PUBLIC HEALTH REPORTS

Public Health Reports
2022, Vol. 137(3) 479–487

DOI: 10.1177/0033354921999173
journals.sagepub.com/home/phr
SAGE

Health Insurance Status as a Predictor of Mode of Colon Cancer Detection but Not Stage at Diagnosis: Implications for Early Detection

Lindsey A. Jones, MS[1]; Katherine C. Brewer, PhD[1]; Leslie R. Carnahan, PhD[2,3]; Jennifer A. Parsons, MA[4]; Blase N. Polite, MD[5]; Carol Estwing Ferrans, PhD, RN[6,7]; Richard B. Warnecke, PhD[6]; and Garth H. Rauscher, PhD[1,6]

Abstract

Objective: For colon cancer patients, one goal of health insurance is to improve access to screening that leads to early detection, early-stage diagnosis, and polyp removal, all of which results in easier treatment and better outcomes. We examined associations among health insurance status, mode of detection (screen detection vs symptomatic presentation), and stage at diagnosis (early vs late) in a diverse sample of patients recently diagnosed with colon cancer from the Chicago metropolitan area.

Methods: Data came from the Colon Cancer Patterns of Care in Chicago study of racial and socioeconomic disparities in colon cancer screening, diagnosis, and care. We collected data from the medical records of non-Hispanic Black and non-Hispanic White patients aged ≥50 and diagnosed with colon cancer from October 2010 through January 2014 (N = 348). We used logistic regression with marginal standardization to model associations between health insurance status and study outcomes.

Results: After adjusting for age, race, sex, and socioeconomic status, being continuously insured 5 years before diagnosis and through diagnosis was associated with a 20 (95% CI, 8-33) percentage-point increase in prevalence of screen detection. Screen detection in turn was associated with a 15 (95% CI, 3-27) percentage-point increase in early-stage diagnosis; however, nearly half (47%; n = 54) of the 114 screen-detected patients were still diagnosed at late stage (stage 3 or 4). Health insurance status was not associated with earlier stage at diagnosis.

Conclusions: For health insurance to effectively shift stage at diagnosis, stronger associations are needed between health insurance and screening-related detection; between screening-related detection and early stage at diagnosis; or both. Findings also highlight the need to better understand factors contributing to late-stage colon cancer diagnosis despite screen detection.

Keywords

colon cancer, cancer, cancer screening, health insurance, stage at diagnosis

Colon cancer is among the most incident cancers and one of the most common causes of cancer-related mortality in the United States.[1] An estimated 147 950 new cases and 53 200 deaths will have been attributed to the disease in 2020.[1] Incidence of late-stage colon cancer diagnosis (stage 3 or 4) is high in the United States. Based on estimates from national cancer registry data, 45% of colon and rectal cancers diagnosed during 2007-2013 were detected at late stage.[2] Prognosis is substantially worse at late stages, with 5-year relative survival ranging from 88% to 80% at stages 1 and 2, respectively, dropping to about 66% at stage 3, and then 13% at stage 4.[2] Hence, great potential remains for a substantial

Corresponding Author:
Garth H. Rauscher, PhD, University of Illinois at Chicago, School of Public Health, Division of Epidemiology and Biostatistics, M/C 923, Chicago, IL 60612, USA.
Email: garthr@uic.edu

reduction in colon cancer mortality and morbidity by increasing the rate of early detection.

Regular screening for adults aged 50-75 is the primary method of preventing excess colon cancer–related morbidity and mortality.[3] Estimates suggest that only approximately 62% of US adults receive on-schedule screening.[4] Adherence to screening guidelines is influenced by numerous factors, such as patient sociodemographic characteristics,[5-9] patient awareness about screening,[7] access to routine care,[5,8,9] and physician recommendation.[7,9] Many such factors rely heavily on the health insurance status of the patient, which has also been strongly associated with patient screening behaviors.[5,6,8] Self-reports of on-schedule screening through endoscopy in 2015 were much higher in the United States among insured people (57%) than among people lacking health insurance (24%).[4] In addition, lacking private health insurance has been associated with poor quality of bowel preparation, which can hinder adenoma detection.[10,11] Low adenoma detection rates during colonoscopy may increase the likelihood of interval and late-stage diagnoses.[12,13] In line with these observations, colon cancer patients lacking private health insurance are less likely than patients with private health insurance to be diagnosed at earlier stages.[14,15]

For colon cancer patients, a major goal of health insurance is to improve access to screening that leads to detection and diagnosis at an early stage, when the cancer is more easily treated. The objective of our study was to describe associations among health insurance status, mode of detection (screen detection vs symptomatic presentation), and stage at diagnosis (early vs late) in a diverse sample of patients recently diagnosed with colon cancer from the Chicago metropolitan area.

Methods

Sample

For our analysis, we used data from the Colon Cancer Patterns of Care in Chicago (CCPCC) study of racial and socioeconomic disparities in colon cancer screening, timing of care, stage at diagnosis, and treatment among patients in the Chicago metropolitan area. CCPCC methods are detailed elsewhere.[16] Briefly, enrolled patients were from 9 hospitals that serve diverse patient populations in or near Chicago; patients self-identified as non-Hispanic White or non-Hispanic Black, were newly diagnosed with colon cancer from October 2010 through January 2014, and resided in Cook, DuPage, Lake, or Will counties in Illinois or Lake County in Indiana. Hospital staff members identified patients potentially eligible for the study and confirmed diagnoses by medical record review. Research team members mailed a letter describing the study to eligible patients at least 45 days after their surgery (or diagnostic colonoscopy if no surgery was needed) and made follow-up calls after 2 weeks. We excluded rectal cancer cases because of differences between rectal and colon cancer symptomology, ease of detection, and treatment patterns.

Patients who consented to participate completed a 90-minute in-person interview and allowed access to their medical records. During the interview, patients self-reported information about their diagnostic and treatment pathways and various health care and demographic characteristics. The study response rate was 54% (n = 407), calculated by using the American Association of Public Opinion Research's Standard Definition Response Rate 3.[17] For the following analyses, we restricted the sample to patients aged ≥50 at diagnosis (n = 348), because screening is recommended for average-risk patients beginning at age 50.[3]

Measures

Before the main study, we conducted cognitive interviews with an initial sample of colon cancer patients to understand the pathways through which they might describe how they became aware of their colon cancer. During interviews for the main study, we gave patients a card and asked them to pick from among 1 of 4 statements that best described how they became aware of the problem that was later diagnosed as colon cancer: (1) "colon symptoms prompting a medical visit": "I was having problems or symptoms with my colon or bowel, so I went to the doctor. They did some tests and told me I had colon cancer"; (2) "noncolon symptoms prompting a medical visit": "I was having other problems, not with my colon or bowel, so I went to the doctor. They did some tests and told me I had colon cancer"; (3) "routine screening": "I was not having any problems with my colon or bowel. I got a test or procedure as a routine check, and my doctor told me there was a problem"; and (4) "asymptomatic surveillance": "I was having a follow-up colonoscopy, because a prior colonoscopy had found polyps or growths, and my doctor told me there was a problem." For this analysis, we defined screen detection as response 3 (routine

[1] Division of Epidemiology and Biostatistics, School of Public Health, University of Illinois at Chicago, Chicago, IL, USA
[2] Division of Community Health Sciences, School of Public Health, University of Illinois at Chicago, Chicago, IL, USA
[3] Center for Research on Women and Gender, College of Medicine, University of Illinois at Chicago, Chicago, IL, USA
[4] Survey Research Laboratory, University of Illinois at Chicago, Chicago, IL, USA
[5] School of Medicine, University of Chicago, Chicago, IL, USA
[6] Institute for Health Research and Policy, University of Illinois at Chicago, Chicago, IL, USA
[7] College of Nursing, University of Illinois at Chicago, Chicago, IL, USA

screening) or response 4 (asymptomatic surveillance) and symptomatic detection as response 1 (colon symptoms prompting a medical visit) or response 2 (noncolon symptoms prompting a medical visit). We abstracted data on stage at diagnosis, based on American Joint Committee on Cancer staging, from patient medical records. For this analysis, we defined late stage as stage 3 or 4 (vs early stage, stage 1, or stage 2).

During interviews, we asked patients detailed questions about their health insurance status leading up to and during diagnosis and treatment. We questioned patients about the following health insurance types in the following order: Medicare Part A, Medicare Part B, Medigap, Medicaid, military, and private health insurance. Example questions for private health insurance coverage were:

- Have you ever had private health insurance as an adult, such as an HMO (health maintenance organization), PPO (preferred provider organization), or fee for service?
- Did you have private health insurance when you were being diagnosed and treated with colon cancer?
- Did you have private health insurance at all in the 5 years prior to being diagnosed with colon cancer?
- During the 5 years before you were diagnosed, for how much of that time would you say that you had private health insurance?

We defined 2 measures of health insurance status. The first indicated whether a patient was continuously insured (publicly and/or privately) for the 5 years before diagnosis and up to and including diagnosis. The second indicated whether a patient had any form of private health insurance at diagnosis; this measure included patients who were using Medicare and had supplemental Medigap insurance.

We collected and categorized the following demographic and socioeconomic data during interviews: race (non-Hispanic White or non-Hispanic Black), age (50-59, 60-69, or ≥70), sex (male or female), marital status (single or married), employment (unemployed or employed), education (<high school graduate, high school graduate, or >high school graduate), and annual household income (<$20 000, $20 000-$50 000, or >$50 000). We created census tract–level indices of concentrated disadvantage and concentrated affluence from 2009-2013 American Community Survey data, as previously described.[18] We divided each index into tertiles, with the lowest and highest levels of socioeconomic disadvantage or affluence represented by the first and third tertiles, respectively. We defined a composite variable for socioeconomic status (SES) by creating an equally weighted sum of income, education, concentrated census-tract disadvantage, and concentrated census-tract affluence (Cronbach $\alpha = 0.71$). Additional covariates included tumor location in the colon (proximal or distal), number of comorbid conditions (0, 1, or ≥2), body mass index (underweight or normal, overweight, or obese), recruitment facility type (public, academic, or private nonacademic), whether the patient received any previous colon cancer screening (yes or no), and county of residence.

Statistical Analysis

We examined associations of patient characteristics with being continuously insured and with private health insurance at diagnosis using Pearson χ^2 tests of association. We similarly examined associations of each health insurance measure with screen detection (vs symptomatic detection) and with later stage at diagnosis (stage 3 or 4 vs stage 1 or 2). We used logistic regression with marginal standardization to model associations among (1) each health insurance measure and mode of cancer detection, (2) mode of cancer detection and stage at diagnosis, and (3) each health insurance measure and stage at diagnosis. We adjusted models of health insurance in predicting mode of detection for age, race, sex, and composite SES; we also adjusted models of mode of detection in predicting stage at diagnosis for health insurance status. Adjusting for tumor location (proximal vs distal) did not meaningfully affect the results; because inclusion of this variable in models reduced the sample size from 348 to 309, we did not include it in our final models. We included nonresponse weights in all analyses to account for differences in response rate by facility, age, race, and sex. We performed analyses using Stata version 14 (StataCorp LLC). We calculated results as prevalence differences (PDs) and 95% CIs using the margins command in Stata with the α level for significance = .20.

Ethical Considerations

The University of Illinois at Chicago Institutional Review Board and the institutional review boards at all health care facilities reviewed and approved this study. All patients provided written consent before participation and received $100 for completing the study interview and consenting to medical record abstraction.

Results

Of the 348 patients in the study, 227 (65%) had private health insurance at diagnosis, and 284 (82%) had health insurance at diagnosis and during the 5 years before diagnosis (ie, had continuous health insurance) (Table 1). The following characteristics were associated with private health insurance at diagnosis and continuous health insurance: non-Hispanic White race, being married, being employed, having at least a high school diploma, having an annual household income ≥$20 000, residing in a census tract in the second or third tertile of concentrated disadvantage, and residing in 1 of the following counties: DuPage, Will, Lake (Illinois), or Lake (Indiana). Age ≥60 was associated with continuous health

Table 1. Prevalence of private health insurance at diagnosis and continuous health insurance by demographic characteristics for patients aged ≥50 in the Colon Cancer Patterns of Care in Chicago study, 2010-2014[a]

		Private health insurance at diagnosis		Continuous health insurance	
Characteristic	**No.**	**No. (%)[b]**	***P* value[c]**	**No. (%)[d]**	***P* value[c]**
Overall	348	227 (65)	NA	284 (82)	NA
Race/ethnicity			<.001		<.001
Non-Hispanic White	165	136 (84)		146 (89)	
Non-Hispanic Black	183	91 (52)		138 (78)	
Age, y			.15		<.001
50-59	128	83 (71)		94 (78)	
60-69	137	81 (66)		109 (84)	
≥70	83	63 (78)		81 (98)	
Sex			.14		.30
Female	174	107 (66)		141 (84)	
Male	174	120 (74)		143 (86)	
Marital status			<.001		<.001
Single	191	95 (53)		138 (75)	
Married	157	132 (88)		146 (95)	
Employment			<.001		<.001
Unemployed	247	141 (62)		196 (83)	
Employed	101	86 (89)		88 (90)	
Education			<.001		<.001
<High school graduate	52	19 (40)		32 (65)	
High school graduate	90	52 (65)		76 (87)	
>High school graduate	206	156 (79)		176 (88)	
Annual household income, $			<.001		<.001
<20 000	120	36 (32)		77 (67)	
20 000-50 000	91	66 (75)		76 (86)	
>50 000	124	115 (94)		119 (96)	
Census-tract disadvantage[e]			<.001		<.001
1st tertile	114	96 (87)		104 (92)	
2nd tertile	112	71 (69)		85 (79)	
3rd tertile	118	57 (69)		92 (81)	
Census-tract affluence[e]			<.001		<.001
1st tertile	119	64 (56)		94 (83)	
2nd tertile	113	75 (74)		92 (85)	
3rd tertile	112	85 (79)		95 (86)	
County of residence			.03		.003
DuPage, Will, Lake (Illinois), or Lake (Indiana)	37	31 (85)		35 (96)	
Cook	311	196 (68)		249 (83)	

Abbreviation: NA, not applicable.
[a]All data obtained from in-person interviews with patients or abstracted from their medical records at 9 participating hospitals.
[b]Prevalence of private health insurance at diagnosis (weighted to correct for nonresponse).
[c]*P* value determined by Pearson χ^2 test; significance set at $P = .20$.
[d]Prevalence of being continuously insured (publicly and/or privately) for the 5 years before diagnosis and up to and including diagnosis (weighted to correct for nonresponse).
[e]The first tertile represents the lowest level of disadvantage or affluence, and the third tertile represents the highest level of disadvantage or affluence.

insurance and residing in a census tract in the third tertile of concentrated affluence with private health insurance at diagnosis. Sex was not associated with either health insurance measure.

Patients with private health insurance at diagnosis or continuous health insurance were less likely than patients lacking private health insurance at diagnosis or lacking continuous health insurance to have been recruited from a public facility and to

Table 2. Prevalence of patient health characteristics by health insurance status for patients aged ≥50 in the Colon Cancer Patterns of Care in Chicago study, 2010-2014[a]

Characteristic	No.	Private health insurance at diagnosis			Continuous health insurance		
		Yes, no. (%)[b]	No, no. (%)[b]	*P* value[c]	Yes, no. (%)[b]	No, no. (%)[b]	*P* value[c]
No. of comorbidities				.94			.43
0	51	33 (16)	18 (16)		38 (15)	13 (22)	
1	91	60 (26)	31 (25)		72 (26)	19 (26)	
≥2	206	134 (58)	72 (59)		174 (59)	32 (52)	
Body mass index				.65			.13
Underweight or normal	117	76 (33)	41 (36)		90 (32)	27 (44)	
Overweight	116	79 (36)	37 (31)		99 (36)	17 (25)	
Obese	112	71 (31)	41 (34)		92 (32)	20 (31)	
Any previous colon cancer screening				.002			<.001
No	142	80 (37)	62 (51)		98 (36)	44 (70)	
Yes	206	147 (63)	59 (29)		186 (64)	20 (30)	
Colon cancer location				.91			.91
Proximal	186	115 (61)	61 (59)		155 (61)	31 (58)	
Distal	123	73 (39)	42 (41)		102 (39)	21 (42)	
Recruitment facility type				<.001			<.001
Public	45	5 (1)	40 (25)		10 (2)	35 (43)	
Academic	177	121 (52)	56 (49)		156 (53)	21 (39)	
Private nonacademic	126	87 (41)	25 (26)		118 (44)	8 (19)	

[a]All data obtained from in-person interviews with patients or abstracted from their medical records at 9 participating hospitals.
[b]Prevalence of patient characteristics (weighted to correct for nonresponse).
[c]*P* value determined by Pearson χ^2 test; significance set at $P = .20$.

report a lack of previous colon cancer screening (Table 2). Number of comorbidities, body mass index, and tumor location were not associated with either health insurance measure.

Of 348 patients, 122 (weighted 35%) had a screen-detected cancer, and 190 (weighted 57%) were diagnosed at stage 3 or 4 (Table 3). We had data on stage at diagnosis for 114 of the screen-detected patients, of whom 54 (47%) had a late-stage diagnosis (results not tabulated). Private health insurance at diagnosis and continuous health insurance were both associated with screen detection versus symptomatic presentation. Neither health insurance measure was associated with stage at diagnosis.

In multivariable models adjusted for age, race, sex, and SES (Table 4), being continuously insured was associated with a 20 percentage-point increase in prevalence of screen detection (39% vs 19%; PD = 0.20; 95% CI, 0.08-0.33). With additional adjustment for health insurance status, screen detection was associated with a 15 percentage-point increase in early-stage diagnosis (53% vs 38%; PD = 0.15; 95% CI, 0.03-0.27). Despite these associations, being

Table 3. Associations of health insurance measures with mode of detection and stage at diagnosis for patients aged ≥50 in the Colon Cancer Patterns of Care in Chicago study, 2010-2014[a]

Characteristic	No.	Screen-detected cancer		Late-stage diagnosis (stage 3 or 4)	
		No. (%)[b]	*P* value[c]	No. (%)[b]	*P* value[c]
Overall	348	122 (35)	NA	190 (57)	NA
Private health insurance at diagnosis			.001		.92
Yes	227	94 (42)		124 (57)	
No	121	28 (24)		66 (57)	
Continuous health insurance			.002		.56
Yes	284	111 (40)		153 (56)	
No	64	11 (17)		37 (61)	

Abbreviation: NA, not applicable.
[a]All data obtained from in-person interviews with patients or abstracted from their medical records at 9 participating hospitals.
[b]Prevalence of screen-detected cancer or late-stage diagnosis (weighted to correct for nonresponse).
[c]*P* value determined by Pearson χ^2 test; significance set at $P = .20$.

Table 4. Multivariable sequence of associations among health insurance status at diagnosis, mode of detection, and stage at diagnosis for patients aged ≥50 in the Colon Cancer Patterns of Care in Chicago study, 2010-2014[a]

Variable	Prevalence difference (95% CI)[b]	*P* value[c]
Continuous health insurance with screen detection[d]	0.20 (0.08 to 0.33)	.002
Screen detection with early stage[e]	0.15 (0.03 to 0.27)	.01
Continuous health insurance with early stage	0.01 (−0.15 to 0.16)	.70
Private health insurance at diagnosis with screen detection[d]	0.15 (0.04 to 0.26)	.01
Screen detection with early stage[e]	0.15 (0.03 to 0.27)	.01
Private health insurance at diagnosis with early stage	−0.05 (−0.18 to 0.08)	.50

[a]All data obtained from in-person interviews with patients or abstracted from their medical records at 9 participating hospitals.
[b]Prevalence differences obtained from logistic regression with predictive margins.
[c]*P* value determined by the likelihood-ratio test; significance set at *P* = .20.
[d]Multivariable logistic regression model of screen detection (dependent variable) adjusted for age, race, sex, and socioeconomic status.
[e]Multivariable logistic regression model of early-stage diagnosis (dependent variable) adjusted for age, race, sex, socioeconomic status, and health insurance status.

continuously insured was not associated with early stage at diagnosis (43% vs 43%; PD = 0.01; 95% CI, −0.15 to 0.16). In similar multivariable models, having private health insurance at diagnosis was associated with a 15 percentage-point increase in prevalence of screen detection (41% vs 26%; PD = 0.15; 95% CI, 0.04-0.26). With additional adjustment for health insurance status, screen detection was associated with a 15 percentage-point increase in early-stage diagnosis (53% vs 38%; PD = 0.15; 95% CI, 0.03-0.27). Despite these associations, having private health insurance was not associated with early stage at diagnosis (PD = −0.05; 95% CI, −0.18 to 0.08). In multivariable subgroup analyses, symptomatic detection was strongly associated with later disease stage among the 218 patients with private health insurance (PD = 0.21; 95% CI, 0.07-0.35) but was not associated with later stage among the 114 patients lacking private health insurance (PD = −0.08; 95% CI, −0.31 to 0.15).

Discussion

Among a sample of non-Hispanic Black and non-Hispanic White colon cancer patients diagnosed at 1 of 9 hospitals serving diverse patient populations in the Chicago metropolitan area during 2010-2014, private health insurance at diagnosis increased the likelihood of screen-detected colon cancer but was not associated with earlier stage at diagnosis. Likewise, being continuously insured during the 5 years before and during diagnosis was associated with screen detection but not with earlier stage at diagnosis.

The lack of association observed between health insurance measures and stage at diagnosis is likely explained in part by the fact that nearly half (47%) of patients with screen detection were still diagnosed with late-stage cancer, resulting in a relatively modest association between mode of detection and stage. Compared with the 15 percentage-point reduction in prevalence of late-stage cancer among screen-detected patients in this study, in another study of breast cancer patients using a similar adjustment scheme,[18] screen detection was associated with a 46 percentage-point increase in the multivariable-adjusted prevalence of early-stage (stage 0 or 1 vs stages 2, 3, or 4) diagnosis (22% vs 68%; G.H.R., unpublished data, 2008). For health insurance to effectively facilitate early-stage cancer diagnosis through screening, 2 things must occur: (1) adults must use their health insurance benefit to get screened, and (2) screening must result in early-stage cancer detection. Our findings suggest that the latter part of this pathway may be suboptimal in this patient population.

Colon cancer differs from other screen-detectable cancers in that the interval between screenings is extremely long. Colonoscopies, the most commonly used screening examination, are recommended every 10 years in average-risk people.[3] The effectiveness of colonoscopy screening in preventing late-stage cancers depends on factors such as procedure quality, bowel preparation quality, and tumor/lesion location. Patients who receive endoscopies from health care providers who have high rates of adenoma detection or specialize in gastroenterology, for example, are less likely than patients whose health care providers lack those characteristics to have an interval colon cancer.[19,20] Inadequate bowel preparation may occur in up to one-quarter of patients receiving colonoscopies and can result in missed lesions or incomplete lesion resections.[20] Furthermore, tumors and lesions in the proximal colon are less effectively detected by colonoscopy than tumors and lesions in the distal colon.[20] Colonoscopy effectiveness may also differ by patient characteristics. Men and non-Hispanic Black people are more likely than women and non-Hispanic White people, respectively, to have poor quality bowel preparation.[21] Low SES, regardless of health insurance, can create barriers to high-quality colonoscopy examinations, especially among racial/ethnic minority populations.[22] Non-Hispanic Black people may be more likely than similarly insured non-Hispanic White people to receive colonoscopies from physicians with

low polyp detection rates and to have interval colon cancers.[23] In addition, proximal colon cancer is more prevalent among females than among males and among non-Hispanic Black people than among non-Hispanic White people.[24] Although colonoscopy quality and patient sociodemographic characteristics may influence stage at diagnosis to some extent, these factors are unlikely to entirely account for our findings, especially given that our analyses controlled for race, sex, and SES.

We were unable to determine whether patients in our analysis received another type of screening before their colonoscopy, which could contribute to delays in detection. A wide variety of other colon cancer screening tests exists, each varying in effectiveness.[25-27] The US Preventive Services Task Force recommends the following as alternatives to colonoscopy: stool-based testing every 1-3 years, computed tomography colonography every 5 years, flexible sigmoidoscopy every 5 years, or flexible sigmoidoscopy plus annual fecal immunochemical test every 10 years.[3] For stool-based tests with abnormal findings, a follow-up colonoscopy examination must be performed or the screening process is considered incomplete. Delays in such follow-up have been associated with later-stage cancer diagnosis[28] and can occur as a result of patient-level or system-level factors.[29-31] Lastly, another possible explanation for the lack of association between health insurance status and stage at diagnosis observed in our study is that insured patients may disproportionately have colon cancer prevented by colonoscopy (via early polyp detection and removal). Screen-detected lesions tend to be less aggressive than lesions that go undetected at screening,[32] which could have resulted in worse disease biology among insured patients than uninsured patients in our sample. Hence, if the insured portion of our study sample had many patients with aggressive disease biology, any association of health insurance status with earlier stage at diagnosis would be obscured.

In contrast to our results, a study of National Cancer Database data found that the odds of late-stage (stage 3 or 4) diagnosis among colorectal cancer patients were 2 times higher among uninsured patients than among privately insured patients.[33] Another National Cancer Database analysis found that uninsured patients had a 25% greater prevalence than privately insured patients of a stage 3 or stage 4 colorectal cancer diagnosis.[15] An analysis of Surveillance, Epidemiology, and End Results data reported 76% lower odds among uninsured patients than among privately insured patients presenting with early-stage (in situ) colorectal cancer.[14] Our study excluded patients with in situ cancer, so the latter results may not provide a good comparison with the results of our study. It is also possible that factors reducing the effectiveness of health insurance and colon cancer screening may be more prevalent in the urban setting of our study sample than in the settings for nationally representative samples. The effectiveness of health insurance in influencing the stage of cancer detection and various other outcomes may also depend on the social determinants of a given population.[34] Other studies using state and hospital tumor registry data found associations between health insurance status and stage at diagnosis[35-37]; however, these studies lacked multivariable analyses or were restricted to only 1 site, highlighting a need for more research examining this association across various population types.

Strengths and Limitations

A major strength of this study was the ability to disentangle the associations among health insurance status, mode of detection, and stage at diagnosis, as most other studies on this topic have been unable to do.[14,15,32,34-36] This disentanglement was possible because of our detailed approach to data collection. We used a highly structured computer-assisted personal interview, informed beforehand by cognitive interviews with our patient population and administered by trained staff members employed by the University of Illinois at Chicago's Survey Research Laboratory. Furthermore, reviews of medical records allowed us to corroborate details of patients' colon cancer experiences.

Our study also had several limitations. First, it had a modest sample size (N = 348) that was not population-based; however, we chose the 9 recruitment facilities to represent a range of hospital types (public, academic, and private nonacademic). Second, the study response rate was modest (54%). We accounted for this modest rate by including nonresponse weights in all analyses for age, race, sex, and recruitment facility. In addition, to explore the possibility of selection bias related to stage at diagnosis, we used Illinois State Cancer Registry data to compare the prevalence of late-stage colon cancer in our study with data for Illinois, Cook County, and the city of Chicago during the same time frame. Among patients aged 50-79, the prevalence of late-stage colon cancer in our study was 57%, similar to the prevalence among patients in Illinois otherwise meeting our study eligibility criteria (55%). It was also similar to the prevalence for Cook County (56%) and the city of Chicago (58%), where most of the study patients resided. Third, the association observed between screen detection and early-stage diagnosis may have been inflated because screening is more likely to detect slow-growing tumors than fast-growing tumors (ie, length–time bias). Fourth, we did not have data to determine patient age at screening initiation, whether patients completed a stool-based test as part of their screening process before colonoscopy, or whether patients were following a recommended screening program.

Conclusions

For health insurance to effectively reduce the prevalence of late-stage colon cancer diagnosis, adults must not only use their health insurance benefit to get screened, but screening must result in early-stage diagnosis. Findings from this

analysis highlight the need to further study and intervene on factors contributing to late-stage colon cancer diagnoses despite screen detection.

Acknowledgments

The authors thank the men and women diagnosed with colon cancer who graciously provided their time and information to the study, thereby making this research possible. We also thank the following institutions, lead personnel, and staff members who contributed their efforts in identifying and recruiting patients into the study: Stroger Hospital of Cook County (Namrata Das Batra, MBBS; Thomas E. Lad, MD), Northwestern Memorial Hospital (Rebekka Sneed; Amy Halverson, MD), Advocate Health Care (Laura Wrona, RN; Deborah Stlaske, MSN, APN; Rosemarie Schubert; Evie Sprague, RN, BSN, OCN; Mahaela Banulescu; Christopher Blair, MS; James Weese, MD; Deepti Singh, MD), Rush University (Amanda Francescatti; Marc Brand, MD), Ingalls Memorial Hospital Cancer Research Center (Margaret Marriott, RN, MS, OCN; Mark Kozloff, MD), and the University of Chicago (Toni Cipriano-Steffans, MA).

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The Colon Cancer Patterns of Care in Chicago (CCPCC) study was funded by a grant from the National Institutes of Health, National Institute on Minority Health and Health Disparities to the University of Illinois at Chicago (no. P60MD003424 to K.C.B., J.A.P., R.B.W., G.H.R., and C.E.F.). The study sponsor did not play any role in the study design. In addition, B.N.P. received a grant from the John Templeton Foundation Grant (no. 36441).

ORCID iDs

Lindsey A. Jones, MS https://orcid.org/0000-0003-2799-7886

Jennifer A. Parsons, MA https://orcid.org/0000-0003-2968-6344

References

1. American Cancer Society. Cancer facts & figures 2020. Accessed November 2, 2020. https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/annual-cancer-facts-and-figures/2020/cancer-facts-and-figures-2020.pdf
2. Cronin KA, Lake AJ, Scott S, et al. Annual report to the nation on the status of cancer, part I: national cancer statistics. *Cancer*. 2018;124(13):2785-2800. doi:10.1002/cncr.31551
3. US Preventive Services Task Force, Bibbins-Domingo K, Grossman DC, et al. Screening for colorectal cancer: US Preventive Services Task Force recommendation statement. *JAMA*. 2016;315(23):2564-2575. doi:10.1001/jama.2016.5989
4. Siegel RL, Miller KD, Fedewa SA, et al. Colorectal cancer statistics, 2017. *CA Cancer J Clin*. 2017;67(3):177-193. doi:10.3322/caac.21395
5. Ioannou GN, Chapko MK, Dominitz JA. Predictors of colorectal cancer screening participation in the United States. *Am J Gastroenterol*. 2003;98(9):2082-2091. doi:10.1111/j.1572-0241.2003.07574.x
6. Courtney RJ, Paul CL, Sanson-Fisher RW, et al. Individual- and provider-level factors associated with colorectal cancer screening in accordance with guideline recommendation: a community-level perspective across varying levels of risk. *BMC Public Health*. 2013;13:248. doi:10.1186/1471-2458-13-248
7. Honein-AbouHaidar GN, Kastner M, Vuong V, et al. Systematic review and meta-study synthesis of qualitative studies evaluating facilitators and barriers to participation in colorectal cancer screening. *Cancer Epidemiol Biomarkers Prev*. 2016;25(6):907-917. doi:10.1158/1055-9965.EPI-15-0990
8. Liang S-Y, Phillips KA, Nagamine M, Ladabaum U, Haas JS. Rates and predictors of colorectal cancer screening. *Prev Chronic Dis*. 2006;3(4):A117.
9. Beydoun HA, Beydoun MA. Predictors of colorectal cancer screening behaviors among average-risk older adults in the United States. *Cancer Causes Control*. 2008;19(4):339-359. doi:10.1007/s10552-007-9100-y
10. Nguyen DL, Wieland M. Risk factors predictive of poor quality preparation during average risk colonoscopy screening: the importance of health literacy. *J Gastrointestin Liver Dis*. 2010;19(4):369-372.
11. Lebwohl B, Wang TC, Neugut AI. Socioeconomic and other predictors of colonoscopy preparation quality. *Dig Dis Sci*. 2010;55(7):2014-2020. doi:10.1007/s10620-009-1079-7
12. Kaminski MF, Regula J, Kraszewska E, et al. Quality indicators for colonoscopy and the risk of interval cancer. *N Engl J Med*. 2010;362(19):1795-1803. doi:10.1056/NEJMoa0907667
13. Corley DA, Jensen CD, Marks AR, et al. Adenoma detection rate and risk of colorectal cancer and death. *N Engl J Med*. 2014;370(14):1298-1306. doi:10.1056/NEJMoa1309086
14. Amini A, Jones BL, Yeh N, et al. Disparities in disease presentation in the four screenable cancers according to health insurance status. *Public Health*. 2016;138:50-56. doi:10.1016/j.puhe.2016.03.014
15. Ward EM, Fedewa SA, Cokkinides V, Virgo K. The association of insurance and stage at diagnosis among patients aged 55 to 74 years in the National Cancer Database. *Cancer J*. 2010;16(6):614-621. doi:10.1097/PPO.0b013e3181ff2aec
16. Jones LA, Ferrans CE, Polite BN, et al. Examining racial disparities in colon cancer clinical delay in the Colon Cancer Patterns of Care in Chicago study. *Ann Epidemiol*. 2017;27(11):731-738. doi:10.1016/j.annepidem.2017.10.006
17. American Association for Public Opinion Research. Standard definitions: final dispositions of case codes and outcome rates for surveys. Revised 2016. Accessed March 8, 2019. https://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf

18. Dookeran KA, 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(1):66-74. doi:10.1245/s10434-014-3945-6
19. Rabeneck L, Paszat LF, Saskin R. Endoscopist specialty is associated with incident colorectal cancer after a negative colonoscopy. *Clin Gastroenterol Hepatol*. 2010;8(3):275-279. doi:10.1016/j.cgh.2009.10.022
20. Adler J, Robertson DJ. Interval colorectal cancer after colonoscopy: exploring explanations and solutions. *Am J Gastroenterol*. 2015;110(12):1657-1664. doi:10.1038/ajg.2015.365
21. Appannagari A, Mangla S, Liao C, Reddy KG, Kupfer SS. Risk factors for inadequate colonoscopy bowel preparations in African Americans and Whites at an urban medical center. *South Med J*. 2014;107(4):220-224. doi:10.1097/SMJ.0000000000000087
22. Stimpson JP, Pagán JA, Chen L-W. Reducing racial and ethnic disparities in colorectal cancer screening is likely to require more than access to care. *Health Aff (Millwood)*. 2012;31(12):2747-2754. doi:10.1377/hlthaff.2011.1290
23. Fedewa SA, Flanders WD, Ward KC, et al. Racial and ethnic disparities in interval colorectal cancer incidence: a population-based cohort study. *Ann Intern Med*. 2017;166(12):857-866. doi:10.7326/M16-1154
24. Kim S-E, Paik HY, Yoon H, Lee JE, Kim N, Sung M-K. Sex- and gender-specific disparities in colorectal cancer risk. *World J Gastroenterol*. 2015;21(17):5167-5175. doi:10.3748/wjg.v21.i17.5167
25. Zauber AG, Lansdorp-Vogelaar I, Knudsen AB, Wilschut J, van Ballegooijen M, Kuntz KM. Evaluating test strategies for colorectal cancer screening: a decision analysis for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2008;149(9):659-669. doi:10.7326/0003-4819-149-9-200811040-00244
26. Hewitson P, Glasziou P, Irwig L, Towler B, Watson E. Screening for colorectal cancer using the faecal occult blood test, Hemoccult. *Cochrane Database Syst Rev*. 2007;24(1):CD001216. doi:10.1002/14651858.CD001216.pub2
27. Vijan S, Hwang EW, Hofer TP, Hayward RA. Which colon cancer screening test? A comparison of costs, effectiveness, and compliance. *Am J Med*. 2001;111(8):593-601. doi:10.1016/S0002-9343(01)00977-9
28. Corley DA, Jensen CD, Quinn VP, et al. Association between time to colonoscopy after a positive fecal test result and risk of colorectal cancer and cancer stage at diagnosis. *JAMA*. 2017;317(16):1631-1641. doi:10.1001/jama.2017.3634
29. Lee SJC, Inrig SJ, Balasubramanian BA, et al. Identifying quality improvement targets to facilitate colorectal cancer screening completion. *Prev Med Rep*. 2018;9(9):138-143. doi:10.1016/j.pmedr.2018.01.004
30. Singh H, Khan R, Giardina TD, et al. Postreferral colonoscopy delays in diagnosis of colorectal cancer: a mixed-methods analysis. *Qual Manag Health Care*. 2012;21(4):252-261. doi:10.1097/QMH.0b013e31826d1f28
31. Denberg TD, Melhado TV, Coombes JM, et al. Predictors of nonadherence to screening colonoscopy. *J Gen Intern Med*. 2005;20(11):989-995. doi:10.1111/j.1525-1497.2005.00164.x
32. Gates TJ. Screening for cancer: concepts and controversies. *Am Fam Physician*. 2014;90(9):625-631.
33. Halpern MT, Ward EM, Pavluck AL, Schrag NM, Bian J, Chen AY. Association of insurance status and ethnicity with cancer stage at diagnosis for 12 cancer sites: a retrospective analysis. *Lancet Oncol*. 2008;9(3):222-231. doi:10.1016/S1470-2045(08)70032-9
34. Abdelsattar ZM, Hendren S, Wong SL. The impact of health insurance on cancer care in disadvantaged communities. *Cancer*. 2017;123(7):1219-1227. doi:10.1002/cncr.30431
35. Farkas DT, Greenbaum A, Singhal V, Cosgrove JM. Effect of insurance status on the stage of breast and colorectal cancers in a safety-net hospital. *J Oncol Pract*. 2012;8(3 suppl):16s-21s. doi:10.1200/JOP.2012.000542
36. Lawrence D, Weigel L, Dale P, Smith B, Honaker MD. Presenting stage in colon cancer is associated with insurance status. *Am Surg*. 2017;83(7):728-732. doi:10.1177/00031348171708300729
37. Parikh AA, Robinson J, Zaydfudim VM, Penson D, Whiteside MA. The effect of health insurance status on the treatment and outcomes of patients with colorectal cancer. *J Surg Oncol*. 2014;110(3):227-232. doi:10.1002/jso.23627