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Examining Racial Disparities in Colon Cancer Clinical Delay in the Colon Cancer Patterns of Care in Chicago Study

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Abstract

Purpose—We explored a potential racial disparity in clinical delay among non-Hispanic (nH) Black and White colon cancer patients and examined factors that might account for the observed disparity.

Methods—Patients aged 30–79 with a newly diagnosed colon cancer from 2010–2014 (N=386) were recruited from a diverse sample of nine public, private and academic hospitals in and around Chicago. Prolonged clinical delay was defined as ≥60 or ≥90 days between medical presentation (symptoms or a screen-detected lesion) and treatment initiation (surgery or chemotherapy). Multivariable logistic regression with model-based standardization was used to estimate the disparity as a difference in prevalence of prolonged delay by race.

Results—Prevalence of delay in excess of 60 days was 12 percentage points (95% CI: 2%, 22%) higher among nH Blacks versus Whites after adjusting for age, facility and county of residence. Travel burden (time and distance traveled from residence to facility) explained roughly one-third of the disparity (33%, p=0.05),individual and area-level socioeconomic status measures explained roughly one-half (51%, p=0.21), and socioeconomic measures together with travel burden explained roughly four-fifths (79%, p= 0.08)

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Conclusions—Low socioeconomic status and increased travel burden are barriers to care disproportionately experienced by nH Black colon cancer patients.

Keywords

Healthcare disparities; minority health; colonic neoplasms

Introduction

Colon cancer is the third most common cancer and the second leading cause of cancer-related deaths in the United States (1) and compared with nH Whites, non-Hispanic (nH) Blacks are more heavily burdened by this disease(2). Potential reasons include poorer access to quality health insurance (3, 4), lower healthcare utilization and adherence to screening (5, 6), more financial barriers, and poorer social support (7).The goal of the following analysis was to explore a potential racial disparity in timing of clinical delay among a sample of nH Black and White colon cancer patients from the Colon Cancer Patterns of Care in Chicago (CCPCC) Study, and to examine the extent to which specific patient characteristics might help to explain the observed disparity in clinical delay. CCPCC is a multi-site study aimed at comprehensively examining racial and socioeconomic disparities in colon cancer screening, timing of care, stage at diagnosis, and treatment within the Chicago area. The goals of the study are to identify factors that if intervened upon could improve care for colon cancer patients, and reduce disparities.

Materials and Methods

Sample and Procedure

Patients from the CCPCC study were newly diagnosed with a first primary invasive colon cancer, and recruited from nine medical facilities in and around Chicago. Facilities included the largest and only public hospital in Chicago, four academic hospitals and four large private non-academic hospitals. As such, hospitals were selected to provide a wide variation in patient and facility characteristics, reflective of the diverse range of hospitals in Chicago and most major metropolitan centers. IRB approvals were obtained at all institutions. Eligible patients were self-identified as nH White or Black, were aged 30 to 79 at diagnosis, were diagnosed between January 1, 2010 and December 31, 2013, and resided in Cook, DuPage, Lake or Will counties in Illinois, or Lake County in Indiana. Potentially eligible patients were identified by staff at participating institutions and recruitment letters and study brochures were mailed to patients at least 45 days after each patient’s surgery (or diagnostic colonoscopy if no surgery was needed). Colon cancer diagnosis was confirmed through review of colonoscopy and pathology reports, and rectal cancer cases were excluded. Patients who agreed to participate consented to complete a 90-minute interview and to allow access to their medical records. Patient interviews focused on a variety of factors related to aspects of patient diagnostic pathways and treatment, patient beliefs and perceptions, healthcare access and utilization, and social and demographic characteristics. Patients received $100 for their participation. The study response rate was 54% (N=407) of which 386 had data needed to calculate length of clinical delay and were included in the analyses.

Measures

Clinical delay was defined as the length of time in days between patient self-reported date of initial medical presentation with symptoms or a screen-detected lesion, and patient self-reported date of initial treatment receipt (either surgery or intravenous/oral chemotherapy). Since medical presentation and treatment occurred across a diverse range of facilities and medical offices, where access to medical records could not be obtained, an audit of self-reported dates could not be performed. Two dichotomous outcome variables were created to represent prolonged clinical delays of ≥60 days versus <60 days, and ≥90 days versus <90 days. Because no current guidelines exist with regard to maximum recommended wait times to colon cancer diagnosis or treatment following medical presentation, clinical delays of at least ≥60 days were considered "prolonged" as less than half of the study sample fell within this category.

Demographic and socioeconomic variables obtained from self-reported patient interview data included race/ethnicity, age at diagnosis, marital status, gender, employment status, education level, and annual household income (categories for all covariates are shown in Table I). Census tract-level measures of socioeconomic status included concentrated disadvantage and affluence and were based on American Community Survey 2009–2013 five-year estimates. The concentrated disadvantage variable incorporated data on percentages of families with incomes below the poverty line, families receiving public assistance, unemployed persons, and female-headed households with children. Concentrated affluence was based on percentages of families with annual incomes ≥$75,000, adults with at least a college education, and civilian labor force members in professional or managerial occupations. Percentages for each individual indicator were standardized (z-score transformed), and resulting values averaged to create each measure (8).

Type of health insurance at diagnosis, access to a regular healthcare provider, history of any prior colon cancer screening, and number of physical exams received within the past five years were included as measures of healthcare access and utilization and were based on patient interview data. Additionally, a healthcare access scale (Cronbach's α=0.88) was created using four-point Likert scale responses to ten interview questions inquiring about patients' abilities to get needed care, to access specialists, to pay for care, and to physically access healthcare facilities (9, 10, 11). Patient responses to six interview questions measuring their likelihood of seeking care under different scenarios were similarly used to create a healthcare utilization scale variable (Cronbach's α=0.82) (9, 10). A social support variable representing how well patient support needs were met was generated by summing patient responses to five four-point Likert scale questions measuring the amount of emotional, spiritual, informational, financial, and everyday support patients reported needing after diagnosis, and subtracting this value from a sum representing how much emotional, spiritual, informational, financial and everyday support patients reported receiving after diagnosis (12).

Distance and time traveled from patient residence to recruitment facility were included as measures of travel burden. Total number of medical visits attended between medical presentation and treatment initiation was determined using patient interview data, along with body mass index and mode of cancer detection. Mode of detection was defined as

symptomatic presentation, screen-detection with patient reported symptoms during the 6 months prior to detection, or screen-detection with no prior symptoms experienced. Number of existing comorbidities was assessed during interviews using the Self-Administered Comorbidity Questionnaire (13). Stage at diagnosis, based on AJCC staging, was extracted from patient medical records, and late stage disease was defined as AJCC stages 3 or 4. Other covariates included patient recruitment facility and county of residence.

Statistical Analyses

Distributions of nH Black and White patients across categories of the variables described above, and prevalence of prolonged clinical delay across covariate categories were compared using χ^2 tests of association. A type 1 analysis was conducted starting with a baseline logistic regression model predicting prolonged clinical delay, and controlling for age at diagnosis, recruitment facility, and county of residence. Variable domains representing race/ethnicity, mode of cancer detection, socioeconomic factors (household income, education, employment status, concentrated disadvantage and affluence), access and utilization of care (health insurance status, history of prior colon cancer screening, history of prior physical exams, level of healthcare utilization, and level of healthcare access), support factors (marital status and level of support needs met), number of medical visits between presentation and treatment, and travel burden (time and distance traveled between home and recruitment facility) were added to the baseline model individually. Likelihood ratio tests were used to assess whether each domain improved model fit. A type 3 analysis was also conducted starting with a baseline model containing all variable domains and control variables described above. Models lacking one of each domain were compared to the baseline model using likelihood ratio tests.

The prevalence difference (PD) for the racial disparity in prolonged clinical delay, adjusted for age at diagnosis, recruitment facility, and county of residence, was estimated using logistic regression and marginal standardization with bias-corrected bootstrapped 95% confidence intervals. The PD from this model represented the underlying disparity after accounting for confounding and selection factors. Prevalence differences were then estimated for models additionally adjusted for each domain representing potential mediators through which the disparity might be transmitted. Lastly, further assessment for mediation was carried out using the method of Karlson, Holm and Breen (14) to generate rescaled disparity coefficients from full and reduced logistic regression models, which were then used to estimate the proportion of the disparity mediated by each domain. Non-response weights were created using post-stratification iterative proportional fitting (15, 16). The weights were created to match the full distribution of eligible patients identified across participating facilities by age, race, gender, and facility, and were used in bivariate and mediation analyses to attempt to account for potential selection biases related to these variables.

Results

Compared to nH Whites, nH Blacks were more likely to have resided in Cook County at the time of diagnosis, to have been recruited from a public medical facility, to be of lower socioeconomic status (SES), and to report less healthcare access and utilization (Table I).

They were also more likely to be single, to have comorbidities, and to have presented medically to an emergency room. Additionally, nH Blacks were more likely to have unmet support needs, such that the amount of reported support needed exceeded the amount of support received. Non-Hispanic Whites were more likely to travel the farthest distance (≥15 miles) or time (≥20 minutes) to reach their medical facility. Age at diagnosis, gender, history of prior colon cancer screening, history of physical exams, and mode of detection did not differ significantly between races.

The overall prevalence of prolonged clinical delay was 35% and 24% for delays of ≥60 days and ≥90 days, respectively (Table II). Compared to patients with screen-detection, symptomatic mode of detection was marginally associated with greater delay in excess of 60 days (38% vs. 27%, p=0.11) but not associated with delay in excess of 90 days (25% vs. 20%, p>0.20).NH Black race, greater concentrated disadvantage, lower concentrated affluence, greater number of medical visits between presentation and treatment, and greater time and distance traveled to the diagnosing facility were associated with prolonged clinical delays.

In logistic regression models controlling for age at diagnosis, recruitment facility, and county of residence, the addition of the race, socioeconomic factors, number of medical visits, and travel burden domains improved the fit of both models predicting prolonged clinical delay (Table III). In type 3 analyses, race and socioeconomic domains were no longer significant predictors of prolonged clinical delay after controlling for other domain variables, while number of medical visits and travel burden remained significant.

In baseline models adjusted for age, recruitment facility, and county of residence, nH Blacks had a 12 percentage point greater prevalence of prolonged clinical delay of ≥60 days, and a 14 percentage point greater prevalence of prolonged clinical delay of ≥90 days as compared to nH Whites (Table IV). Adjusting for socioeconomic factors accounted for roughly one half and one third of the disparity in the models predicting prolonged clinical delays of ≥60 days and ≥90 days, respectively. After additionally adjusting for travel burden, roughly four fifths of the disparity was accounted for in the model predicting prolonged clinical delay of ≥60 days.

Discussion

In this multi-institutional study of colon cancer patients diagnosed at nine different medical facilities in counties near and including Chicago between 2010 and 2014, a racial disparity was identified where compared to nH Whites, nH Blacks had a 12 and 14 percentage point greater prevalence of prolonged clinical delay of ≥60 days and ≥90 days, respectively. Travel burden appears to play an important role in mediating this disparity. It is interesting to note that nH White patients were more likely to travel the farthest distance (≥15 miles) and time (≥20 minutes) to reach their facilities as compared to nH Black patients. Additionally, patients within the farthest distance and longest time traveled categories also had the lowest prevalence of prolonged clinical delays.

Massarweh et al. observed that greater distance traveled to treatment facility was associated with shorter times to treatment receipt in a study including 296,474 colon cancer patients from the National Cancer Database. The authors suggested that patients traveling the farthest may be more likely to experience shorter treatment delays due to an increased risk of presenting with more advanced stage disease (17). In our study sample, however, late stage colon cancer diagnosis status did not differ significantly between patients with or without prolonged clinical delays, which may be reflective of the population density and multiple healthcare facilities in metropolitan Chicago as compared to the majority of the country. Another possible explanation for shorter delays experienced by patients traveling the farthest is that they may be more likely to receive multiple diagnostic tests or more attention with planning for next steps in a single medical visit as compared to patients living closer to their facilities.

For patients traveling <15 miles, travel burden was associated with delay, and nH Blacks tended to travel farther compared to nH Whites, consistent with previous research (18). Prior research has also found that nH Black patients are more likely than nH Whites to delay receipt of needed care due to travel burden issues (19), including lack of transportation (20). Patients with the ability to electively travel far for cancer-related care tend to have better outcomes as compared to more localized patients treated at the same facility (21).

Socioeconomic factors appear to play an even larger role than travel burden in mediating the racial disparity in clinical delay (although these factors likely act in part by influencing aspects of patient travel). While studies in the United States are lacking, Lejeune et al. conducted a large retrospective study in the United Kingdom and found that colorectal cancer patients who were more socioeconomically deprived were more likely to experience long treatment delays. The authors also found that the impact of treatment delay on survival was greatest for low SES patients (22).

While prior research has demonstrated that delays to adjuvant chemotherapy following surgical resection is associated with worse survival among colon cancer patients (23), most studies examining the impacts of delays on colon cancer diagnosis and/or initial treatment have concluded that these delays do not negatively impact patient survival. Additionally, it has been suggested that such delays may actually be associated with reductions in disease-specific mortality (24–27). These observations have reportedly persisted even after accounting for patient triaging factors such as tumor stage (24, 25), tumor grade (25), urgency of treatment (26), and emergent case status (27). One rationalization has been that greater delays can be indicative of higher quality of care (e.g., more thorough diagnostic testing, and more time and resources devoted to planning for appropriate treatment strategies) (24, 28). While this may be the case for some patients, it is conceptually less likely that delays to treatment among socioeconomically deprived patients are the result of higher quality of care. The idea that causes of prolonged colon cancer clinical delay may vary across levels of SES is one potential explanation for the SES-mortality gradient reported by Lejeune et al (22). As such, the racial disparity identified in this study should not be dismissed as harmless based on prior research showing a lack of association between colon cancer diagnostic and/or treatment delays and reduced survival, as more studies examining these associations across levels of SES are needed.

Aside from potential impacts of prolonged clinical delay on patient survival, delays can lead to reduced patient satisfaction (29), and could be associated with increased stress and medical mistrust. It is well-established that nH Blacks have a greater overall distrust of the healthcare system compared to nH Whites (30–32), and that fear and mistrust of the medical community reduces the likelihood of nH Black patients seeking needed care (31). Hence, efforts to address the racial colon cancer clinical delay disparity could possibly assist with increasing medical trust and healthcare utilization among nH Black patients.

It is important to note that clinical delay represents both patient and healthcare system influences on delay. For example, delay could be the result of missed appointments due to patient difficulty getting transportation, time off from work or other reasons. Patient reasons for delay could be mitigated by system or facility factors such as providing navigation services to help patients negotiate the complexities of the healthcare system. Therefore, clinical delay represents a complex intermingling of patient and system influences.

The main limitations of this study are as follows. The study sample was not population-based, increasing the likelihood of selection bias, and reducing generalizability of findings. Recruitment facilities were chosen, however, to represent a range of public and private, academic and non-academic settings and diverse patient populations. Additionally, selection factors including county of residence and recruitment facility were controlled for in all multivariable models. Next, the patient response rate was 54%, leaving open the possibility that patients who chose to participate may have differed from patients who did not in terms of important characteristics. To reduce the impact of differential participation by age, race, gender and facility, non-response weights were developed and included in analyses. Stage at diagnosis was not adjusted for in all multivariable models. Since nH Black colon cancer patients are more likely to be diagnosed at later stages as compared to nH White patients, lack of adjustment for triaging of more advanced stage at presentation would tend to lead to an underestimation in our estimates of the racial disparity in clinical delay. Next, time and distance traveled variables were calculated under the assumption that patients would travel the shortest possible route to reach their recruitment facilities. This assumption may not accurately reflect travel distance or time for patients relying on public transportation, and does not account for other facilities that patients may have sought care at. Misclassification of patient address/zip code might have occurred if patients moved in order to obtain treatment, which would tend to attenuate the association between travel burden and delay. Next, the self-reported nature of dates used to calculate length of clinical delay may have impacted the accuracy of this measure. There is also potential for recall bias in patient interview data, however number of days between initial surgery (or diagnostic colonoscopy if no surgery was performed), and date of initial recruitment phone call, two weeks following letter mail out, was not associated with clinical delay of ≥60 days ($p=0.47$) or ≥90 days ($p=0.30$), and did not differ significantly by race ($p=0.27$). Lastly, healthcare access and utilization domain variables were based on patient self-reports, and this type of self-reported data can be subject to social-desirability bias. In addition, because we adjusted for diagnosing facility in our analysis, our ability to detect associations with access and utilization was limited due to the strong association between type of diagnosing facility and these variables. Despite this limitation, SES factors, which likely act upstream of access and

utilization factors, and travel burden, an important aspect of healthcare access, were predictive of the prolonged delay outcomes.

Conclusions

In summary, our findings support that nH Blacks may experience greater difficulty than nH Whites in receiving colon cancer treatment after initial presentation, and highlight that racial disparities related to colon cancer likely extend past the point of screening/medical presentation. The findings further suggest that interventions to help colon cancer patients overcome barriers related to low SES and travel burden could potentially reduce disparities in colon cancer clinical delay. While public health efforts such as the Affordable Care Act have aimed to expand health coverage among underrepresented minority groups, analyses such as these highlight that barriers to care outside of health coverage must also be identified and addressed.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Appendix: Characteristics of facilities participating in the Colon Cancer Patterns of Care in Chicago (CCPCC) Study

Characteristics	Facility 1	Facility 2	Facility 3	Facility 4	Facility 5	Facility 6	Facility 7	Facility 8	Facility 9
	Non-academic					Academic			
Facility Type	Public	Private	Private	Private	Private	Public	Private	Private	Private

Characteristics	Facility 1	Facility 2	Facility 3	Facility 4	Facility 5	Facility 6	Facility 7	Facility 8	Facility 9
			Non-academic					Academic	
Number Enrolled in CCPCC Study	56	72	22	21	24	29	38	64	81
The remaining information is from the 2010 Annual Hospital Questionnaire, Illinois Department of Public Health, Health Systems Development http://www.idph.state.il.us/about/hfpb/pdf/2010%20Hospital%20Profiles%208–7-13.pdf									
Number of Hospital Beds in 2010	464	690	408	193	583	491	568	894	739
Number of 2010 Patient Admissions	23,620	40,704	17,845	11,374	18,029	17,287	22,523	50,982	30,140
White (%)	26.3	53.6	68.9	4.3	31.3	18.0	30.3	59.1	44.9
Black (%)	53.2	33.4	22.5	82.7	63.2	51.9	46.9	23.1	36.5
American Indian (%)	0.3	0.1	0.2	0.1	0	0.2	0.1	0.1	0.3
Asian (%)	3.7	0.6	3.8	0.1	0.2	2.0	1.3	3.3	0.2
Hawaiian/Pacific (%)	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0
Unknown Race (%)	16.3	12.3	4.5	12.8	5.2	27.8	21.2	14.3	18.1
Hispanic or Latino (%)	25.9	8.3	31.0	11.7	3.7	23.2	4.7	9.8	14.1
Not Hispanic or Latino (%)	74.0	79.5	64.6	87.7	94.8	76.8	68.9	85.7	83.0
Unknown Ethnicity (%)	0.1	12.3	4.5	0.6	1.5	0.0	26.3	4.4	2.9
Number of 2010 Outpatient Visits	724,210	345,454	152,368	83,883	380,146	434,350	476,466	512,026	416,383
Served by Medicare (%)	8.4	21.8	15.4	16.6	29.4	23.2	28.7	29.1	27.3
Served by Medicaid (%)	16.9	23.6	22.4	29.7	16.5	32.9	17.8	9.6	17.9
Served by other Public (%)	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.1
Served by Private Insurance (%)	4.9	48.4	59.0	44.0	45.5	39.8	49.6	54.3	49.0
Served by Private Pay (%)	16.7	5.7	1.5	8.1	5.0	1.8	0.0	2.5	2.7
Served by Charity Care (%)	53.0	0.4	1.6	1.6	3.5	2.4	4.0	4.5	3.0

List of Abbreviations

nH	non-Hispanic
CCPCC	Colon Cancer Patterns of Care in Chicago
IRB	institutional review board
PD	prevalence difference
AJCC	American Joint Committee on Cancer
SES	socioeconomic status

References

1. Siegel RL, Miller KD, Jemal A. Cancer Statistics. CA: Can J Clin. 2014; 64:104–17.
2. American Cancer Society 2014–2016 Report. Atlanta, GA: 2014. Colorectal Cancer Facts and Figures, 2014–2016.
3. Smith JC, Medalia C. Vital Signs: Health Insurance Coverage and Health Care Utilization—United States, 2006–2009 and January–March 2010. MMWR Morb Mortal Wkly Rep. 2010; 59:1448–54. [PubMed: 21063276]
4. Asplin BR, Rhodes KV, Levy H, Lurie N, Crain AL, Carlin BP, et al. Insurance status and access to urgent ambulatory care follow-up appointments. JAMA. 2005; 294:1258–54.
5. Turner BJ, Weiner M, Yang C, TenHave T. Predicting adherence to colonoscopy or flexible sigmoidoscopy on the basis of physician appointment-keeping behavior. Ann of Intern Med. 2004; 140:528–32. [PubMed: 15068980]
6. Braschi C, Pelto DJ, Hennelly MO, Lee KK, Shah B, Montgomery GH, et al. Patient-, provider-, and system-level factors in low adherence to surveillance colonoscopy guidelines: implications for future interventions. J Gastrointest Cancer. 2014; 45:500–3. [PubMed: 25319370]
7. Hendren S, Chin N, Fisher S, Winters P, Griggs J, Mohile S, et al. Patients' barriers to receipt of cancer care, and factors associated with needing more assistance from a patient navigator. J Natl Med Assoc. 2011; 103:701–10. [PubMed: 22046847]
8. Dookeran K, Silva A, Warnecke RB, Rauscher GH. Race/Ethnicity and Disparities in Mastectomy Practice in the Breast Cancer Care in Chicago Study. Ann Surg Oncol. 2015; 22:66–74. [PubMed: 25135847]
9. Facione NC, Miaskowski C, Dodd MJ, Paul SM. The self-reported likelihood of patient delay in breast cancer: new thoughts for early detection. Prev Med. 2002; 34:397–407. [PubMed: 11914045]
10. Facione NC, Dodd MJ, Holzemer W, Meleis AI. Help seeking for self-discovered breast symptoms. Implications for early detection. Cancer Pract. 1997; 5:220–7. [PubMed: 9250078]
11. Facione NC. Breast cancer screening in relation to access to health services. Oncol Nurs Forum. 1999; 26:689–96. [PubMed: 10337647]
12. Teieda S, Stolley MR, Vijayasiri G, Campbell RT, Ferrans CE, Warnecke RB, et al. Correlates of negative psychological consequences of breast cancer among recently diagnosed ethnically diverse women. Psychooncology. 2015 Under Review.
13. Sangha O, Stucki G, Liang MH, Fossel AH, Katz JN. The Self-Administered Comorbidity Questionnaire: a new method to assess comorbidity for clinical and health services research. Arthritis Rheum. 2003; 49:156–63. [PubMed: 12687505]
14. Kohler U, Karlson KB, Holm A. Comparing coefficients of nested nonlinear probability models. Stata Journal. 2011; 11:420–38.
15. Little R. Post-Stratification: A Modeler's Perspective. J Am Stat Assoc. 1993; 88:423.
16. University of Southampton National Centre for Research Methods. Adjusting for non-response by weighting. 2009. http://www.restore.ac.uk/PEAS/nonresponse.php
17. Massarweh NN, Chiang YJ, Xing Y, Chang GJ, Haynes AB, You YN, et al. Association between travel distance and metastatic disease at diagnosis among patients with colon cancer. J Clin Oncol. 2014; 32:942–8. [PubMed: 24516014]
18. Scoggins JF, Fedorenko CR, Donahue SM, Buchwald D, Blough DK, Ransey SD. Is distance to provider a barrier to care for Medicaid patients with breast, colorectal, or lung cancer? J Rural Health. 2012; 28:54–62. [PubMed: 22236315]
19. Kullgren JT, McLaughlin CG, Mitra N, Armstrong K. Nonfinancial barriers and access to care for U.S. adults. Health Serv Res. 2012; 47:462–85. [PubMed: 22092449]
20. King CJ, Chen J, Dagher RK, Holt CL, Thomas SB. Decomposing differences in medical care access among cancer survivors by race and ethnicity. Am J Med Qual. 2015; 30:459–69. [PubMed: 24904178]
21. Lamont EB, Hayreh D, Pickett KE, Dignam JJ, List MA, Stenson KM, et al. Is patient travel distance associated with survival on phase II clinical trials in oncology? J Natl Cancer Inst. 2003; 95:1370–5. [PubMed: 13130112]

22. Lejeune C, Sassi F, Ellis L, Godward S, Mak V, Day M, et al. Socio-economic disparities in access to treatment and their impact on colorectal cancer survival. Int J of Epidemiol. 2010; 39:710–7. [PubMed: 20378687]

23. Biagi JJ, Raphael MJ, Mackillop WJ, Kong W, King WD, Booth CM. Association between time to initiation of adjuvant chemotherapy and survival in colorectal cancer: a systematic review and meta-analysis. JAMA. 2011; 305:2335–42. [PubMed: 21642686]

24. Amri R, Bordeianou LG, Sylla P, Berger DL. Treatment delay in surgically-treated colon cancer: does it affect outcomes? Ann Surg Oncol. 2014; 21:3909–16. [PubMed: 24849522]

25. Ramos M, Esteva M, Cabeza E, Campillo C, Llobera J, Aguilo A. Relationship of diagnostic and therapeutic delay with survival in colorectal cancer: a review. Eur J Cancer. 2007; 43:2467–78. [PubMed: 17931854]

26. Iversen LH, Antonsen S, Laurberg S, Lautrup MD. Therapeutic delay reduces survival of rectal cancer but not of colonic cancer. Br J Surg. 2009; 96:1183–9. [PubMed: 19787765]

27. Pruitt SL, Harzke AJ, Davidson NO, Schootman M. Do diagnostic and treatment delays for colorectal cancer increase risk of death? Cancer Causes Control. 2013; 24:961–77. [PubMed: 23446843]

28. McConnell YJ, Inglis K, Porter GA. Timely access and quality of care in colorectal cancer: are they related? Int J Qual Health Care. 2010; 22:219–28. [PubMed: 20207714]

29. Robinson KM, Christensen KB, Ottesen B, Krasnik A. Diagnostic delay, quality of life and patient satisfaction among women diagnosed with endometrial or ovarian cancer: a nationwide Danish study. Qual Life Res. 2012; 21:1519–25. [PubMed: 22138966]

30. Boulware LE, Cooper LA, Ratner LE, LaVeist TA, Powe NR. Race and trust in the healthcare system. Public Health Rep. 2003; 118:358–65. [PubMed: 12815085]

31. Matthews AK, Sellergren SA, Manfredi C, Williams M. Factors influencing medical information seeking among African American cancer patients. J Health Commun. 2002; 7:205–19. [PubMed: 12166874]

32. Kennedy BR, Mathis CC, Woods AK. African Americans and their distrust of the healthcare system: healthcare for diverse populations. J Cult Divers. 2007; 14:56–60. [PubMed: 19175244]

Table I

Distribution of study sample by race and across categories of covariates

Characteristic	Non-Hispanic Black (n = 198)		Non-Hispanic White (n = 188)		p[a]
	No.	%	No.	%	
Age at Diagnosis					
< 50 yrs	38	19	36	19	
50–64 yrs	102	52	86	46	
≥ 65 yrs	58	29	66	35	
Gender					
Female	102	52	93	49	
Male	96	48	95	51	
Marital Status					
Married	64	32	112	60	<0.0001
Single	133	68	75	40	
Employment					
Employed	48	24	76	40	0.0011
Unemployed	150	76	112	60	
Education					
< High School Graduate	38	19	11	6	<0.0001
High School Graduate	58	29	38	20	
> High School Graduate	102	52	139	74	
Annual Household Income					
< $20,000	97	50	27	15	<0.0001
$20,000–$50,000	62	32	39	22	
> $50,000	36	18	111	63	
Census Tract Disadvantage					
1st tertile	16	8	112	61	<0.0001
2nd tertile	62	31	66	36	
3rd tertile	119	60	7	4	
Census Tract Affluence					
1sttertile	101	51	27	15	<0.0001

Characteristic	Non-Hispanic Black (n = 198)		Non-Hispanic White (n = 188)		p[a]
	No.	%	No.	%	
2nd tertile	64	32	63	34	
3rd tertile	32	16	95	51	
No. of Comorbidities					
0	22	11	40	21	0.013
1	55	28	55	29	
2 or more	121	61	93	49	
Body Mass Index (CDC Criteria)					
Underweight to normal weight	69	35	66	35	
Overweight	54	27	70	37	
Obese	75	38	52	28	
Healthcare Utilization Scale					
1st tertile	59	30	80	43	0.005
2nd tertile	74	38	45	24	
3rd tertile	64	32	63	34	
Prior Colon Cancer Screening					
Yes	108	56	98	53	
No	86	44	86	47	
No. of Physical Exams in Past 5 Years					
< 5 exams	97	49	97	52	
≥ 5 exams	101	51	91	48	
Healthcare Access Scale					
1st tertile	97	49	46	24	<0.0001
2nd tertile	60	30	60	32	
3rd tertile	41	21	82	44	
Has Regular Healthcare Provider					
Yes	150	76	163	87	0.05
No	48	24	25	13	
Health Insurance at Diagnosis					
Private	94	47	156	83	<0.0001
Public or Uninsured	104	53	32	17	

Characteristic	Non-Hispanic Black (n = 198)		Non-Hispanic White (n = 188)		p[a]
	No.	%	No.	%	
Mode of Cancer Detection					
Symptomatic Presentation	143	73	129	69	
Symptomatic, Screen-detected	19	10	19	10	
Non-symptomatic, Screen-detected	35	18	40	21	
Level of Support Needs Met					
1st tertile	83	42	42	22	0.01
2nd tertile	44	22	54	29	
3rd tertile	71	36	92	49	
Recruitment Facility Type					
Public	62	31	17	9	<0.0001
Academic	68	34	106	56	
Private, non-academic	68	34	65	35	
County of Residence					
Cook	190	96	149	82	<0.0001
DuPage, Will, Lake (IL), or Lake (IN)	8	4	33	18	
Initial Medical Visit					
Screening Appointment	55	28	59	31	<0.0001
Medical Appointment	53	27	91	48	
Walk-in Visit	18	9	12	6	
Emergency Room Visit	72	36	26	14	
No. of Medical Visits Between Presentation and Treatment					
0	175	88	169	90	
1 or more	23	12	19	10	
Distance from Home to Facility					
< 5 miles	56	28	45	24	<0.0001
5 – 9.9 miles	61	31	50	27	
10 – 14.9 miles	56	28	23	12	
≥ 15 miles	24	12	67	36	
Travel Time from Home to Facility					
<10 minutes	70	36	55	30	<0.0001

Characteristic	Non-Hispanic Black (n = 198)		Non-Hispanic White (n = 188)		p[a]
	No.	%	No.	%	
10 – 19.9 minutes	101	51	55	30	
≥ 20 minutes	26	13	75	41	
Late Stage Diagnosis					
Yes	114	62	97	56	
No	69	38	76	44	

[a] p-values > 0.20 are not shown

Table II

Prevalence of prolonged clinical delay overall and by categories of covariates

Characteristic	No.	Prolonged Clinical Delay (%) ≥ 60 days	p[a]	Prolonged Clinical Delay (%) ≥ 90 days	p[a]
Overall	386	35	N/A	24	N/A
Age at Diagnosis					
< 50 yrs	74	34		22	
50–64 yrs	188	38		24	
≥ 65 yrs	124	35		25	
Gender					
Female	195	36		26	
Male	191	36		22	
Race					
Non-Hispanic Black	198	41	0.03	31	0.002
Non-Hispanic White	188	31		17	
Marital Status					
Married	176	33		23	
Single	210	39		25	
Employment					
Employed	124	35		22	
Unemployed	262	37		25	
Education					
< High School Graduate	49	39		29	
High School Graduate	96	31		22	
> High School Graduate	241	37		24	
Annual Household Income					
< $20,000	124	38		27	
$20,000–$50,000	101	36		24	
> $50,000	147	36		22	
Census tract Disadvantage					
1st tertile	128	33	0.15	19	0.02
2nd tertile	128	34		21	

Characteristic	No.	Prolonged Clinical Delay (%) ≥ 60 days	p[a]	Prolonged Clinical Delay (%) ≥ 90 days	p[a]
3rd tertile	126	42		33	
Census tract Affluence					
1st tertile	128	38	0.04	28	0.04
2nd tertile	127	41		28	
3rd tertile	127	28		17	
No. of Comorbidities					
0	62	37		23	
1	112	35		27	
2 or more	212	36		23	
Body Mass Index (CDC Criteria)					
Under to Normal weight	135	41		26	
Overweight	124	29		19	
Obese	127	37		27	
Healthcare Utilization Scale					
1st tertile	139	33		18	0.09
2nd tertile	119	37		27	
3rd tertile	127	36		28	
Prior Colon Cancer Screening					
Yes	206	37		25	
No	172	35		23	
No. of Physical Exams in Past 5 Years					
< 5 exams	194	35		24	
≥ 5 exams	192	36		24	
Healthcare Access Scale					
1st tertile	143	38		26	
2nd tertile	120	33		22	
3rd tertile	123	37		24	
Has Regular Healthcare Provider					
Yes	313	36		24	
No	73	34		25	
Health Insurance					

Characteristic	No.	Prolonged Clinical Delay (%) ≥ 60 days	p[a]	Prolonged Clinical Delay (%) ≥ 90 days	p[a]
Private	250	36		23	
Public or Uninsured	136	37		26	
Mode of Cancer Detection					
Symptomatic presentation	272	39	0.19	25	
Symptomatic, screen-detected	38	32		24	
Non-symptomatic, screen-detected	75	27		20	
Level of Support Needs Met					
1st tertile	125	42		30	0.08
2nd tertile	98	38		23	
3rd tertile	163	31		20	
Recruitment Facility Type					
Public	79	33		24	
Private Academic	174	38		25	
Private, non-academic	133	35		23	
County of Residence					
Cook	339	38	.04	25	0.20
DuPage, Will, Lake (IL), or Lake (IN)	47	23		17	
Initial Medical Visit					
Screening Appointment	114	28	0.18	21	
Medical Appointment	144	42		26	
Walk-in Visit	30	40		27	
Emergency Room Visit	98	33		23	
No. of Medical Visits Between Presentation and Initial Treatment					
0	344	33	0.01	22	0.01
1 or more	42	55		40	
Distance Traveled to Facility					
< 5 miles	101	29	0.01	22	0.06
5 – 9.9 miles	111	40		25	
10 – 14.9 miles	79	47		34	
≥ 15 miles	91	29		18	
Travel Time from Home to Facility					

Characteristic	No.	Prolonged Clinical Delay (%) ≥ 60 days	p[a]	Prolonged Clinical Delay (%) ≥ 90 days	p[a]
<10 minutes	125	33	0.02	23	0.06
10 – 19.9 minutes	156	44		30	
≥20 minutes	101	27		17	
Late Stage Diagnosis					
Yes	211	37		24	
No	145	34		24	

[a] p-values≥ 0.20 are not shown

Table III

Comparison of nested multivariable models of prolonged clinical delay

	N	Prolonged clinical delay (≥ 60 days) p[a]	Prolonged clinical delay (≥ 90 days) p[a]
Type 1 analysis[b]			
Race	386	0.04	0.002
Mode of Detection	386	0.11	
Socioeconomic Factors[d]	368	0.10	0.06
Healthcare Access & Utilization[e]	385		
Support[f]	386		0.18
Number of Medical Visits[g]	386	0.001	0.001
Travel Burden[h]	382	0.01	0.11
Stage at Diagnosis[i]	376		
Type 3 analysis[c]			
Remove Race	356		
Remove Mode of Detection	356	0.11	
Remove Socioeconomic Factors[d]	356		
Remove Access & Utilization[e]	356		
Remove Support[f]	356	0.10	0.19
Remove Number of Medical Visits[g]	356	0.001	<0.001
Remove Travel Burden[h]	356	0.01	0.11
Remove Stage at Diagnosis[i]	356		

[a] From a Chi-Squared likelihood ratio test comparing two nested models (p-values >0.20 are suppressed)

[b] Logistic regression models adjusted for each given domain were compared to a reduced model lacking the respective domain using likelihood ratio tests. All models were additionally adjusted for continuous age, recruitment facility, and county of residence.

[c] A logistic regression model adjusted for all domain variables was compared to reduced models lacking one of each domain using likelihood ratio tests. All models were additionally adjusted for continuous age, recruitment facility, and county of residence.

[d] Individual level household income, education and employment status, and census tract-level concentrated affluence and disadvantage

[e] Health insurance status at diagnosis, regular healthcare provider, history of prior colon cancer screening, history of prior physical exams, healthcare access, and healthcare utilization

[f] Marital status and unmet support needs

[g] Number of visits between medical presentation and treatment

[h] Time and distance traveled from home to recruitment facility

[i] Ordinal variable with stages defined as AJCC stages 1, 2, 3 or 4

Table IV

Proportion of the association between race and prolonged clinical delay mediated by selected domains

	Prolonged clinical delay (≥ 60 days)			Prolonged clinical delay (≥ 90 days)		
	PD (95% CI)	**Proportion Mediated (%)**	**p[a]**	**PD (95% CI)**	**Proportion Mediated (%)**	**p[a]**
Crude	0.09 (−0.01, 0.18)	NA	NA	0.13 (0.04, 0.21)	NA	NA
Adjusted[b]	0.12 (0.02, 0.22)	NA	NA	0.14 (0.03, 0.23)	NA	NA
Mode of detection	0.12 (0.02, 0.21)	3	0.65	0.14 (0.03, 0.22)	1	0.66
Healthcare access & utilization[c]	0.15 (0.05, 0.26)	−28	0.22	0.15 (0.05, 0.24)	−8	0.62
Support[d]	0.10 (0.02, 0.24)	10	0.38	0.13 (0.04, 0.23)	6	0.43
Number of medical visits[e]	0.10 (0.01, 0.21)	12	0.25	0.13 (0.01, 0.23)	8	0.25
Travel Burden[f]	0.09 (0.00, 0.21)	33	0.05	0.11 (0.01, 0.22)	18	0.06
SES[g]	0.05 (−0.03, 0.17)	51	0.21	0.09 (−0.01, 0.19)	30	0.22
Stage at Diagnosis[h]	0.12 (0.01, 0.23)	1	0.70	0.14 (0.05, 0.24)	−1	0.72
SES, travel burden	0.03 (−0.04, 0.18)	79	0.08	0.07 (−0.01, 0.20)	45	0.08
SES, travel burden, no. of medical visits, support	0.03 (−0.06, 0.18)	92	0.04	0.06 (−0.03, 0.21)	55	0.03

[a] Representing the significance of the difference between race coefficients from full and reduced models

[b] Adjusted for continuous age, recruitment facility, and county of residence

[c] Health insurance status at diagnosis, regular healthcare provider, history of prior colon cancer screening, history of prior physical exams, healthcare access, and healthcare utilization

[d] Marital status and unmet support needs

[e] Number of visits between medical presentation and treatment

[f] Time and distance traveled from home to recruitment facility

[g] Individual level household income, education and employment status, and census tract-level concentrated affluence and disadvantage

[h] Ordinal variable with stages defined as AJCC stages 1, 2, 3 or 4