Insufficient counseling and long wait times with primary care provider		25 of 32 COREQ items
Palmer et al, 2010 (Paskett et al., 1997)	60 adults with no history of colon cancer in an urban community health center in Washington DC	100	Cross-sectional interviews	Colonoscopy bowel preparation, perceived high risk and low benefit of colonoscopy, fear (invasion, sedation, and hospital/clinic setting)		Lack of insurance	16 of 32 COREQ items
Winterich et al*, 2011 (James et al., 2011)	65 men with three levels of education from urban and rural settings in North Carolina	54	Cross-sectional interviews	Low education, fear of pain, and fear of invasion			18 of 32 COREQ items
Bass et al, 2011 (Wilkins et al., 2012)	23 low-income and insured adults from clinic at large urban hospital	100	Cross-sectional focus groups	Knowledge, fear (procedure, invasion, cancer diagnosis), and perceived lack of benefit of screening	Insufficient counseling and lack of physician recommendation		21 of 32 COREQ items
Holt et al, 2009 (Beeker et al., 2000)	165 adults from rural and urban counties in Alabama with high projected rates of colon cancer	59	Cross sectional focus groups	Knowledge, low perceived risk of cancer, and fear (pain, cancer diagnosis, invasion embarrassment)	Lack of physician recommendation		21 of 32 COREQ items

Winterich et al*, 2009 (Ruggieri et al., 2013)	64 men with three levels of education from urban and rural settings in North Carolina	55	Cross-sectional interviews	Fear of invasion		Financial barriers, lack of insurance and lack of referral	19 of 32 COREQ items
Palmer et al, 2008 (Winterich et al., 2011)	36 adults with no history of colon cancer from urban setting in Washington DC	100	Cross-sectional interviews	Knowledge, lack of understanding of procedure, low perceived risk of cancer, fear (pain, invasion, cancer diagnosis), mistrust of provider, competing priorities, and transportation	Lack of physician recommendation	Financial barriers, lack of insurance and of referral	20 of 32 COREQ items
Beeker et al, 2000 (Tong et al., 2007)	Approximately 140 insured adults from urban and rural settings in several states	Not Stated	Cross-sectional focus groups	Fear and anxiety of invasion			12 of 32 COREQ items

** These two studies used the same study population in 2002 and in 2009
AA, African American; COREQ, Consolidated criteria for reporting qualitative research

Table 3.2: Barriers to colonoscopic screening in African Americans: quantitative studies

Study	Subject Population	% AA	Study Design	Patient Barriers	Provider Barriers	System Barriers	Study Quality Assessment
Ruggieri et al, 2013 (Janz et al., 2003)	102 patients in an urban setting and 29 internal medicine residents	95	Cross-sectional survey	Fear (cancer, complications, pain), embarrassment, bothersome preparation, and cancer fatalism	Physicians did not identify: 1) patient barriers (fear of pain, cancer diagnosis, embarrassment, and bowel preparation); 2) patient motivations (screening to avoid illness, removing pre-cancerous growths, and; 3) patient facilitators (physician recommendation, accuracy of colonoscopy, and peace of mind)		17 of 22 STROBE items
Lukin et al, 2012 (James et al., 2002)	157 unscreened patients in urban New York setting	100	Cross sectional interviews and chart review within randomized trial	Non-significant trend between comorbid conditions and unscreened status		Higher proportion of colonoscopies in patients with more primary care visits (p-value not reported)	17 of 22 STROBE items
White et al, 2012 (Consedine et al., 2011)	512 American Medical Association family practitioners, internists, and gastroenterologists	1.8	Cross-sectional web-based survey		28% correctly identified 45 as the age to screen AAs. AA physicians were more likely than non-AAs to identify this age (67% vs. 27.8%)		17 of 22 STROBE items
Wilkins et al, 2012	635 rural Georgia	20	Cross-sectional	Lack of understanding, fear (complication,	Insufficient time with physician was more likely	Financial barriers were	16 of 22 STROBE

(Benarroch-Gampel et al., 2012)	residents		interviews	bowel preparation, pain), lack of perceived benefit, lack of symptoms, and transportation problems were more likely to be reported by AAs than by whites	to be reported by AAs than by whites	more likely to be reported by AAs than by whites	items
Benarroch-Gampel et al, 2012 (Holt et al., 2009)	974,879 Texas Medicare Beneficiaries	7.2	Retrospectiv e review of Medicare claims	Low income negatively correlated with colonoscopy use			21 of 22 STROBE items
Consedine et al, 2011 (Bass et al., 2011)	245 AAs, Jamaicans, and European-Americans in urban New York	34	Cross-sectional survey	Fecal/rectal embarrassment and physician-patient intimacy embarrassment were reported by AAs and predicted screening. No difference across racial/ethnic groups			16 of 22 STROBE items
Ward et al, 2010 (Smedley et al.)	30 residents in an urban academic internal medicine program	13	Cross-sectional survey		Few residents perceived barriers including cost, access to care, need for referrals, and mistrust. Residents identified low patient knowledge, fear, logistics, bowel preparation, conflicting obligations, and comorbidities		14 of 22 STROBE items
Tabbarah et al, 2005 (Palmer et al., 2008)	375 low-income patients in urban Pennsylvania health centers	47	Cross-sectional telephone survey	Transportation problems were more likely to be reported by AAs than by whites		Financial barriers more likely reported by AAs than whites	20 of 22 STROBE items

Janz et al, 2003 (Palmer et al., 2010)	355 residents of urban Michigan	48	Cross-sectional telephone survey	Knowledge (AAs were more likely than whites to have never heard of colonoscopy)	Lack of physician recommendation for colonoscopy compared to FOBT or flex sig (p-value not reported). Recommendation associated with high colonoscopy completion (88-92%)		16 of 22 STROBE items
Taylor et al, 2003 (Sabatino et al., 2012)	74 patients in low-income, urban Seattle primary care center	100	Cross-sectional mail or telephone survey	16% believed AAs more likely than whites to get colon cancer. 53% believed colon cancer was preventable. Beliefs did not correlate with colonoscopy rates	Ever having a physician recommendation was associated with having had a colonoscopy in the last 10 years		17 of 22 STROBE items
James et al, 2002 (Winterich et al., 2009)	397 participants in church-based health programs in urban North Carolina	98	Cross-sectional telephone survey	Lack of symptoms and lower age negatively correlated with colonoscopy within the prior 5 years. Fear reported but did not correlate colonoscopy rates	Lack of physician recommendation negatively correlated with colonoscopy rates	Financial barriers reported did not correlate with colonoscopy rates	18 of 22 STROBE items

Unless noted in table, results reported are statistially significant.
AA, African American(s); STROBE, Strengthening the Reporting of Observational Studies in Epidemiology

Figure 3.3: Number of studies identifying patient, provider, and system barriers to colonoscopic screening in blacks

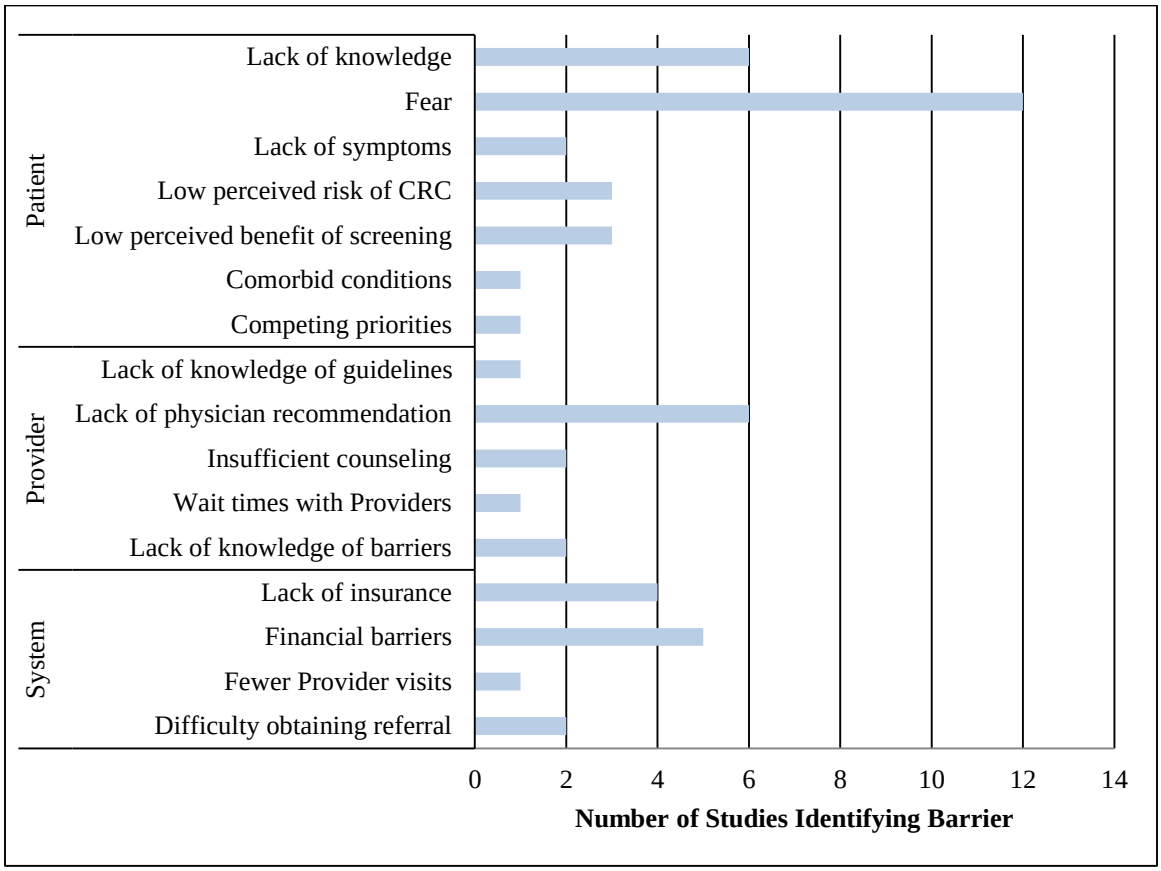
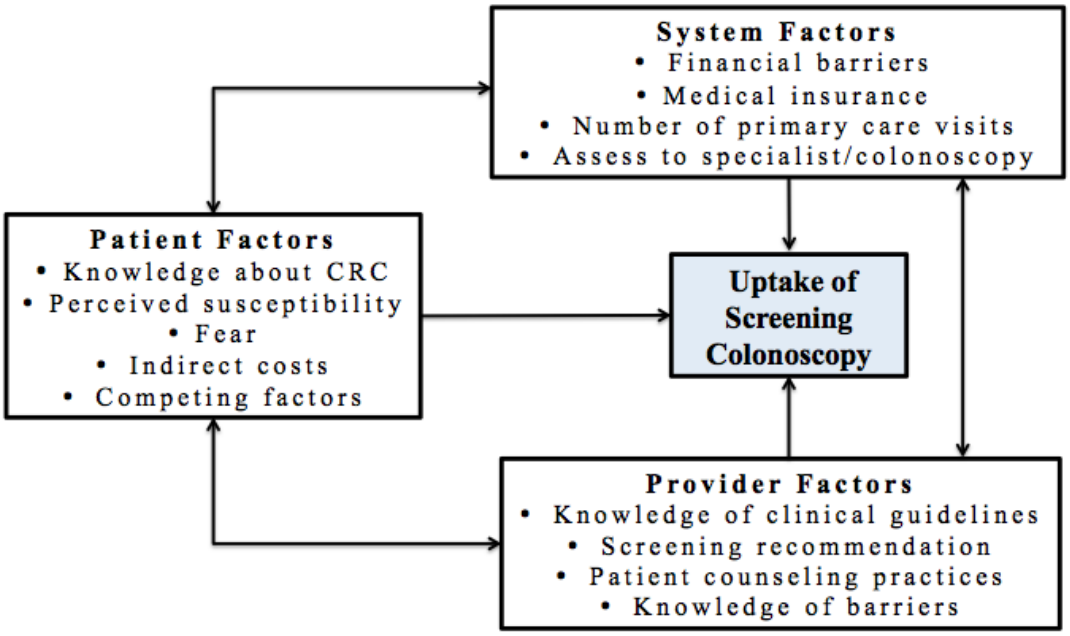


Figure 3.4. Summary of barriers to uptake of colonoscopic colorectal cancer screening among African Americans



3.7 References

ACS. (2014). American Cancer Society Cancer Facts & Figures for African Americans, 2013-2014. Atlanta: American Cancer Society.

Agrawal, S., Bhupinderjit, A., Bhutani, M. S., Boardman, L., Nguyen, C., Romero, Y., . . . Committee of Minority Affairs and Cultural Diversity, A.erican College of Gastroenterology. (2005). Colorectal cancer in African Americans. *Am J Gastroenterol, 100*(3), 515-523; discussion 514. doi: 10.1111/j.1572-0241.2005.41829.x

Ananthakrishnan, A. N., Schellhase, K. G., Sparapani, R. A., Laud, P. W., & Neuner, J. M. (2007). Disparities in colon cancer screening in the Medicare population. *Arch Intern Med, 167*(3), 258-264. doi: 10.1001/archinte.167.3.258

Bass, S. B., Gordon, T. F., Ruzek, S. B., Wolak, C., Ward, S., Paranjape, A., . . . Ruggieri, D. G. (2011). Perceptions of colorectal cancer screening in urban African American clinic patients: differences by gender and screening status. *J Cancer Educ, 26*(1), 121-128. doi: 10.1007/s13187-010-0123-9

Beeker, C., Kraft, J. M., Southwell, B. G., & Jorgensen, C. M. (2000). Colorectal cancer screening in older men and women: qualitative research findings and implications for intervention. *J Community Health, 25*(3), 263-278.

Benarroch-Gampel, J., Sheffield, K. M., Lin, Y. L., Kuo, Y. F., Goodwin, J. S., & Riall, T. S. (2012). Colonoscopist and primary care physician supply and disparities in colorectal cancer screening. *Health Serv Res, 47*(3 Pt 1), 1137-1157. doi: 10.1111/j.1475-6773.2011.01355.x

Bloom, J. R., Stewart, S. L., Oakley Girvan, I., Oakley-Girvans, I., Banks, P. J., & Chang, S. (2006). Family history, perceived risk, and prostate cancer screening among African American men. *Cancer Epidemiol Biomarkers Prev, 15*(11), 2167-2173. doi: 10.1158/1055-9965.EPI-05-0738

Cabana, M. D., Rand, C. S., Powe, N. R., Wu, A. W., Wilson, M. H., Abboud, P. A., & Rubin, H. R. (1999). Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA, 282*(15), 1458-1465.

CDC. (2010). Centers For Disease Control and Prevention: Vital signs: colorectal cancer screening among adults aged 50-75 years - United States, 2008. *MMWR Morb Mortal Wkly Rep, 59*(26), 808-812.

CDC. (2012). Centers for Disease Control and Prevention: Cancer screening - United States, 2010. *MMWR Morb Mortal Wkly Rep, 61*(3), 41-45.

Consedine, N. S., Horton, D., Ungar, T., Joe, A. K., Ramirez, P., & Borrell, L. (2007). Fear, knowledge, and efficacy beliefs differentially predict the frequency of digital rectal

examination versus prostate specific antigen screening in ethnically diverse samples of older men. *Am J Mens Health, 1*(1), 29-43. doi: 10.1177/1557988306293495

Consedine, N. S., Ladwig, I., Reddig, M. K., & Broadbent, E. A. (2011). The many faeces of colorectal cancer screening embarrassment: preliminary psychometric development and links to screening outcome. *Br J Health Psychol, 16*(3), 559-579. doi: 10.1348/135910710X530942

Cress, R. D., Morris, C. R., & Wolfe, B. M. (2000). Cancer of the colon and rectum in California: trends in incidence by race/ethnicity, stage, and subsite. *Prev Med, 31*(4), 447-453. doi: 10.1006/pmed.2000.0730

Curry, L. A., Nembhard, I. M., & Bradley, E. H. (2009). Qualitative and mixed methods provide unique contributions to outcomes research. *Circulation, 119*(10), 1442-1452. doi: 10.1161/CIRCULATIONAHA.107.742775

Dimou, A., Syrigos, K. N., & Saif, M. W. (2009). Disparities in colorectal cancer in African-Americans vs Whites: before and after diagnosis. *World J Gastroenterol, 15*(30), 3734-3743.

Doubeni, C. A., Laiyemo, A. O., Klabunde, C. N., Young, A. C., Field, T. S., & Fletcher, R. H. (2010). Racial and ethnic trends of colorectal cancer screening among Medicare enrollees. *Am J Prev Med, 38*(2), 184-191. doi: 10.1016/j.amepre.2009.10.037

Flocke, S. A., & Stange, K. C. (2004). Direct observation and patient recall of health behavior advice. *Prev Med, 38*(3), 343-349. doi: 10.1016/j.ypmed.2003.11.004

Holt, C. L., Shipp, M., Eloubeidi, M., Clay, K. S., Smith-Janas, M. A., Janas, M. J., . . . Fouad, M. N. (2009). Use of focus group data to develop recommendations for demographically segmented colorectal cancer educational strategies. *Health Educ Res, 24*(5), 876-889. doi: 10.1093/her/cyp024

Howlader, N. , Noone, AM. , & Krapcho, M. (2011). SEER Cancer Statistics Review, 1975-2008. Bethesda, MD: National Cancer Institute.

Inadomi, J. M., Vijan, S., Janz, N. K., Fagerlin, A., Thomas, J. P., Lin, Y. V., . . . Hayward, R. A. (2012). Adherence to colorectal cancer screening: a randomized clinical trial of competing strategies. *Arch Intern Med, 172*(7), 575-582. doi: 10.1001/archinternmed.2012.332

James, A. S., Campbell, M. K., & Hudson, M. A. (2002). Perceived barriers and benefits to colon cancer screening among African Americans in North Carolina: how does perception relate to screening behavior? *Cancer Epidemiol Biomarkers Prev, 11*(6), 529-534.

James, A. S., Daley, C. M., & Greiner, K. A. (2011). Knowledge and attitudes about colon cancer screening among African Americans. *Am J Health Behav, 35*(4), 393-401.

Janz, N. K., Wren, P. A., Schottenfeld, D., & Guire, K. E. (2003). Colorectal cancer screening attitudes and behavior: a population-based study. *Prev Med, 37*(6 Pt 1), 627-634.

Johnson-Jennings, M. D., Tarraf, W., Xavier Hill, K., & Gonzalez, H. M. (2014). United States colorectal cancer screening practices among American Indians/Alaska Natives, blacks, and non-Hispanic whites in the new millennium (2001 to 2010). *Cancer, 120*(20), 3192-3299. doi: 10.1002/cncr.28855

Jones, R. M., Vernon, S. W., & Woolf, S. H. (2010). Is discussion of colorectal cancer screening options associated with heightened patient confusion? *Cancer Epidemiol Biomarkers Prev, 19*(11), 2821-2825. doi: 10.1158/1055-9965.EPI-10-0695

Khatami, S., Xuan, L., Roman, R., Zhang, S., McConnel, C., Halm, E. A., & Gupta, S. (2012). Modestly increased use of colonoscopy when copayments are waived. *Clin Gastroenterol Hepatol, 10*(7), 761-766.e761. doi: 10.1016/j.cgh.2012.02.027

Klabunde, C.N, Brown, M, Ballard-Barbash, R, White, M.C, Thompson, T, Plescia, M , & King, S.C. (2012). Cancer Screening — United States, 2010. *MMWR, 61(03);41-45*.

Kravitz, R. L., Hays, R. D., Sherbourne, C. D., DiMatteo, M. R., Rogers, W. H., Ordway, L., & Greenfield, S. (1993). Recall of recommendations and adherence to advice among patients with chronic medical conditions. *Arch Intern Med, 153*(16), 1869-1878.

Lee, D. J., Consedine, N. S., & Spencer, B. A. (2011). Barriers and facilitators to digital rectal examination screening among African-American and African-Caribbean men. *Urology, 77*(4), 891-898. doi: 10.1016/j.urology.2010.11.056

Lomas, J., Anderson, G. M., Domnick-Pierre, K., Vayda, E., Enkin, M. W., & Hannah, W. J. (1989). Do practice guidelines guide practice? The effect of a consensus statement on the practice of physicians. *N Engl J Med, 321*(19), 1306-1311. doi: 10.1056/NEJM198911093211906

Lukin, D. J., Jandorf, L. H., Dhulkifl, R. J., Thélémaque, L. D., Christie, J. A., Itzkowitz, S. H., & Duhamel, K. N. (2012). Effect of comorbid conditions on adherence to colorectal cancer screening. *J Cancer Educ, 27*(2), 269-276. doi: 10.1007/s13187-011-0303-2

May, FP, Whitman, CB, Varlyguina, K, Bromely, EG, & Spiegel, BM. (2014). Addressing low colorectal cancer screening in African Americans: focus groups reveal how to develop an effective intervention. *Gastroenterology*(2014;146:S-548).

McLachlan, S. A., Clements, A., & Austoker, J. (2012). Patients' experiences and reported barriers to colonoscopy in the screening context--a systematic review of the literature. *Patient Educ Couns, 86*(2), 137-146. doi: 10.1016/j.pec.2011.04.010

NAS. (2014) *National Academy of Sciences: Population Health Implications of the Affordable Care Act: Workshop Summary*. Washington DC: 2014 by the National Academy of Sciences.

Nelson, R. L., Persky, V., & Turyk, M. (1999). Carcinoma in situ of the colorectum: SEER trends by race, gender, and total colorectal cancer. *J Surg Oncol, 71*(2), 123-129.

O'Malley, A. S., Forrest, C. B., Feng, S., & Mandelblatt, J. (2005). Disparities despite coverage: gaps in colorectal cancer screening among Medicare beneficiaries. *Arch Intern Med, 165*(18), 2129-2135. doi: 10.1001/archinte.165.18.2129

Palmer, R. C., Midgette, L. A., & Dankwa, I. (2008). Colorectal cancer screening and African Americans: findings from a qualitative study. *Cancer Control, 15*(1), 72-79.

Palmer, R. C., Midgette, L. A., & Mullan, I. D. (2010). Colorectal cancer screening preferences among African Americans: which screening test is preferred? *J Cancer Educ, 25*(4), 577-581. doi: 10.1007/s13187-010-0081-2

Paskett, E. D., Rushing, J., D'Agostino, R., Tatum, C., & Velez, R. (1997). Cancer screening behaviors of low-income women: the impact of race. *Womens Health, 3*(3-4), 203-226.

Peek, M. E., Sayad, J. V., & Markwardt, R. (2008). Fear, fatalism and breast cancer screening in low-income African-American women: the role of clinicians and the health care system. *J Gen Intern Med, 23*(11), 1847-1853. doi: 10.1007/s11606-008-0756-0

Pignone, M., Rich, M., Teutsch, S. M., Berg, A. O., & Lohr, K. N. (2002). Screening for colorectal cancer in adults at average risk: a summary of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med, 137*(2), 132-141.

Rex, D. K., Johnson, D. A., Anderson, J. C., Schoenfeld, P. S., Burke, C. A., Inadomi, J. M., & Gastroenterology, American College of. (2009). American College of Gastroenterology guidelines for colorectal cancer screening 2009 [corrected]. *Am J Gastroenterol, 104*(3), 739-750. doi: 10.1038/ajg.2009.104

Ruggieri, D. G., Bass, S. B., Rovito, M. J., Ward, S., Gordon, T. F., Paranjape, A., . . . Ruzek, S. B. (2013). Perceived colonoscopy barriers and facilitators among urban African American patients and their medical residents. *J Health Commun, 18*(4), 372-390. doi: 10.1080/10810730.2012.727961

Sabatino, S. A., Lawrence, B., Elder, R., Mercer, S. L., Wilson, K. M., DeVinney, B., . . . Force, Community Preventive Services Task. (2012). Effectiveness of interventions to increase screening for breast, cervical, and colorectal cancers: nine updated systematic reviews for the guide to community preventive services. *Am J Prev Med, 43*(1), 97-118. doi: 10.1016/j.amepre.2012.04.009

Smedley, BD, Stith, AY, Nelson, AR, & eds. Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care. *Washington, D.C.: National Academies Press*.

Sudano, J. J., & Baker, D. W. (2003). Intermittent lack of health insurance coverage and use of preventive services. *Am J Public Health, 93*(1), 130-137.

Tabbarah, M., Nowalk, M. P., Raymund, M., Jewell, I. K., & Zimmerman, R. K. (2005). Barriers and facilitators of colon cancer screening among patients at faith-based neighborhood health centers. *J Community Health, 30*(1), 55-74.

Taylor, V., Lessler, D., Mertens, K., Tu, S. P., Hart, A., Chan, N., . . . Thompson, B. (2003). Colorectal cancer screening among African Americans: the importance of physician recommendation. *J Natl Med Assoc, 95*(9), 806-812.

Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care, 19*(6), 349-357. doi: 10.1093/intqhc/mzm042

von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., Vandenbroucke, J. P., & Initiative, STROBE. (2014). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. *Int J Surg, 12*(12), 1495-1499. doi: 10.1016/j.ijsu.2014.07.013

Ward, S. H., Parameswaran, L., Bass, S. B., Paranjape, A., Gordon, T. F., & Ruzek, S. B. (2010). Resident physicians' perceptions of barriers and facilitators to colorectal cancer screening for African Americans. *J Natl Med Assoc, 102*(4), 303-311.

White, P. M., Sahu, M., Poles, M. A., & Francois, F. (2012). Colorectal cancer screening of high-risk populations: A national survey of physicians. *BMC Res Notes, 5*, 64. doi: 10.1186/1756-0500-5-64

Whitlock, E. P., Lin, J. S., Liles, E., Beil, T. L., & Fu, R. (2008). Screening for colorectal cancer: a targeted, updated systematic review for the U.S. Preventive Services Task Force. *Ann Intern Med, 149*(9), 638-658.

Wilkins, T., Gillies, R. A., Harbuck, S., Garren, J., Looney, S. W., & Schade, R. R. (2012). Racial disparities and barriers to colorectal cancer screening in rural areas. *J Am Board Fam Med, 25*(3), 308-317. doi: 10.3122/jabfm.2012.03.100307

Winterich, J. A., Quandt, S. A., Grzywacz, J. G., Clark, P., Dignan, M., Stewart, J. H., & Arcury, T. A. (2011). Men's knowledge and beliefs about colorectal cancer and 3 screenings: education, race, and screening status. *Am J Health Behav, 35*(5), 525-534.

Winterich, J. A., Quandt, S. A., Grzywacz, J. G., Clark, P. E., Miller, D. P., Acuña, J., & Arcury, T. A. (2009). Masculinity and the body: how African American and White men experience cancer screening exams involving the rectum. *Am J Mens Health, 3*(4), 300-309. doi: 10.1177/1557988308321675

Woolf, S. H. (1993). Practice guidelines: a new reality in medicine. III. Impact on patient care. *Arch Intern Med, 153*(23), 2646-2655.

Zauber, A. G., Winawer, S. J., O'Brien, M. J., Lansdorp-Vogelaar, I., van Ballegooijen, M., Hankey, B. F., . . . Waye, J. D. (2012). Colonoscopic polypectomy and long-term

prevention of colorectal-cancer deaths. *N Engl J Med, 366*(8), 687-696. doi: 10.1056/NEJMoa1100370

Chapter 4:

Low Uptake Of Colorectal Cancer Screening Among African Americans in an Integrated Veterans Affairs Healthcare Network

4.1 Abstract

Introduction: Disparities in colorectal cancer (CRC) screening are the result of interplay between patient characteristics, provider practices, and attributes of the healthcare system. As inequalities in access to healthcare are minimized in the Veterans Affairs (VA) health system, the VA is an ideal setting to test whether patient-level and provider-level factors impact CRC screening after controlling for system-level factors. We examined rates and predictors of CRC screening uptake as well as time-to-screening in a population of African Americans and non-African Americans in a healthcare system that minimizes variation in insurance and access.

Methods: We studied a random sample of African American and non-African American Veterans in the VA Greater Los Angeles Healthcare System, an integrated network of 12 sites serving a racially- and ethnically-diverse population in Southern California. The primary outcomes were 1) uptake of any CRC screening procedure after the age of screening eligibility (age ≥50 for non-African Americans and African Americans before 2009 and age ≥45 for African Americans after 2009); and 2) uptake of colonoscopic screening after the age of screening eligibility. We performed logistic regression to compare screening uptake and predictors of screening in African Americans and non-African Americans and Cox proportional hazards regression analysis to compare time-to-screening.

Results: The overall screening rate by any method was 50% (N=357). Adjusted rates for any screening were lower among African Americans than non-African Americans (42%v.58%; OR=0.49,95%CI=0.31–0.77). Colonoscopic screening was also lower in African Americans (11%v.23%; adjusted OR=0.43,95%CI=0.24–0.77). Other than race, homelessness, lower service connectedness, taking more prescription drugs, and not seeing a primary care provider within two years of screening eligibility predicted lower uptake of screening. Time-to-screening colonoscopy screening was longer in African Americans (adjusted HR=0.43,95%CI=0.25–0.75).

Conclusions: We found marked disparities in CRC screening despite similar access to care across races. Despite current guidelines aimed to increase screening in African Americans, participation in screening remained low and use of colonoscopy was infrequent. Poor adherence to guidelines may be due to inadequate provider knowledge, failure of providers to recommend screening to African Americans, ineffective communication between providers and patients, or patient refusal of recommendations.

4.2 Introduction

The specific causes for colorectal cancer (CRC) outcome inequalities in African Americans are not fully characterized. Biologic susceptibility, a dietary proclivity to fats and red meats, increased smoking, social and economic disparities, and low utilization of screening methods have been implicated (Agrawal et al., 2005; Baquet & Commiskey, 1999; Butler et al., 2003). Particular attention has been paid to low adherence to screening guidelines among African Americans, and multiple studies demonstrate that African Americans are less likely to engage in CRC screening than non-African Americans (Agrawal et al., 2005; Ananthakrishnan, Schellhase, Sparapani, Laud, & Neuner, 2007; Benarroch-Gampel et al., 2012; Breen, Wagener, Brown, Davis, & Ballard-Barbash, 2001; CDC, 2010; Doubeni et al., 2010; Johnson-Jennings, Tarraf, Xavier Hill, & Gonzalez, 2014; Wilkins et al., 2012). In 2009, in response to evidence supporting a younger age of presentation and a high prevalence of proximal tumors in African Americans, the American College of Gastroenterology (ACG) updated CRC screening guidelines, suggesting initiation of CRC screening at age 45 and use of colonoscopy as the preferred screening modality in African Americans (Rex et al., 2009).

The 2002 Institute of Medicine (IOM) report, *Unequal Treatment: Confounding Racial and Ethnic Disparities in Health Care,* attributed healthcare disparities to the interplay between patient characteristics, provider practices, and attributes of the healthcare system (Smedley, Stith, & Nelson, 2003). Patient-level characteristics are defined as demographic and health characteristics unique to an individual that may predict or act as barriers to screening. Provider-related factors include specific practices or preferences that may determine whether screening is recommended by a clinician. System-level attributes are the aspects of the healthcare system that affect a patient's ability to obtain CRC screening.

The Veterans Affairs (VA) health system presents an ideal model to test whether patient and provider factors impact CRC screening after controlling for system-level factors. Because access inequalities are minimized in the VA, and given recent studies indicating fewer disparities in CRC treatment in VA settings, it is possible that CRC screening rates are equal between races in the VA population. However, the extent to which disparities in screening adherence currently exist in the VA population is unknown (Sabounchi, Keihanian, & Anand, 2012).

We aimed to determine rates of screening uptake and time to screening uptake in African American and non-African American Veterans in a large VA Healthcare System database. In addition, we sought to identify modifiable predictors of CRC screening in non-African American and African American Veterans using a conceptual framework accounting for a wide range of clinical and demographic characteristics.

4.3 Methods

4.3.1 Study Population and Data Collection

This study was reviewed and approved by the West Los Angeles-Veterans Affairs Institutional Review Board. We sought patients seeking care in the VA Greater Los Angeles Healthcare System, an integrated network of 12 sites serving a diverse population in Southern California. We used a random number generator to identify African Americans over age 45 years and non-African Americans over age 50 years. We then extracted demographic and clinical data from the VA electronic medical records, the Computerized Patient Record System (CPRS). Included subjects were eligible for initial CRC screening between January 1996 and October 2012. Before January 2009, all subjects were considered screening eligible after a 50^{th} birthday. Due to new screening recommendations for African Americans in the 2009 ACG CRC screening guidelines, we also included African Americans who turned 45 after 2009.

We excluded subjects with one or more of the following: 1) no VA CPRS chart notes within two years of his/her age of CRC screening eligibility; 2) a history of colon, rectal, or CRC diagnosed before his/her age of eligibility; 3) a colectomy performed before age of eligibility; 4) a recorded family history of colon, rectal, or CRC; 5) a history of ulcerative colitis or Crohn's disease; or 6) CRC screening at any time before his/her age of screening eligibility (colonoscopy, flexible sigmoidoscopy, colonography, barium enema, Fecal Immunochemical Testing (FIT) or Fecal Occult Blood Test (FOBT)).

4.3.2 Outcome Variables

The primary outcome was uptake of any CRC screening procedure after the age of screening eligibility (age ≥50 for non-African Americans and African Americans before 2009

and age ≥45 for African Americans after 2009). Included screening methods were those listed in the 2009 ACG guidelines: colonoscopy, flexible sigmoidoscopy, colonography, barium enema imaging, FIT, or FOBT. Secondary outcomes were uptake of colonoscopic screening and time-to-screening, which we calculated by subtracting the date of CRC screening from the date of screening eligibility. If multiple screening methods were employed, we used the date of the first screening test as the endpoint.

4.3.3 Predictor Variables

Prior to data collection, we created a conceptual model to delineate potential predictors and barriers to screening uptake. The conceptual framework was informed by the IOM disparities report and includes predisposing patient characteristics, provider practices, and system-level factors that predict or act as barriers to screening (Smedley et al., 2003). Using a standard data extraction form, we systematically extracted CPRS data for each included subject.

Demographic characteristics included sex, race/ethnicity, zip code, level of service connectedness to the VA, history of combat experience, marital status, employment, and housing status at age of eligibility. We also extracted health information from the age of screening eligibility for each subject, including physiological and psychological comorbidities, number of primary care physician visits, substance abuse history (alcohol, tobacco, and illicit drugs), and use of prescription medications, psychiatric medications, narcotics, NSAIDs and aspirin. We computed a Charlson Comorbidity Index score for each subject, where higher scores reflect greater disease burden (Charlson, Szatrowski, Peterson, & Gold, 1994). The index is a tool that has been validated for use in administrative databases, with a higher score corresponding to a larger burden of co-morbidity (Charlson et al., 1994; Deyo, Cherkin, & Ciol, 1992).

Specific information about subject socioeconomic status (SES) is not available in CPRS. As a proxy for SES, we used subject zip code and data on median income by zip code to compute a SES income variable for each subject. Data on median incomes were obtained from the American Community Survey (USCB, 2011). Estimates are based on five years of data collection within each zip code and are subdivided by race.

Service connectedness is a system-level variable for patients treated at VA hospitals based on the degree to which a given injury or condition can be attributed to military service experiences. In our analysis, service connectedness was a three-level variable, where patients with no service connectedness (none) were compared to those with 10-50% service connectedness (low) and those with more than 50% service connectedness (high). In the VA system, individuals with high service connectedness do not bear financial responsibility for screening services, while those with low service connectedness bear some financial responsibility. In addition to service connectedness, we documented if each subject had medical insurance and/or care outside the VA healthcare network.

4.3.4 Statistical Analyses

4.3.4.1 Sample Size Calculation

Our objective was to measure the independent effect of African American race on screening uptake while controlling for relevant confounders. To ensure the sample size was large enough to detect significant differences between African Americans and non-African Americans, we performed a power calculation using a two-sided test with 80% power. Based on prior literature estimates of a 41% screening rate in African Americans and a 56% screening rate

in non-African Americans, we determined that at least 174 individuals would be needed for each study group (Agrawal et al., 2005).

4.3.4.2 Data Analyses

For race, we used a dichotomous variable – African American versus all other racial/ethnic groups. The non-African American cohort included individuals of Caucasian, Hispanic, Asian, and other non-African American descent. We performed independent samples *t*-tests and chi-squared tests to examine differences in demographic variables between African American and non-African American subjects.

To examine predictors of screening utilization, we conducted both univariate and multivariate logistic regression analyses for screening by any method or by colonoscopy. We included predictors in multivariate models if univariate odds ratios had p-values <0.05 and adjusted correlated predictors to reduce overlapping variance. We then utilized Cox proportional hazard regression analyses to examine the effect of each predictor variable on time-to-screening uptake. Further, we explored predictors of screening in the overall study sample and in the subgroup of African Americans using the same approach. To examine differences in time-to-screening between African American and non-African Americans, we performed Kaplan-Meier survival analyses with log-rank testing. We applied censoring when a subject died before screening or if a subject remained unscreened at the end of the study. As less than 3% of the sample had missing data, we did not impute missing values.

4.3.4.3 Sensitivity Analyses

We performed two sensitivity analyses. First, we compared time-to-screening for African Americans over age 45 to time-to-screening for non-African Americans over age 50 in order to assess for an independent effect of the African Americans between ages 45 and 50 considered non-adherent to screening guidelines when guidelines changed in 2009. In our second sensitivity analyses, we excluded the small subset of non-African American minorities (Hispanic, Asian, and other non-Caucasians) from the non-African American sample to compare screening uptake between African Africans and Caucasians.

All analyses were conducted using SAS for Windows, version 9.3 (SAS Institute, Inc.; Cary, NC, USA).

4.4 Results

4.4.1 Descriptive Characteristics and Screening Uptake

Figure 4.1 details the inclusion and exclusion criteria that yielded our final sample of 357 subjects. As shown in **Table 4.1**, African Americans were significantly different from non-African Americans in frequency of homelessness ($p<0.01$), median income ($p<0.01$), number of primary care visits within two years of age of screening eligibility ($p<0.01$), and number of prescriptions at age of eligibility for screening ($p=0.03$).

A total of 179 (50%) subjects received CRC screening by at least one method. Forty-two percent of African Americans were screened by any method, compared to 58% of non-African Americans. In adjusted logistic regression analysis, African Americans were 51% less likely to receive screening by any method when compared to non-African Americans (adjusted OR=0.49, 95%CI=0.31–0.77). Colonoscopy uptake also varied by race. Overall, 17% of VA subjects were screened by colonoscopy. Eleven percent of African Americans were screened by colonoscopy, compared to 23% of non-African American subjects (adjusted OR=0.43, 95%CI=0.24–0.77).

Figure 4.2 demonstrates that time to screening by any method was significantly longer in African Americans vs. non-African Americans (adjusted HR = 0.63; 95%CI = 0.46–0.85). When we restricted the time-to-screening analyses to uptake of screening colonoscopy, time-to-screening in African Americans compared to non-African Americans was also longer (adjusted HR=0.43; 95%CI=0.25–0.75).

4.4.2 Predictors of Colorectal Cancer Screening Uptake

In addition to race, we identified several additional predictors of CRC screening uptake. Both unadjusted and adjusted odds ratios for key predictors of screening by any method are

shown in **Table 4.2**. African American race (OR=0.49, 95%CI=0.31–0.77), homelessness (OR=0.43, 95%CI=0.25–0.77), lack of a primary care visit within two years of screening eligibility (OR=4.86, 95%CI=2.10–11.26), greater use of prescription drugs (OR=0.75, 95%CI=0.61–0.93), and lower service connectedness (OR=1.33, 95%CI=1.01–1.77) were independent predictors of lower screening by any method.

When examining predictors of CRC screening by colonoscopy, African American race (OR=0.43, 95%CI=0.24–0.77) and lower service connectedness (OR=1.46, 95%CI=1.06–2.02) were predictive of lower screening uptake in adjusted multivariate models. When we examined time-to-screening, we found that both race (HR=0.63, 95%CI=0.46–0.85) and lack of primary care visits within two years of screening eligibility (HR=3.26, 95%CI=1.75–6.07) were significant in multivariate analyses, predicting greater time-to-screening by any method.

4.4.3 Race-Specific Predictors of Colorectal Cancer Screening

After determining an association between race and screening uptake, we sought predictors of screening within the subset of African Americans. Not visiting a primary care provider within two years of screening eligibility (adjusted OR=3.09, 95% CI=1.25–7.64) and homelessness (adjusted OR=0.47, 95% CI=0.24–0.95) were associated with lower screening uptake by any method for African Americans. No variables predicted uptake of screening by colonoscopy in African Americans.

4.4.4 Sensitivity Analyses: American College of Gastroenterology Guideline Changes and Other Minority Groups

To study the impact of the 2009 ACG CRC screening guideline changes, we performed a sensitivity analysis in which we compared screening uptake in African Americans vs. non-African Americans over the age of 50: uptake was 42.4% vs. 58.1%, respectively (p=0.003). Differences in uptake of colonoscopic screening also remained significant (11.1% vs. 22.9%; p=0.003) when only subjects aged 50 and older were included. Notably, only 6 additional African Americans became eligible for screening when the 2009 guideline change was applied.

In order to assess for possible bias from the inclusion of non-African American minority groups (Hispanic, Asian, and non-Caucasians), we also conducted a sensitivity analysis that excluded this subgroup from the dataset. When comparing African Americans to whites, uptake of any screening was 42.1% vs. 58.1% (p=.005) while uptake of colonoscopic screening was 11.2% vs. 22.8% (p=.006).

4.5 Discussion

4.5.1 Summary of Findings

We found that previously described disparities in uptake of CRC screening in African Americans were also evident in a sample of randomly selected patients in a large, urban VA healthcare network that minimizes variation in insurance and access to care. African Americans were 51% less likely to uptake CRC screening by any method. Further, despite ACG recommendations for screening by colonoscopy in African Americans, uptake of screening colonoscopy was 46% lower in African American Veterans than in non-African American Veterans in our adjusted models. These screening uptake patterns persisted over time in survival analysis.

When adjusting for race, homelessness, low service connectedness, greater use of prescription drugs, and lack of a primary care visit within two years of CRC screening eligibility independently predicted low screening. Notably, individuals with a primary care visit within two years of CRC screening eligibility were nearly four times more likely to have had at least one CRC screening test. For screening by colonoscopy, race and service connectedness again emerged as significant predictors. Further, when we examined the subset of African American Veterans, we found that a primary care visit within two years of screening eligibility and having a place of residence were associated with an increased likelihood of screening.

The 16% difference in overall screening uptake between African Americans and non-African Americans is within the range of the 6% to 18% discrepancy seen in the non-VA published literature (Agrawal et al., 2005; Ananthakrishnan et al., 2007; Services, 2012). Our finding of an 11% uptake of colonoscopy among African Americans is also consistent with prior research (Cooper & Koroukian, 2004; Shih, Zhao, & Elting, 2006). While racial differences in

CRC screening resolve after adjusting for SES in some studies, we did not identify an independent role of SES when adjusting for zip-code-based income (O'Malley, Forrest, Feng, & Mandelblatt, 2005). This may reflect smaller variations in SES status among VA patients versus other healthcare settings, or may reflect partial omitted variable bias in the use of zip-code-based income as a proxy for SES (Doubeni, Laiyemo, Reed, Field, & Fletcher, 2009; Seeff et al., 2004).

Use of primary care services as a predictor of CRC screening has been demonstrated in both African Americans and non African Americans in the literature (Seeff et al., 2004; Zapka, Puleo, Vickers-Lahti, & Luckmann, 2002). Similarly, there are known associations between having a usual place of medical care and uptake of prostate cancer screening in African American males as well as with uptake of breast and cervical cancer screening in African American women (Ross, Taylor, & Howard, 2011; Selvin & Brett, 2003). The common relationship across various screening programs emphasizes the role that regular use of medical care plays in uptake of screening and preventive services (Cronan et al., 2008). Perhaps more striking, our study demonstrates that even in a healthcare network where all Veterans have similar access to services, those subjects who see a primary care provider near the age of CRC screening eligibility are most likely to be enrolled in a screening program.

4.5.2 Study Strengths

Our study has several strengths. First, we employed a highly granular dataset in order to examine the relationship between race and screening uptake with great precision. By extracting detailed, patient- and provider-level information from VA records, we minimized the effect of system variation in utilization of healthcare services while collecting granular data to inform our

analyses. The VA provides medical services to all Veterans, regardless of race, personal income, ability to purchase insurance, education, occupation, and health status. In addition, individuals within the network have access to identical system-level benefits. By investigating the effect of patient, provider, and system-related characteristics on uptake of CRC screening in this population, we attempted to minimize confounding by issues of access to insurance, socioeconomic status, and the healthcare facility that complicate studies of healthcare inequities.

Second, the study population was selected to include only those subjects with a documented interaction with the healthcare network near the time of CRC screening eligibility. We sought to limit the analysis to individuals actually interacting with the system to minimize the likelihood that VA patients with no mechanism for preventative services or with established care outside the VA system were included in the study. Our sensitivity analyses suggest that even when we assume low-uptake of the 2009 ACG guidelines for earlier and more aggressive screening in African Americans, CRC screening within our VA network remains underutilized in African Americans. In addition, our sensitivity analysis suggests a relationship between African American race and screening uptake, even when we limited the study sample to African Americans over age 50. Lastly, incorporation of survival analysis for time-to-screening, application of the 2009 ACG guidelines, and focus on a system that attempts to minimize access to care disparities are strengths of our analysis and novel contributions to the literature.

4.5.3 Study Limitations

While use of a VA patient population was beneficial for further understanding of the factors that predict CRC screening, the population also presents limitations. First, it is difficult to extrapolate our findings outside of the Greater Los Angeles VA. In other healthcare networks

and in more diverse patient populations, there are system barriers to screening that are not encountered in the VA healthcare system – this is both a weakness and a strength that provides rationale for investigating this question in the VA. Lack of insurance coverage, lack of a usual source of healthcare, poor access to gastroenterologists, and difficulty navigating the healthcare system prevent some African Americans from getting screened in traditional settings (Holt et al., 2009; James, Daley, & Greiner, 2011; Patel et al., 2012). Further, given that the VA population is predominately male, we were unable to investigate the role of gender in adherence to CRC screening uptake. Previous literature suggests that CRC screening is higher in females; however, the small number of females in our study population precluded this analysis (Agrawal et al., 2005).

4.5.4 Implications of Findings

The results of our study may inform healthcare providers, patients, and designers of health policy. While modifications in CRC screening guidelines aim to assure that primary care providers and gastroenterologists employ best screening practices, disparities in health will persist unless we understand why guidelines are underused in some populations. Poor adherence to guidelines may be due to inadequate provider knowledge, failure of providers to recommend screening to African Americans, ineffective communication between providers and patients, or patient refusal of recommendations. As evidence supports guideline knowledge deficits among primary care providers and gastroenterologists, at least some of the disparities may be reversed with formal education about guidelines and quality assessment of adherence to guidelines among providers (White, Sahu, Poles, & Francois, 2012). Empowering African American patients with

information about their health risks and the benefits of screening is also imperative to improve screening uptake.

Efforts to improve provider and patient knowledge are fundamental now as the healthcare system in the United States evolves. With the advent of the Affordable Care Act and universal insurance, all Americans will have access to regular and continuous care. Our findings support the conclusions of other researchers that individuals with regular primary care demonstrate increased uptake of preventative services. Access without health knowledge does not guarantee patient or provider adherence, however. The incidence and mortality from CRC in African Americans can only improve if we identify pathways to increase awareness about screening benefits and underuse among both providers and patients.

4.5.5 Conclusions

In conclusion, our analysis suggests that disparities in CRC screening between African Americans and non-African Americans exist in a large, urban VA healthcare network. These inequities in health exist in a patient population that has the same source of healthcare and despite 2009 guidelines aimed to increase screening efforts in African Americans, confirming that there is still a need for focused and targeted efforts to address barriers to screening and screening colonoscopy in African Americans. Our findings also highlight that established primary care at the time of screening eligibility plays a significant role in screening uptake. As insurance coverage is extended to all Americans, it will be important to emphasize regular use of healthcare services in middle-aged adults and knowledge about the benefits of screening in order to increase CRC screening in African Americans and overall.

4.6 Tables and Figures

Table 4.1: Baseline characteristics of subjects eligible for CRC screening by race

	Total ***n = 357***	**African Americans** ***n = 178***	**Non African Americans** ***n = 179***	***p*** **Value**
Male Gender, *n* (%)	332 (93%)	169 (95%)	163 (91%)	0.27
Married, *n* (%)	80/260 (31%)	38/132 (29%)	42/128 (33%)	0.48
Employed, *n* (%)	126/276 (46%)	67/147 (46%)	59/129 (46%)	0.98
Homeless, *n* (%)	82 (22%)	55 (31%)	27 (15%)	**<0.01**
Median Income, Mean (SD)	50990.06 (21603.78)	41310.84 (21413.67)	56537.22 (19727.52)	**<0.01**
Combat Experience, *n* (%)	21 (6%)	9 (5%)	12 (7%)	0.54
Service Connectedness, Mean Percentage (SD)	22.75 (33.65)	21.01 (31.77)	24.47 (35.45)	0.33
PCP Visit within 2 Years of Age of Eligibility, *n* (%)	309 (87%)	144 (81%)	165 (93%)	**<0.01**
Subject receives health services from non-VA provider, *n* (%)	48/242 (25%)	22/129 (27%)	26/113 (23%)	0.25
Number of Prescriptions at Age of Eligibility, Mean (SD)	4.22 (4.05)	4.70 (4.39)	3.75 (3.63)	**0.03**
History of alcohol/drug abuse, *n* (%)	41 (11%)	20 (11%)	21 (12%)	0.88
Charlson Comorbidity Index, Mean (SD)	0.39 (1.09)	0.40 (1.10)	0.37 (1.08)	0.83

PCP, primary care provider; VA, Veterans Affairs

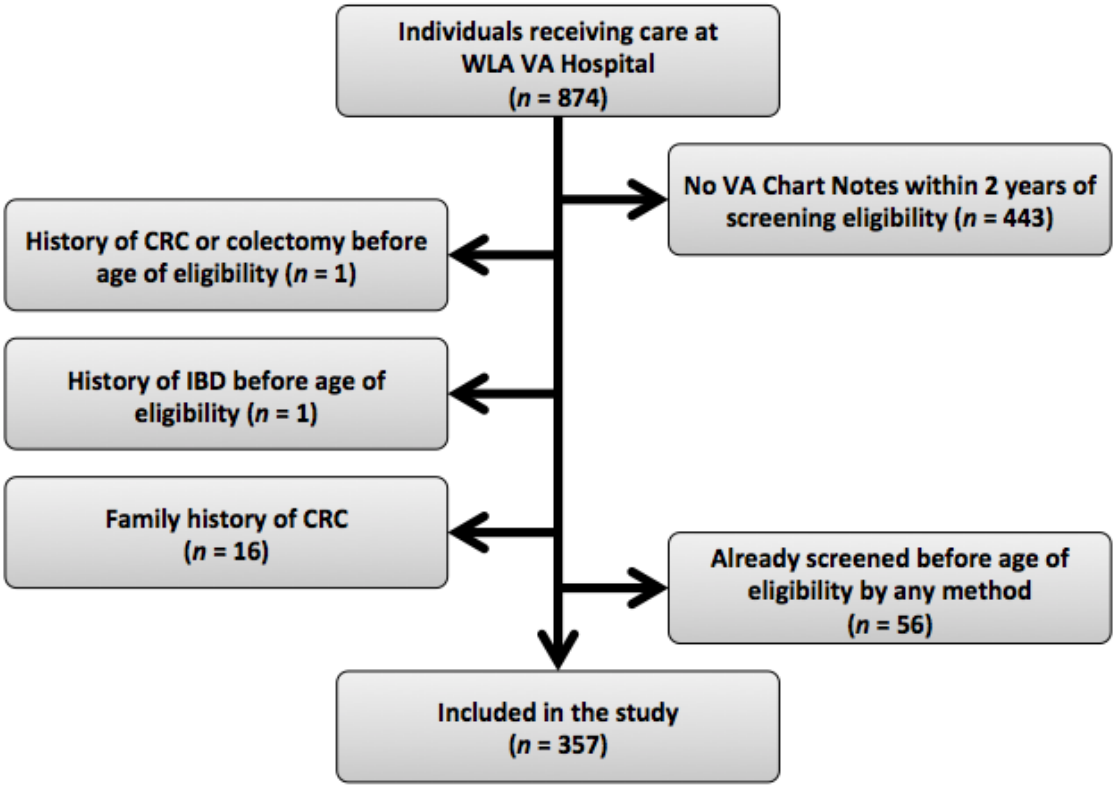
Table 4.2: Univariate and multivariate global predictors of CRC screening by any method (*n* = 357)

Predictor	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Race/Ethnicity (African-American versus all other groups)	0.53 (0.35 – 0.80)	0.49 (0.31 – 0.77)
Male Gender	1.10 (0.49 – 2.46)	--
Married	1.30 (0.77 – 2.20)	--
Employed	1.47 (0.91 – 2.37)	--
Homeless	0.37 (0.22 – 0.62)	0.43 (0.25 – 0.77)
Median Income	1.49 (0.97 – 2.29)	--
Combat Experience	2.62 (0.99 – 6.92)	--
Service Connectedness	1.31 (1.02 – 1.69)	1.33 (1.01 – 1.77)
PCP Visit within Two Years of Eligibility for Screening	3.69 (1.81 – 7.54)	4.86 (2.10 – 11.26)
Subject receives health services from non-VA provider	1.42 (0.76 – 2.68)	--
Number of Prescriptions at Age of Eligibility	0.81 (0.67 – 0.98)	0.75 (0.61 – 0.93)
History of Alcohol Abuse	0.99 (0.42 – 2.36)	--
History of Drug Abuse	0.54 (0.23 – 1.25)	
Charlson Comorbidity Index Score	0.89 (0.73 – 1.08)	--

Non-significant univariate predictors were removed from multivariate analysis

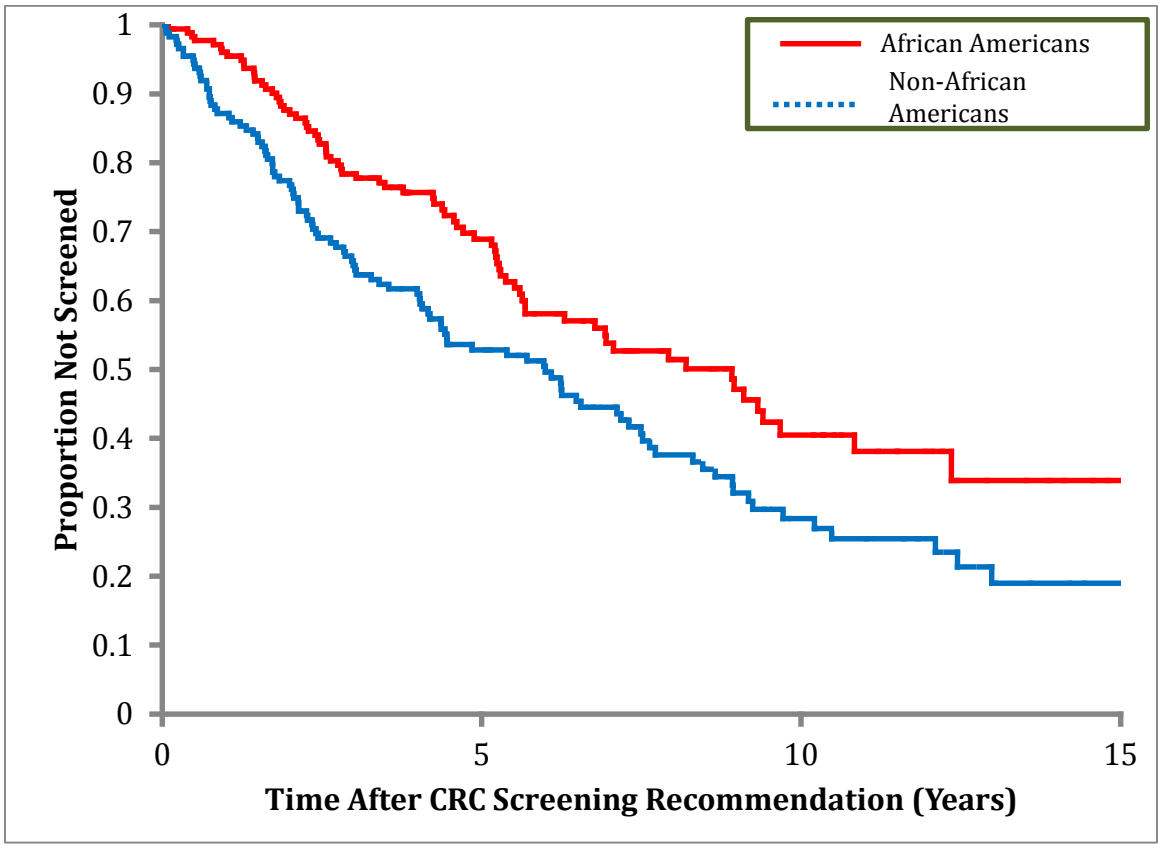
PCP, Primary care provider; VA, Veterans Affairs

Figure 4.1: Flowchart of Exclusion Criteria for CRC Disparities Study



WLA, West Los Angeles; VA, Veterans Affairs; IBD, Inflammatory Bowel Disease; CRC, colorectal cancer

Figure 4.2: Kaplan-Meier survival analysis for probability of CRC screening by any method in eligible subjects



Censoring applied when a subject died before screening or if a subject remained unscreened at the end of the study

4.7 References

Agrawal, S., Bhupinderjit, A., Bhutani, M. S., Boardman, L., Nguyen, C., Romero, Y., . . . Figueroa-Moseley, C. (2005). Colorectal cancer in African Americans. *Am J Gastroenterol, 100*(3), 515-523; discussion 514. doi: 10.1111/j.1572-0241.2005.41829.x

Ananthakrishnan, A. N., Schellhase, K. G., Sparapani, R. A., Laud, P. W., & Neuner, J. M. (2007). Disparities in colon cancer screening in the Medicare population. *Arch Intern Med, 167*(3), 258-264. doi: 10.1001/archinte.167.3.258

Baquet, C. R., & Commiskey, P. (1999). Colorectal cancer epidemiology in minorities: a review. *J Assoc Acad Minor Phys, 10*(3), 51-58.

Benarroch-Gampel, J., Sheffield, K. M., Lin, Y. L., Kuo, Y. F., Goodwin, J. S., & Riall, T. S. (2012). Colonoscopist and primary care physician supply and disparities in colorectal cancer screening. *Health Serv Res, 47*(3 Pt 1), 1137-1157. doi: 10.1111/j.1475-6773.2011.01355.x

Breen, N., Wagener, D. K., Brown, M. L., Davis, W. W., & Ballard-Barbash, R. (2001). Progress in cancer screening over a decade: results of cancer screening from the 1987, 1992, and 1998 National Health Interview Surveys. *J Natl Cancer Inst, 93*(22), 1704-1713.

Butler, L. M., Sinha, R., Millikan, R. C., Martin, C. F., Newman, B., Gammon, M. D., . . . Sandler, R. S. (2003). Heterocyclic amines, meat intake, and association with colon cancer in a population-based study. *Am J Epidemiol, 157*(5), 434-445.

CDC. (2010). Centers For Disease Control and Prevention: Vital signs: colorectal cancer screening among adults aged 50-75 years - United States, 2008. *MMWR Morb Mortal Wkly Rep, 59*(26), 808-812.

Charlson, M., Szatrowski, T. P., Peterson, J., & Gold, J. (1994). Validation of a combined comorbidity index. *J Clin Epidemiol, 47*(11), 1245-1251.

Cooper, G. S., & Koroukian, S. M. (2004). Racial disparities in the use of and indications for colorectal procedures in Medicare beneficiaries. *Cancer, 100*(2), 418-424. doi: 10.1002/cncr.20014

Cronan, T. A., Villalta, I., Gottfried, E., Vaden, Y., Ribas, M., & Conway, T. L. (2008). Predictors of mammography screening among ethnically diverse low-income women. *J Womens Health (Larchmt), 17*(4), 527-537. doi: 10.1089/jwh.2007.0331

Deyo, R. A., Cherkin, D. C., & Ciol, M. A. (1992). Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol, 45*(6), 613-619.

Doubeni, C. A., Laiyemo, A. O., Klabunde, C. N., Young, A. C., Field, T. S., & Fletcher, R. H. (2010). Racial and ethnic trends of colorectal cancer screening among Medicare enrollees. *Am J Prev Med, 38*(2), 184-191. doi: 10.1016/j.amepre.2009.10.037

Doubeni, C. A., Laiyemo, A. O., Reed, G., Field, T. S., & Fletcher, R. H. (2009). Socioeconomic and racial patterns of colorectal cancer screening among Medicare enrollees in 2000 to 2005. *Cancer Epidemiol Biomarkers Prev, 18*(8), 2170-2175. doi: 10.1158/1055-9965.epi-09-0104

Holt, C. L., Shipp, M., Eloubeidi, M., Clay, K. S., Smith-Janas, M. A., Janas, M. J., . . . Fouad, M. N. (2009). Use of focus group data to develop recommendations for demographically segmented colorectal cancer educational strategies. *Health Educ Res, 24*(5), 876-889. doi: 10.1093/her/cyp024

James, A. S., Daley, C. M., & Greiner, K. A. (2011). Knowledge and attitudes about colon cancer screening among African Americans. *Am J Health Behav, 35*(4), 393-401.

Johnson-Jennings, M. D., Tarraf, W., Xavier Hill, K., & Gonzalez, H. M. (2014). United States colorectal cancer screening practices among American Indians/Alaska Natives, blacks, and non-Hispanic whites in the new millennium (2001 to 2010). *Cancer, 120*(20), 3192-3299. doi: 10.1002/cncr.28855

O'Malley, A. S., Forrest, C. B., Feng, S., & Mandelblatt, J. (2005). Disparities despite coverage: gaps in colorectal cancer screening among Medicare beneficiaries. *Arch Intern Med, 165*(18), 2129-2135. doi: 10.1001/archinte.165.18.2129

Patel, K., Hargreaves, M., Liu, J., Kenerson, D., Neal, R., Takizala, Z., . . . Blot, B. (2012). Factors influencing colorectal cancer screening in low-income African Americans in Tennessee. *J Community Health, 37*(3), 673-679. doi: 10.1007/s10900-011-9498-8

Rex, D. K., Johnson, D. A., Anderson, J. C., Schoenfeld, P. S., Burke, C. A., Inadomi, J. M., & Gastroenterology, A. C. o. (2009). American College of Gastroenterology guidelines for colorectal cancer screening 2009 [corrected]. *Am J Gastroenterol, 104*(3), 739-750. doi: 10.1038/ajg.2009.104

Ross, L. E., Taylor, Y. J., & Howard, D. L. (2011). Trends in prostate-specific antigen test use, 2000-2005. *Public Health Rep, 126*(2), 228-239.

Sabounchi, S., Keihanian, S., & Anand, B. S. (2012). Impact of race on colorectal cancer. *Clin Colorectal Cancer, 11*(1), 66-70. doi: 10.1016/j.clcc.2011.03.026

Seeff, L. C., Nadel, M. R., Klabunde, C. N., Thompson, T., Shapiro, J. A., Vernon, S. W., & Coates, R. J. (2004). Patterns and predictors of colorectal cancer test use in the adult U.S. population. *Cancer, 100*(10), 2093-2103. doi: 10.1002/cncr.20276

Selvin, E., & Brett, K. M. (2003). Breast and cervical cancer screening: sociodemographic predictors among White, Black, and Hispanic women. *Am J Public Health, 93*(4), 618-623.

Services, U. S. D. o. H. a. H. (Producer). (2012, 20 January 2013.). Percentage of Adults Who Receive Recommended Colorectal Cancer Screening by Race. Retrieved from https://healthmeasures.aspe.hhs.gov/measure/25#Race.

Shih, Y. C., Zhao, L., & Elting, L. S. (2006). Does Medicare coverage of colonoscopy reduce racial/ethnic disparities in cancer screening among the elderly? *Health Aff (Millwood), 25*(4), 1153-1162. doi: 10.1377/hlthaff.25.4.1153

Smedley, B., Stith, A., & Nelson, A. (2003). Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care. In I. o. Medicine (Ed.). Washington, DC.

USCB. (2011). United States Census Bureau; American Community Survey: Median Income in the past 12 months (in 2011 Inflation-Adjusted Dollars); Survey 5-year Estimates. . Retrieved November 15, 2013, from http://factfinder2.census.gov

White, P. M., Sahu, M., Poles, M. A., & Francois, F. (2012). Colorectal cancer screening of high-risk populations: A national survey of physicians. *BMC Res Notes, 5*, 64. doi: 10.1186/1756-0500-5-64

Wilkins, T., Gillies, R. A., Harbuck, S., Garren, J., Looney, S. W., & Schade, R. R. (2012). Racial disparities and barriers to colorectal cancer screening in rural areas. *J Am Board Fam Med, 25*(3), 308-317. doi: 10.3122/jabfm.2012.03.100307

Zapka, J. G., Puleo, E., Vickers-Lahti, M., & Luckmann, R. (2002). Healthcare system factors and colorectal cancer screening. *Am J Prev Med, 23*(1), 28-35.

Chapter 5:

Dissertation Discussion

5.1 Discussion Overview

The purpose of this dissertation was to investigate different aspects of black-white disparities in colorectal cancer (CRC) incidence, screening, and outcomes in the United States (U.S.). Three distinct studies were performed: 1) a retrospective analyses from a large, national cancer database to describe disparities in CRC indicators over time; 2) a systematic review of the literature to understand barriers to colonoscopic screening in African Americans; and 3) an examination of the role of patient- and provider-level factors on CRC screening uptake in a healthcare system with minimal system-level variation. Each study offers a different perspective to inequities in CRC and provides valuable information that will guide future research and intervention development to further reduce CRC disparities.

This final dissertation chapter provides a summary of the findings and strengths of each dissertation study. In addition, the chapter addresses the main limitations of the dissertation work and discusses the implications of the findings on future research, policy, and programs.

5.2 Improving Black-White Disparities in Colorectal Cancer Incidence and Stage at Diagnosis

Study one provides evidence that the large disparities previously seen in CRC incidence and stage at presentation may have decreased over the past four decades. We used a large, national cancer database provided by the National Cancer Institute (NCI) to demonstrate that while black Americans continue to have higher rates of CRC than white Americans, the black-

white incidence differential has decreased from 13.1 per 100,000 individuals in 2004 when the incidence inequity was highest to 8.7 per 100,000 in recent years. In addition, while the proportion of individuals presenting with late stage disease was much higher in blacks than whites in the 1970s, late stage disease has decreased considerably in blacks—so much so that both groups now have a similar proportion of cases with advanced disease at presentation.

These findings tell a somewhat different narrative than the prevailing story in the literature of fixed, persistent black-white CRC disparities (Mayberry et al., 1995; Siegel, Naishadham, & Jemal, 2013; Soneji, Iyer, Armstrong, & Asch, 2010). It appears that efforts to increase primary and secondary CRC prevention in the U.S. have been at least somewhat successful. For incidence, we can attribute at least some of the disparity improvement to better primary prevention of CRC, which mainly occurs through lifestyle risk reduction and screening endoscopy (colonoscopy or flexible sigmoidoscopy) for the removal of colonic adenomas. In the case of stage of CRC presentation, all screening, whether for prevention or early detection, contributes to the overall shift towards early presenting disease.

The results from study one suggest a need for further primary prevention of CRC in African Americans. The two major mechanisms through which primary prevention can occur are 1) lifestyle and health risk modification through tobacco cessation, obesity prevention, and diet change and 2) continued efforts to reduce CRC disparities through CRC screening. While lifestyle change can impact incidence for several chronic diseases and malignancies, it is often difficult to accomplish. Thus, preventive screening tools like colonoscopy and flexible sigmoidoscopy are particularly critical for primary prevention of CRC and reducing disparities. In order to close the black-white incidence gap, we must encourage these preventive screening methods among African Americans. The American College of Gastroenterology (ACG) has

moved in this direction and recommends the exclusive use of colonoscopy to screen for CRC in blacks. However, there are many obstacles to colonoscopic screening faced by blacks in the U.S. Study two summarizes those widespread barriers.

5.3 Several Barriers Prevent Colonoscopic Colorectal Cancer Screening in African Americans

In study two, we contribute to the literature a systematic review of barriers to colonoscopic screening among African Americans. Following the conceptual framework for inequities in healthcare provided by the institute of Medicine (IOM), barriers to colonoscopic screening were categorized into patient-, provider-, and system-level factors (Smedley, Stith, & Nelson, 2003). The prevailing patient-level barriers to screening colonoscopy were fear, sub-optimal knowledge about CRC and colonoscopy, and other competing life or health factors. Provider-level barriers to screening were lack of recommendation for screening, poor provider knowledge of patient barriers, inconsistent screening guidelines regarding the age and method for screening initiation in African Americans, and insufficient patient counseling. At the system level, barriers included the costs associated with screening, lack of health insurance coverage, infrequent primary care provider (PCP) visits, and limited access to specialists. We suggest in this study that the interaction between these patient, provider, and system contributors underlie the complex nature of black-white CRC screening disparities.

Study two brings to light the many obstacles we must overcome to achieve primary prevention of CRC via colonoscopy at the population level. While the ACG and others encourage colonoscopic screening over the other screening methods in blacks, our findings and those of others about barriers to colonoscopic screening suggest some caution about this

universal recommendation. Colonoscopy is an invasive procedure that requires the appropriate clinical setting, endoscopic equipment, patient sedation and anesthesia, and specific provider training. Providing this service will be a challenge for most communities and healthcare systems that do not have the adequate number of proceduralists or capacity to perform colonoscopies for all black patients (Cole et al., 2014; Curbow et al., 2015). In fact, as study three demonstrates, equitable use of colonoscopy is a challenge even in healthcare systems with equal access to services.

5.4 When System-Level Factors are Minimized, Disparities in Screening Uptake Persist

Study three attempts to identify patient- and provider-level barriers to CRC screening and examine CRC screening rates in a cohort of individuals with similar access to the healthcare system. The Veterans Affairs (VA) is unique in that it offers a setting for population-based research where most subjects have the same insurance, coverage provisions, and locations for clinical care. We hand-extracted demographic and health information data at the West Los Angeles (WLA) VA for Veterans eligible for initiation of CRC screening and found that African Americans were 51% less likely than non-African Americans to have completed CRC screening within two years of screening eligibility. Further, uptake of screening colonoscopy was 46% lower in African American Veterans than in non-African American Veterans in adjusted models. Other significant barriers to screening uptake were homelessness, low service connectedness, greater use of prescription drugs, and lack of a primary care visit within two years of CRC screening eligibility. Time-to-screening colonoscopy was also longer in African Americans than in non-African Americans.

In addition to detecting race-based differences in screening uptake, the findings complement results from study two and suggest a strong role of the provider encounter in uptake of CRC screening. Frequent patient-provider interaction was a robust predictor of screening completion for the entire study population and for the subset of African Americans in the VA. Thus, both study two and three emphasize the potential power of the patient-provider interface and of patient-provider communication. While it is clear that the provider recommendation for CRC screening itself is one critical aspect of the provider role, it is likely that other provider-related characteristics and practices influence screening uptake as well.

5.5 Synthesizing the Findings

Study one highlights the success of CRC prevention and early detection methods that have come into use over the past three decades. The study also emphasizes a continued need for strategies to improve CRC prevention in African Americans. While disparities in CRC incidence and late stage presentation have narrowed over the past four decades, an incidence gap remains. That gap will persist unless we bend the incidence curve downward in blacks so that rates in African Americans approach the lower incidence rates seen in whites. Bending the curve requires targeted public health efforts to improve uptake of primary prevention methods in the black community.

Studies two and three, however, provide insight into why the exclusive use of strategies aimed at CRC prevention may not translate to reductions in CRC disparities. The studies emphasis the potentially negative effects of social and lifestyle factors like financial obligations, logistical challenges and homelessness on screening uptake for blacks. In addition, they highlight the importance of connectedness to a healthcare system, whether through a PCP or strong

attachment to an integrated healthcare network. In light of these findings, there are major concerns about the feasibility of population-wide colonoscopic screening among blacks. As African Americans receive healthcare in various settings across the U.S, it may be difficult for members of the African American community to complete colonoscopic CRC screening. In fact, the most effective tool to minimize CRC burden in blacks may vary by patient population or clinical setting (Naylor, Ward, & Polite, 2012). In addition, completion of screening is test-dependent in blacks. African Americans are more likely to select non-colonoscopic screening methods when given the option between stool-based or endoscopic screening and are more likely to complete screening when fecal occult blood testing (FOBT) is offered (Inadomi et al., 2012; McMahon et al., 1999; Zimmerman, Tabbarah, Trauth, Nowalk, & Ricci, 2006). Insistence on colonoscopy over other screening tests like FOBT, Fecal Immunochemical Testing (FIT) or the newly approved stool DNA (sDNA) test may only further promote disparities in screening.

Given the high burden of CRC on blacks, we would argue that the best test is the screening test that gets done, whether that is a screening colonoscopy or stool-based examination. Thus, while future efforts to address disparities in CRC incidence, screening, and outcomes should focus on increasing the use of colonoscopy among African Americans to reduce disease incidence, we must also encourage screening by any method to decrease the overall burden of disease. CRC prevention is ideal; however, detecting CRC early in African Americans impacts survival and mortality, which are also worthy goals.

5.6 Dissertation Limitations

There are several limitations in this research that must be recognized.

5.6.1 Study Samples

Limitations of the study sample are relevant to studies one and three. The individuals in the study one cohort are cancer patients from up to 18 regions of the U.S. Use of one of the largest cancer registries in the country provided access to a large number of CRC cases and allowed for stratification of these cases by year, race, and stage. The sample source is limited, however, in its inclusion of cancer cases from only specific regions of the U.S. and the inability to stratify by Hispanic ethnicity.

Study three, on the other hand, addresses CRC disparities in a unique population of U.S. Veterans that are eligible for CRC screening. While lack of SEER data on patient ethnicity required us to include patients of Hispanic ethnicity in analyses aimed to detect black-white differences in study one, primary data collection in study three allowed us to identify a cohort of non-Hispanic African Americans. We could then compare screening uptake in this group of black Veterans to Veterans of other racial and ethnic backgrounds. The study sample is small, however highly comprehensive, which allowed us to examine the relationship between factors other than race and screening uptake as well. Two major limitations of the study three sample are the inclusion of only Veterans and the predominance of males, both intrinsic traits of the VA patient population.

5.6.2 Generalizability

As in all observational and cross-sectional analyses, we must consider the degree to

which study findings are generalizable to other populations, settings, situations, and time periods (Campbell & Stanley, 1963; Greenhalgh, 1997). The dissertation draws data and results from three distinct cross-sections of the U.S. population. In study one, the addition of U.S. regions to the SEER database over time led to different national samplings for SEER 9, 13, and 18. SEER 9 provides data over the longest period of time but includes only 9% of Americans from 1975 to 2011 (NCI, 2014). While SEER 18 includes more regions and is considered more representative of the U.S. population, it still includes only 28% of Americans (NCI, 2014). SEER datasets are the only available data sources that allows us to examine long-term trends in CRC indicators in the U.S.; however, we must recognize that findings generated from this database may not be relevant to non-SEER regions or populations with income or education levels that are different than those of the SEER population (NCI, 2012).

While study two aims to summarize barriers to screening in African Americans, findings may not be applicable to all African Americans. The systematic review pools together findings from 19 distinct peer-reviewed publications. Each of these 19 studies used specific inclusion and exclusion criteria and aimed to answer a particular question. The African Americans represented in the systematic review were subjects in studies of mostly low- and middle-income subjects. While many U.S. African Americans reside in low- or middle-income communities, African Americans are represented in a diverse cross-section of the U.S. population (USCB, 2011). As a result, the findings of the systematic review may not be representative of blacks with higher socioeconomic standing.

Lastly, study three faces similar limitations in generalizability. As the study was performed in the VA setting, findings may not be generalizable to the entire U.S. population. Further, our study cohort was obtained from one VA. While the WLA VA is a large, integrated

network of 12 sites serving a diverse patient population, the population that it serves might not be representative of all U.S. Veterans. As so few women Veterans receive care at the VA and only 7% of our sample was female, the results of the VA database study are also not likely generalizable to women Veterans.

5.6.3 Omitted Variable Bias

Another common limitation of cross-sectional studies is omitted variable bias. Omitted variable bias is relevant to each of the quantitative studies included in the systematic review and to study three of the dissertation where analyses were limited to the variables available in the VA Computerized Patient Record System (CPRS) database. In study three, we used proxy variables to represent concepts in the study's conceptual model. Proxies are rarely perfect, and imperfect proxies introduce the possibility that measures included in the regression models are inadequate measures of concepts (Remler & Ryzin, 2011). The resulting omitted variable bias contributes to the error term in the regression model, limits the reliability of the model, and limits the ability to infer causation. This effect is particularly concerning when the omitted variable is related to the main predictor in the study (Remler & Ryzin, 2011; Sackett, Laczo, & Lippe, 2003).

As there are known associations between race, SES, and health service utilization, we wanted to include both subject race and SES in the logistic regression models in study three (Cox et al., 2012; Demeter, Reed, Lix, MacWilliam, & Leslie, 2005; Hsieh et al., 2013). SES is often difficult to proxy, however, and we were limited by the patient-level information available to us in the VA medical chart. As we did not have access to individual or household income, we used subject zip code and data on median income by zip code from the American Community Survey to compute a socioeconomic status (SES) score for each subject (USCB, 2011). Because SES is

inversely related to our main predictor, black race, the use of zip-code-based income as a proxy for SES may have biased the effect of race on screening uptake. Many studies have demonstrated that racial differences in CRC screening resolve after adjusting for SES (Doubeni, Laiyemo, Reed, Field, & Fletcher, 2009; Seeff et al., 2004). That we did not find this may reflect partial omitted variable bias in the use of zip-code-based income as a proxy for SES.

5.6.4 Causality

While cross-sectional studies can detect associations between dependent and independent variables, they are unable to demonstrate directionality or causation. All three dissertation studies make the assumption that race itself impacts CRC disparities. In studies one and two, we imply that some aspect of race drives study findings. Study three more overtly uses regression analysis to suggest that black race intrinsically causes lack of screening.

Race is an extremely complex concept with many historical, social, and economic overtones. Rather than a discrete person-level trait, it is a marker for several factors, making it challenging to determine the aspects of race that most directly affect screening behavior. There are several possible direct and indirect mechanisms on the patient-, provider-, and system-levels through which race may impact screening and explain our findings. At the level of the individual, race may be a marker for educational attainment, living conditions, insurance status and/or SES. As discussed, low SES is associated with lack of screening behavior and also often related to underrepresented racial or ethnic status (Liss & Baker, 2014; Thomas, DiClemente, & Snell, 2014). The mean level of education is lower for blacks than for whites in the U.S. as well, and education predicts screening (Ewert & Kominski, 2014). African Americans are also more likely to be uninsured and more likely to live in areas where there is poor access to medical

services like primary care and cancer screening (Shane & Ayyagari, 2014; Thomas et al., 2014). Each of these patient-level factors, while all closely related to race, may provide the more direct pathway through which race impacts screening uptake.

Race may also influence screening uptake through provider behavior. Studies two and three emphasize a strong relationship between provider practices and patient screening behavior. In fact, in study three, frequent encounters with a provider were more predictive of screening uptake than non-African American race. Whether a provider recommends screening may be impacted by provider bias or discrimination, counseling practices, a provider's perception of the patient's likelihood to obtain screening, or competing clinical demands in the care of black patients (Schulman et al., 1999). Provider discrimination in particular has gained attention in health equity research as several studies demonstrate that providers with negative discriminatory behavior towards certain racial/ethnic groups may be less likely to recommend screening or care to members of those groups (Born et al., 2009; Jacobs et al., 2014; O'Malley, Forrest, Feng, & Mandelblatt, 2005).

System-level factors related to race may also provide mechanisms for the relationship between race and screening. Black patients may be more likely to receive care in settings where there are provider deficiencies in knowledge about CRC screening guidelines or hesitancy to recommend screening due to inadequate access to screening services (Bartlett-Prescott, Klesges, & Kritchevsky, 2005). In addition, while insurance status is typically an individual-level trait, it often dictates the method of CRC screening available to an individual. Many African Americans seek healthcare in Federally Qualified Health Centers (FQHCs) and other community-based health facilities. As FQHCs are often challenged to meet the clinical demands of their patient population despite limited resources, they may provide only stool-based guaiac tests that offer

CRC detection but limited CRC prevention (Coronado et al., 2015; Gwede et al., 2013). These patient-, provider-, and system-mediated mechanisms are potential explanations for how race may impact screening behavior. Unfortunately, the present dissertation does not lend itself to disentangling all of these alternative explanations.

5.7 Implications for Future Research

Future research should examine additional CRC indicator trends, investigate other sources of variation in CRC incidence, outcomes, and screening uptake, and develop interventions to improve screening and CRC outcomes in blacks.

5.7.1 Colorectal Cancer Indicator Trends

The dissertation focuses on left side of the CRC cancer control continuum (**Figure 1.3**). There are black-white disparities in CRC indicators other than incidence and stage at diagnosis that should be evaluated over time as we consider future research, interventions, and policy. National CRC mortality estimates suggest diverging trends in CRC-related mortality between blacks and whites in recent decades. In addition, five-year survival with CRC is lower for blacks in national cross-sectional data. How survival in blacks has compared to survival in whites over time has not been characterized in the literature (Alexander et al., 2004; Le, Ziogas, Lipkin, & Zell, 2008). Age at CRC diagnosis is also an important CRC indicator, especially in the setting of recent evidence supporting an increasing incidence of CRC in Americans under the age of 50 and suggestions by the ACG to screen blacks at age 45 (ACS, 2014; Rex et al., 2009; Siegel, Desantis, & Jemal, 2014).

The SEER dataset provides a platform to study white and black trends and black-white disparities in these additional CRC indicators over the past four decades. Doing so will determine whether there are persistent disparities in CRC indicators other than incidence and stage and may influence future strategy to reduce disparities. In addition to SEER, the Centers for Disease Control (CDC) National Program of Cancer Registries (NPCR) data provide cancer incidence and mortality data for 99% of the U.S. population (CDC, 2014). While NPCR data are not available for an extended period of time, future research might compare recent disparities in CRC incidence and outcomes in NPCR and SEER. An overall better understanding of how these outcomes have fared over time may provide additional insight to the impact of national screening programs, policy to improve screening uptake, and advances in the management and treatment of CRC.

5.7.2 Additional Sources of Variation

The analyses in the present dissertation have focused on the role of race on CRC incidence, screening, and outcomes. Disease incidence, outcomes, and service utilization in the U.S., however, often varies on factors other than race, including geographic region, urban/rural status, density of providers, and availability of services. There may be variation in the use of CRC screening tests that is not captured by SEER or VA data. Variation in service utilization implies underuse, overuse, or misuse of services in the U.S. healthcare system and, thus, deficiencies in the overall quality of healthcare (IOM, 2013). Understanding how the incidence of CRC, CRC screening, and CRC outcomes vary by region and care setting will provide the information necessary to determine how to target future policy and programs to improve the overall burden of CRC.

5.7.3 Development of Interventions to Improve Screening and Colorectal Cancer Outcomes in Blacks

One of the main goals of this dissertation work was to perform studies to provide foundational knowledge for future interventions aimed to improve CRC screening disparities in the U.S. To date, there have been extensive efforts across the U.S. healthcare system to improve uptake of CRC screening. Prior interventions include the training of more gastroenterologists and ancillary staff to perform screening procedures, use of report cards to audit rates of CRC screening, provision of "patient navigator" programs to enhance completion of screening tests, creation of provider educational workshops to raise awareness about CRC screening, and media campaigns, among many other approaches (Baron et al., 2010; Chen et al., 2008; Cram et al., 2003; Naylor et al., 2012; Percac-Lima et al., 2009; Wolf et al., 2005). Among African Americans in particular, targeted interventions have also included health-marketing campaigns, patient educational sessions, print media campaigns, telephone counseling, use of computer-based or patient-navigator education programs, and culturally tailored interventions in faith-based settings (Chen et al., 2008; Christy et al., 2013; Menon et al., 2008; Naylor et al., 2012).

The findings of this dissertation, however, suggest that the most effective interventions will be multilevel interventions that address patient-, provider-, and system-level barriers to screening. At the patient-level, interventions must attend to competing health and life factors and provide patients with education about CRC risk and the benefits of screening. Doing so will generate community awareness about CRC among blacks and empower individuals to impact their own health. At the level of the provider, future interventions must provide streamlined

mechanisms to facilitate patient-provider discussions about screening and identify mechanisms for efficient and effective access to screening. If we can harness the power of the provider's influence on screening behaviors, we can capitalize on one of the most significant mechanisms through which screening is achieved. System change will involve maximizing access—increasing the number of primary care and specialty providers in resource limited settings, increasing insurance enrollment, and developing programs that provide screening tools in resource limited settings. Health systems should also consider which screening tests are most appropriate for their patient population and assure that the proper mechanisms are in place for test distribution, follow-up, and continued screening surveillance. Innovative approaches to screening like sDNA, which offers high specificity for CRC and an ability to detect CRC in early stages, should be considered in settings were colonoscopy is not feasible (Imperiale et al., 2014).

5.8 Implications for Future Policies and Programs

As the U.S. government strives for improved health equity for all Americans, we must evaluate the impact of recent healthcare reform on use of preventive services and identify areas where system-level deficiencies stymie equitable distribution of screening services.

5.8.1 Colorectal Cancer Screening in the Era of Healthcare Reform

The Patient Protection and Affordable Care Act (PPACA or ACA) is the most substantial piece of healthcare legislation since the passing of Medicare and Medicaid in 1965 and aims to improve the quality, cost, and equity of healthcare provided in the U.S. by expanding medical insurance coverage (NAS, 2014). The law improves access to healthcare services for individuals with low income and mandates insurance companies to provide CRC screening without cost

sharing or copays. As access to insurance is a cited barrier to CRC screening uptake, the reform may result in improved screening rates in previously uninsured populations. Further, as the law is intended to assist those with the most need, traditionally underserved groups like African Americans may benefit most from the reform (NAS, 2014).

Moving forward, it will be important to evaluate the impact of the ACA on CRC incidence, screening, and outcome disparities. While the ACA attempts to address access to insurance, theoretical access to insurance does not guarantee use of screening services. There are several factors related to access that drive utilization of screening and many steps that one must make before healthcare reform like the ACA achieves its goal of improving access to healthcare. (Khatami et al., 2012). In order to achieve screening uptake, for example, a patient must actively enroll in an insurance plan, have physical access to a healthcare facility, understand the benefits of screening, take action to pursue a screening test, and then complete the screening process. Adding to that complexity, the screening process might include both a stool-based test and a colonoscopy if the stool test is positive. Unless there are efforts to help individuals enroll in insurance plans, educate individuals about the importance of screening, and assure that there are policies and programs to increase the number and quality of physical access points for all Americans eligible for screening, insurance reform alone might not equate to use of vital healthcare services like CRC screening. Furthermore, there is variation in the expansion of healthcare coverage by state, which leaves room for discrepancies between who receives and does not receive screening. In all, while the ACA intends to improve healthcare equity in the U.S. by addressing the problem of poor access to healthcare access, increasing appropriate uptake of services is more complex requires several additional considerations.

5.8.2 Incomplete Screening

Policy and programs for the management of individuals with positive screening tests is also critical. Currently, insurance will cover the cost of CRC screening tests in non-symptomatic individuals. In the setting of symptoms or a positive stool-based or radiographic screening test, however, the colonoscopy required for follow-up is considered diagnostic and therefore not covered by insurance. This inconsistency is compounded in resource limited settings like FQHCs where colonoscopy is often not provided on premises and health systems must identify channels for referring individuals with positive screening tests to other facilities (Coronado et al., 2015; Gwede et al., 2013). In order to assure equal access to complete CRC screening, we must consider policies that require insurance companies to cover colonoscopy in these settings. For systems like FQHCs, we must develop affiliations with larger healthcare systems to assure assess to colonoscopy when indicated.

5.9 Conclusion

There is strong evidence that race and ethnic background influence healthcare utilization and healthcare outcomes in the U.S. While inequities in health and healthcare have persisted for decades, there is increasing emphasis in health services research and healthcare policy to fully understand the mechanisms that drive disparities in care so that effective interventions can be developed and implemented to eliminate inequities. Addressing disparities in health and healthcare will not only improve health outcomes for underserved groups but will also improve the overall quality of healthcare in the U.S.

In the case of CRC, black-white disparities exist across the spectrum of disease from

CRC risk factors and incidence to CRC-related survival and mortality. Lack of prevention and early disease detection are important contributors to poor outcomes in blacks. CRC can be largely prevented by the detection and removal of colonic adenomas, and survival is significantly better when CRC is diagnosed in early stages. The development of effective screening methods has promoted national efforts to improve CRC prevention and CRC outcomes in the U.S. population as a whole and among U.S. blacks. With these efforts, we have seen improvements in at least some CRC indicators.

This research may inform healthcare providers, health service researchers, patients, and health policy makers about the role of black race on CRC screening and outcomes. While we have seen improvements in some CRC indicators in blacks over the past four decades, there is still an ongoing need to address disparities in screening and in critical disease determinants like stage of diagnosis. By developing a deeper understanding of the specific patient, provider, and system obstacles to CRC screening, we can create interventions to help eliminate CRC disparities among African Americans.

5.10 References

ACS. (2014). American Cancer Society: Colorectal Cancer Facts & Figures 2014-2016. Atlanta: American Cancer Society.

Alexander, D., Chatla, C., Funkhouser, E., Meleth, S., Grizzle, W. E., & Manne, U. (2004). Postsurgical disparity in survival between African Americans and Caucasians with colonic adenocarcinoma. *Cancer, 101*(1), 66-76. doi: 10.1002/cncr.20337

Baron, R. C., Melillo, S., Rimer, B. K., Coates, R. J., Kerner, J., Habarta, N., . . . Leeks, K. J. (2010). Intervention to increase recommendation and delivery of screening for breast, cervical, and colorectal cancers by healthcare providers a systematic review of provider reminders. *Am J Prev Med, 38*(1), 110-117. doi: 10.1016/j.amepre.2009.09.031

Bartlett-Prescott, J. D., Klesges, L. M., & Kritchevsky, S. B. (2005). Health promotion referrals in an urban clinic: removing financial barriers influences physician but not patient behavior. *Am J Health Promot, 19*(5), 376-382.

Born, W., Engelman, K., Greiner, K. A., Bhattacharya, S. B., Hall, S., Hou, Q., & Ahluwalia, J. S. (2009). Colorectal cancer screening, perceived discrimination, and low-income and trust in doctors: a survey of minority patients. *BMC Public Health, 9*, 363. doi: 10.1186/1471-2458-9-363

Campbell, D., & Stanley, J. (1963). *Experimental and Quasi-Experimental Designs for Research*: Houghton Mifflin/Cengage.

CDC. (2014). U.S. Cancer Statistics Working Group. United States Cancer Statistics: 1999–2011 Incidence and Mortality Web-based Report. . Retrieved April 2, 2015, from http://www.cdc.gov/uscs.

Chen, L. A., Santos, S., Jandorf, L., Christie, J., Castillo, A., Winkel, G., & Itzkowitz, S. (2008). A program to enhance completion of screening colonoscopy among urban minorities. *Clin Gastroenterol Hepatol, 6*(4), 443-450. doi: S1542-3565(07)01151-2 [pii]
10.1016/j.cgh.2007.12.009

Christy, S. M., Perkins, S. M., Tong, Y., Krier, C., Champion, V. L., Skinner, C. S., . . . Rawl, S. M. (2013). Promoting colorectal cancer screening discussion: a randomized controlled trial. *Am J Prev Med, 44*(4), 325-329. doi: 10.1016/j.amepre.2012.11.032

Cole, H., Schoenthaler, A., Braithwaite, R. S., Ladapo, J., Mentor, S., Uyei, J., & Trinh-Shevrin, C. (2014). Community-based settings and sampling strategies: implications for reducing racial health disparities among black men, New York City, 2010-2013. *Prev Chronic Dis, 11*, E105. doi: 10.5888/pcd11.140083

Coronado, G. D., Petrik, A. F., Spofford, M., Talbot, J., Do, H. H., & Taylor, V. M. (2015). Clinical perspectives on colorectal cancer screening at Latino-serving federally qualified health centers. *Health Educ Behav, 42*(1), 26-31. doi: 10.1177/1090198114537061

Cox, E. D., Nackers, K. A., Young, H. N., Moreno, M. A., Levy, J. F., & Mangione-Smith, R. M. (2012). Influence of race and socioeconomic status on engagement in pediatric primary care. *Patient Educ Couns, 87*(3), 319-326. doi: 10.1016/j.pec.2011.09.012

Cram, P., Fendrick, A. M., Inadomi, J., Cowen, M. E., Carpenter, D., & Vijan, S. (2003). The impact of a celebrity promotional campaign on the use of colon cancer screening: the Katie Couric effect. *Arch Intern Med, 163*(13), 1601-1605. doi: 10.1001/archinte.163.13.1601

Curbow, B. A., Dailey, A. B., King-Marshall, E. C., Barnett, T. E., Schumacher, J. R., Sultan, S., & George, T. J., Jr. (2015). Pathways to colonoscopy in the South: seeds of health disparities. *Am J Public Health, 105*(4), e103-111. doi: 10.2105/ajph.2014.302347

Demeter, S., Reed, M., Lix, L., MacWilliam, L., & Leslie, W. D. (2005). Socioeconomic status and the utilization of diagnostic imaging in an urban setting. *CMAJ, 173*(10), 1173-1177. doi: 10.1503/cmaj.050609

Doubeni, C. A., Laiyemo, A. O., Reed, G., Field, T. S., & Fletcher, R. H. (2009). Socioeconomic and racial patterns of colorectal cancer screening among Medicare enrollees in 2000 to 2005. *Cancer Epidemiol Biomarkers Prev, 18*(8), 2170-2175. doi: 10.1158/1055-9965.epi-09-0104

Ewert, S., & Kominski, R. (2014). Measuring Alternative Educational Credentials: 2012. Household Economic Studies; U.S. Department of Commerce, Education and Statistics Administration, U.S Census Bureau.

Greenhalgh, T. (1997). Assessing the methodological quality of published papers. *BMJ, 315*(7103), 305-308.

Gwede, C. K., Davis, S. N., Quinn, G. P., Koskan, A. M., Ealey, J., Abdulla, R., . . . Meade, C. D. (2013). Making it work: health care provider perspectives on strategies to increase colorectal cancer screening in federally qualified health centers. *J Cancer Educ, 28*(4), 777-783. doi: 10.1007/s13187-013-0531-8

Hsieh, M. C., Chiu, Y. W., Velasco, C., Wu, X. C., O'Flarity, M. B., & Chen, V. W. (2013). Impact of race/ethnicity and socioeconomic status on adjuvant chemotherapy use among elderly patients with stage III colon cancer. *J Registry Manag, 40*(4), 180-187.

Imperiale, T. F., Ransohoff, D. F., Itzkowitz, S. H., Levin, T. R., Lavin, P., Lidgard, G. P., . . . Berger, B. M. (2014). Multitarget stool DNA testing for colorectal-cancer screening. *N Engl J Med, 370*(14), 1287-1297. doi: 10.1056/NEJMoa1311194

Inadomi, J. M., Vijan, S., Janz, N. K., Fagerlin, A., Thomas, J. P., Lin, Y. V., . . . Hayward, R. A. (2012). Adherence to colorectal cancer screening: a randomized clinical trial of competing strategies. *Arch Intern Med, 172*(7), 575-582. doi: 10.1001/archinternmed.2012.332

IOM. (2013). Institute of Medicine: Delivering High-Quality Cancer Care: Charting a New Course for a System in Crisis. Washington, D.C.: The National Academies Press.

Jacobs, E. A., Rathouz, P. J., Karavolos, K., Everson-Rose, S. A., Janssen, I., Kravitz, H. M., . . . Powell, L. H. (2014). Perceived discrimination is associated with reduced breast and cervical cancer screening: the Study of Women's Health Across the Nation (SWAN). *J Womens Health (Larchmt), 23*(2), 138-145. doi: 10.1089/jwh.2013.4328

Khatami, S., Xuan, L., Roman, R., Zhang, S., McConnel, C., Halm, E. A., & Gupta, S. (2012). Modestly increased use of colonoscopy when copayments are waived. *Clin Gastroenterol Hepatol, 10*(7), 761-766.e761. doi: 10.1016/j.cgh.2012.02.027

Le, H., Ziogas, A., Lipkin, S. M., & Zell, J. A. (2008). Effects of socioeconomic status and treatment disparities in colorectal cancer survival. *Cancer Epidemiol Biomarkers Prev, 17*(8), 1950-1962. doi: 10.1158/1055-9965.epi-07-2774

Liss, D. T., & Baker, D. W. (2014). Understanding current racial/ethnic disparities in colorectal cancer screening in the United States: the contribution of socioeconomic status and access to care. *Am J Prev Med, 46*(3), 228-236. doi: 10.1016/j.amepre.2013.10.023

Mayberry, R. M., Coates, R. J., Hill, H. A., Click, L. A., Chen, V. W., Austin, D. F., . . . et al. (1995). Determinants of black/white differences in colon cancer survival. *J Natl Cancer Inst, 87*(22), 1686-1693.

McMahon, L. F., Jr., Wolfe, R. A., Huang, S., Tedeschi, P., Manning, W., Jr., & Edlund, M. J. (1999). Racial and gender variation in use of diagnostic colonic procedures in the Michigan Medicare population. *Med Care, 37*(7), 712-717.

Menon, U., Szalacha, L. A., Belue, R., Rugen, K., Martin, K. R., & Kinney, A. Y. (2008). Interactive, culturally sensitive education on colorectal cancer screening. *Med Care, 46*(9 Suppl 1), S44-50. doi: 10.1097/MLR.0b013e31818105a0

NAS. (2014) *National Academy of Sciences: Population Health Implications of the Affordable Care Act: Workshop Summary*. Washington DC: 2014 by the National Academy of Sciences

Naylor, K., Ward, J., & Polite, B. N. (2012). Interventions to improve care related to colorectal cancer among racial and ethnic minorities: a systematic review. *J Gen Intern Med, 27*(8), 1033-1046. doi: 10.1007/s11606-012-2044-2

NCI. (2012). National Cancer Institute: Cancer Trends Progress Report 2011-2012. . Retrieved February 10, 2015, from http//progressreport.cancer.gov/doc.asp?

NCI. (2014). National Cancer Institute. Cancer Incidence—Surveillance, Epidemiology, and End Results (SEER) Registries Research Data. Retrieved February 28, 2015., from http://seer.cancer.gov/data/seerstat/nov2011/.

O'Malley, A. S., Forrest, C. B., Feng, S., & Mandelblatt, J. (2005). Disparities despite coverage: gaps in colorectal cancer screening among Medicare beneficiaries. *Arch Intern Med, 165*(18), 2129-2135. doi: 10.1001/archinte.165.18.2129

Percac-Lima, S., Grant, R. W., Green, A. R., Ashburner, J. M., Gamba, G., Oo, S., . . . Atlas, S. J. (2009). A culturally tailored navigator program for colorectal cancer screening in a community health center: a randomized, controlled trial. *J Gen Intern Med, 24*(2), 211-217. doi: 10.1007/s11606-008-0864-x

Remler, D. K., & Ryzin, G. G. V. (2011). *Research Methods in Practice: Strategies for Description and Causation: Strategies for Description and Causation*: SAGE Publications.

Rex, D. K., Johnson, D. A., Anderson, J. C., Schoenfeld, P. S., Burke, C. A., & Inadomi, J. M. (2009). American College of Gastroenterology guidelines for colorectal cancer screening 2009 [corrected]. *Am J Gastroenterol, 104*(3), 739-750. doi: 10.1038/ajg.2009.104

Sackett, P. R., Laczo, R. M., & Lippe, Z. P. (2003). Differential prediction and the use of multiple predictors: the omitted variables problem. *J Appl Psychol, 88*(6), 1046-1056. doi: 10.1037/0021-9010.88.6.1046

Schulman, K. A., Berlin, J. A., Harless, W., Kerner, J. F., Sistrunk, S., Gersh, B. J., . . . Escarce, J. J. (1999). The effect of race and sex on physicians' recommendations for cardiac catheterization. *N Engl J Med, 340*(8), 618-626. doi: 10.1056/nejm199902253400806

Seeff, L. C., Nadel, M. R., Klabunde, C. N., Thompson, T., Shapiro, J. A., Vernon, S. W., & Coates, R. J. (2004). Patterns and predictors of colorectal cancer test use in the adult U.S. population. *Cancer, 100*(10), 2093-2103. doi: 10.1002/cncr.20276

Shane, D. M., & Ayyagari, P. (2014). Will health care reform reduce disparities in insurance coverage?: Evidence from the dependent coverage mandate. *Med Care, 52*(6), 528-534. doi: 10.1097/mlr.0000000000000134

Siegel, R., Desantis, C., & Jemal, A. (2014). Colorectal cancer statistics, 2014. *CA Cancer J Clin, 64*(2), 104-117. doi: 10.3322/caac.21220

Siegel, R., Naishadham, D., & Jemal, A. (2013). Cancer statistics, 2013. *CA Cancer J Clin, 63*(1), 11-30. doi: 10.3322/caac.21166

Smedley, B., Stith, A., & Nelson, A. (2003). Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care. In I. o. Medicine (Ed.). Washington, DC.

Soneji, S., Iyer, S. S., Armstrong, K., & Asch, D. A. (2010). Racial disparities in stage-specific colorectal cancer mortality: 1960-2005. *Am J Public Health, 100*(10), 1912-1916. doi: 10.2105/ajph.2009.184192

Thomas, T. L., DiClemente, R., & Snell, S. (2014). Overcoming the triad of rural health disparities: How local culture, lack of economic opportunity, and geographic location instigate health disparities. *Health Educ J, 73*(3), 285-294. doi: 10.1177/0017896912471049

USCB. (2011). United States Census Bureau; American Community Survey: Median Income in the past 12 months (in 2011 Inflation-Adjusted Dollars); Survey 5-year Estimates. . Retrieved November 15, 2013, from http://factfinder2.census.gov

Wolf, M. S., Fitzner, K. A., Powell, E. F., McCaffrey, K. R., Pickard, A. S., McKoy, J. M., . . . Bennett, C. L. (2005). Costs and cost effectiveness of a health care provider-directed intervention to promote colorectal cancer screening among Veterans. *J Clin Oncol, 23*(34), 8877-8883. doi: 23/34/8877 [pii]
10.1200/JCO.2005.02.6278

Zimmerman, R. K., Tabbarah, M., Trauth, J., Nowalk, M. P., & Ricci, E. M. (2006). Predictors of lower endoscopy use among patients at three inner-city neighborhood health centers. *J Urban Health, 83*(2), 221-230. doi: 10.1007/s11524-005-9028-z