Original Article

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National disparities in colorectal cancer screening in patients with comorbid conditions: an analysis of the Behavioral Risk Factor Surveillance System

Abstract

Context: Each year, approximately 53,200 people die in the U.S. from colorectal cancer (CRC), indicating a need to increase screening efforts. Some studies have suggested mammography use is higher in patients with comorbid conditions, a reflection of increased follow up. Another study found that patients with obesity were less likely to be screened for CRC than nonobese patients. However, no study has assessed the impact of multiple comorbidities on CRC screening.

Objectives: To analyze CRC screening rates in patients with comorbidities compared with healthy patients, and to assess whether the number of comorbid diagnoses impacted screening rates.

Methods: A cross sectional analysis of patients who received CRC screening was performed using the 2018 and 2019 Behavioral Risk Factor Surveillance System (BRFSS). Respondents were classified as having had CRC screening if they answered "yes" to either of the following: "Have you ever had a blood stool test?" or "Have you ever had a sigmoidoscopy/colonoscopy?" Respondents younger than age 50 were excluded. A weighted multivariate logistic regression model was constructed to determine adjusted risk ratios (ARR). Confidence intervals (CI) were reported at 95%.

Results: We identified 279,784 respondents who met inclusion criteria. Of those, 79.7% (sample n=222,879; population N=46,304,360) of respondents had received CRC screening. Patients with diabetes, hypertension, skin cancer, chronic obstructive pulmonary disease (COPD), arthritis, depression, and chronic kidney disease were significantly more likely to be screened than those without comorbidities. There was no statistically significant difference in screening rates between patients with and without cardiovascular disease. Compared with patients with zero comorbidities, those with one were significantly more likely to receive screening (ARR, 1.11; CI, 1.09–1.12) as were those with two to four (ARR, 1.2; CI, 1.18–1.22). Patients with five or more comorbidities were significantly less likely to be screened than those with two to four (ARR, 1.12; CI, 1.1–1.14).

Conclusions: Patients with one or more comorbidities were more likely to be screened than those without comorbidities, but those with five or more conditions were less likely to be screened than patients with two to four conditions. This indicates that physicians may be more fatigued and less likely to recommend CRC screening to patients with many comorbidities compared with patients diagnosed with only a few conditions. The results of this study add to the literature by identifying an interaction between the number of comorbidities and likelihood of being screened for CRC.

Keywords: colonoscopy; colorectal cancer; comorbidity; mortality; screening.

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Each year, approximately 148,000 individuals in the U.S. are diagnosed with colorectal cancer (CRC) and approximately 53,000 die from the disease [1]. Further, for men and women combined, it is the second leading cause of cancer death in the U.S. [1]. Screening has been identified as an efficient way to reduce CRC morbidity and mortality, with a large U.S. study [2] noting that an increase in screening adherence of roughly 40%

corresponded with a 52% reduction in cancer mortality. The financial impact of having a CRC diagnosis is also significant for patients, with 41% of 493 CRC survivors in one study [3] reporting cancer related financial stress. Therefore, further research is warranted to understand characteristics that contribute to the likelihood of a patient not being screened.

Disparities in cancer screening utilization have been identified among individuals without insurance, of specific racial or ethnic minority groups, with low health literacy, and with poor physician-patient relationships [4]. Previous literature has suggested that mammography [5] and CRC screening usage [6] is higher in patients with comorbid conditions, a reflection of increased follow up. Alternatively, a survey of 8,550 U.S. citizens [7] found that patients with obesity were significantly less likely to be screened for CRC rather than nonobese patients.

No prior study, to our knowledge, has assessed the impact of multiple comorbidities on CRC screening. We posit that comorbid conditions negatively influence CRC screening rates. Thus, our primary objective for this study was to analyze CRC screening rates in patients with diabetes, hypertension, coronary artery disease, skin cancer, chronic obstructive pulmonary disease (COPD), arthritis, depression, and chronic kidney disease compared with healthy patients. Our secondary objective was to assess CRC screening rates in patients with no diagnoses compared with those with multiple comorbidities to determine whether the number of diagnoses influenced patients' likelihood of being screened.

Methods

Study design and setting

A cross sectional analysis of the 2018 and 2019 Behavioral Risk Factor Surveillance System (BRFSS) was performed to assess the prevalence of CRC screening rates in patients with and without comorbid conditions. BRFSS is a self reported health survey funded by the Centers for Disease Control and Prevention and collected from participants in all 50 states, Guam, Puerto Rico, and the District of Columbia. To collect a randomized, representative sample, BRFSS gathers cell phone and landline data and divides phone numbers into strata based upon proximity to other area codes. The resulting strata are then randomly sampled using computer automation. Respondents received no compensation for completing the survey. Verbal consent is given prior to data collection by local health departments as directed by the Centers for Disease Control and Prevention. Institutional Review Board approval for the distribution and collection of the BRFSS questionnaire is granted by the respective state departments of health each year.

Data extracted for this study were deidentified and publicly available and therefore did not meet requirements for institutional review board approval nor clinical trial registry. This study was not funded. All participants included in the BRFSS dataset provided verbal informed consent prior to participation.

Participants

Respondents were classified as having undergone CRC screening if they answered "yes" to either of the following: "Have you ever had a blood stool test?" or "Have you ever had a sigmoidoscopy/colonoscopy?" Those who had not answered one of these in the affirmative or who reported "no" to either or both were classified as not having been screened. The use of computed tomography colonography or other imaging modalities for CRC screening was not assessed by BRFSS. Data extracted from the system included sociodemographics, CRC screening, and comorbid conditions. Race and ethnicity were self reported and based upon self identification. BRFSS collected the following races and ethnicities: White, non Hispanic; Black, non Hispanic; Asian, non Hispanic; American Indian/Alaskan Native, non Hispanic; Hispanic; or other race, non Hispanic. Respondents unwilling or unable to state male or female sex were excluded from data collection.

Noninstitutionalized respondents 50 years of age or older were included in the sample. Respondents younger than 50 years of age were excluded to account for the U.S. Preventive Services Task Force guidelines on CRC screening at the time of survey collection. The 2018 and 2019 BRFSS questionnaires did not collect data on individual risk of CRC, such as family history of CRC, presence of previous dysplastic colonic polyps, or genetic predispositions for CRC.

Statistical analyses

The 2018 and 2019 data were combined prior to statistical analysis. To determine the adjusted risk ratios (ARR) [8] of patients who had undergone CRC screening with and without comorbidities, weighted multivariate logistic regression models were constructed. To assess our secondary objective, we constructed a regression model of CRC screening rates in patients with zero, one, two to four, and five or more comorbidities. ARRs were adjusted for the following variables: age, gender, race, education, and healthcare coverage. A variable asking whether an individual had a primary care physician (PCP) was considered for the regression models, but was eliminated due to multicollinearity with healthcare coverage. Confidence intervals (CI) were reported at 95%. Sampling weights were provided by BRFSS, adjusted for the combined datasets, and used to compute population estimates and standard errors. Statistical analyses were performed using Stata 16.1 in November 2020.

Results

We identified a sample of 279,784 (population N=60,724,150) respondents who answered the question about having undergone CRC screening. Of those, 79.7% (sample n=222,879; population N=46,304,360) of respondents received CRC screening at guideline recommended intervals (Table 1). Respondents who were not

Table 1: Sociodemographic factors of patients who had undergone vs. those who had not undergone colorectal cancer (CRC) screening (sample n=279,784; population N=60,724,150).

		Not screened n=56,905; N=14,419,790 % (95% CI)	CRC screened n=222,879; N=46,304,360 % (95% CI)
Age, years	50–54	34.72 (33.77–35.69)	13.57 (13.22–13.92)
	55–59	19.45 (18.73–20.18)	16.63 (16.28–16.98)
	60–64	15.58 (14.86–16.34)	19.67 (19.29–20.05)
	65–69	9.31 (8.812–9.825)	15.93 (15.62–16.25)
	70–74	6.49 (6.006–7.009)	14.3 (13.98–14.62)
	75–80	4.92 (4.489–5.391)	9.69 (9.427–9.959)
	80+	9.53 (8.931–10.17)	10.22 (9.951–10.49)
Sex	Male	50.94 (49.98–51.89)	45.3 (44.84–45.76)
	Female	49.06 (48.11–50.02)	54.7 (54.24–55.16)
Race/ethnicity[a]	White, non Hispanic	63.21 (62.19–64.22)	75.2 (74.73–75.66)
	Black, non Hispanic	10.91 (10.31–11.54)	9.94 (9.653–10.24)
	Asian, non Hispanic	5.53 (4.907–6.215)	3.34 (3.059–3.649)
	American Indian/Alaskan Native	1.35 (1.203–1.51)	0.95 (0.8818–1.02)
	Hispanic	16.93 (16.03–17.88)	8.98 (8.637–9.339)
	Other race, non Hispanic	2.07 (1.871–2.286)	1.59 (1.503–1.681)
Healthcare coverage	Yes	85.28 (84.5–86.03)	96.42 (96.22–96.6)
	No	14.72 (13.97–15.5)	3.59 (3.396–3.784)
Education	Did not graduate high school	21.4 (20.48–22.36)	11.16 (10.79–11.55)
	High school graduate	30.4 (29.57–31.24)	26.4 (26.01–26.8)
	Attended college but did not graduate	26.46 (25.63–27.31)	31.81 (31.37–32.25)
	College or technical school graduate	21.73 (21.04–22.44)	30.62 (30.24–31.01)

[a]Hispanic ethnicity was based on self identification and reporting.

compliant with screening recommendations were primarily aged 50–54 years (19,757; 34.72%), male (28,987; 50.94%), had healthcare coverage (48,528; 85.28%), and were high school graduates (17,299; 30.4%).

Of patients who were not screened for CRC, the most prevalent comorbidities were hypertension (21,658; 38.06%), arthritis (17,327; 30.45%), and diabetes mellitus (10,971; 19.28%) (Table 2). Patients with all comorbid conditions—diabetes, hypertension, cardiovascular disease, skin cancer, COPD, arthritis, depression, and chronic kidney disease—were all significantly more likely to be screened than those without these comorbidities. ARR for each comorbidity is shown in Table 3. Compared with patients with zero comorbidities, those with one were significantly more likely to receive screening (ARR, 1.11; 95% CI, 1.09–1.12) as were those with two to four conditions (ARR, 1.2; 95% CI, 1.18–1.22) and five or more comorbidities (ARR, 1.12; 95% CI, 1.1–1.14). Respondents with five or more comorbidities (ARR, 1.12; 95% CI, 1.1–1.14) were significantly less likely to receive screening compared with those with two to four conditions (ARR, 1.2; 95% CI, 1.18–1.22).

Table 2: Prevalence of comorbidities in individuals age 50 years and older by colorectal cancer (CRC) screening status (sample n=279,784; population N=60,724,150).

	Not screened n=56,905; N=14,419,790 % (95% CI)	CRC screened n=222,879; N=46,304,360 % (95% CI)
Diabetes mellitus	19.28 (18.47–20.13)	24.08 (23.65–24.52)
Hypertension[a]	38.06 (35.09–41.12)	51.52 (49.94–53.1)
CVD	1.86 (1.519–2.268)	2.01 (1.873–2.166)
Skin cancer	5.81 (5.45–6.189)	13.8 (13.51–14.09)
COPD	9.04 (8.519–9.581)	11.57 (11.27–11.88)
Arthritis	30.45 (29.58–31.32)	47.07 (46.62–47.53)
Depression	14.0 (13.4–14.61)	18.55 (18.2–18.91)
CKD	4.08 (3.579–4.65)	5.39 (5.198–5.588)

[a]Hypertension data was only available for 2019 set (n=11,005). CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease. Cardiovascular disease was assessed by answering yes to having angina, a heart attack, or a stroke.

Table 3: Adjusted risk ratios of completing colon cancer screening among individuals 50 years of age and older with or without comorbid conditions (sample n=279,784; population n=60,724,150).

	No interaction	Sex interaction present	
		Male	Female
	ARR (95% CI)	ARR (95% CI)	ARR (95% CI)
Diabetes	1.07 (1.05, 1.08)		
Hypertension[a]	1.09 (1.06, 1.13)		
Cardiovascular disease	1.01 (0.97, 1.06)		
Skin cancer		1.12 (1.10, 1.14)	1.09 (1.07, 1.11)
Chronic obstructive pulmonary disease	1.05 (1.04, 1.07)		
Arthritis	1.12 (1.11, 1.13)		
Depression	1.09 (1.08, 1.10)		
Chronic kidney disease	1.03 (1.01, 1.06)		
Comorbidities (compared with 0)			
1	1.11 (1.09, 1.12)		
2–4	1.20 (1.18, 1.22)		
5+	1.12 (1.10, 1.14)		

[a]Hypertension data was only available for 2019 set (n=11,005). Cardiovascular disease was assessed by answering yes to having angina, a heart attack, or a stroke. ARR, adjusted risk ratio; CI, confidence interval.

Discussion

Our study found that respondents with comorbidities were more likely to have been screened for CRC than those without underlying conditions. Moreover, patients with one or more comorbidities were more likely to have received screening than those with zero comorbidities. This is supported by data from prior studies in endoscopy based CRC screening [6] as well as mammography [5]. However, this is the first study of which we are aware to identify an interaction between number of comorbidities and likelihood of CRC screening. These findings indicate that researchers and clinicians should assess other reasons that impact CRC screening compliance.

Notably, all patients with one or more comorbidities were more likely to have been screened than those without comorbidities, but those with five or more conditions were significantly less likely to have been screened than patients with two to four conditions. This indicates that physicians may be more burned out and less likely to recommend CRC screening to patients with many comorbidities compared with patients who have only been diagnosed with only a few conditions. Evidence suggests that burnout is directly correlated with work overload [9]. Furthermore, patients with high complexity require more physical and mental effort from physicians compared with patients with low complexity; in a previous literature review [10], the subsequent mental demand was shown to result in exhaustion and difficulties in forming a strong physician-patient relationship. This creates more communication issues, leading to delayed follow up, slower recovery times, and gaps in healthcare maintenance [11].

Aside from physician burnout, the decrease in CRC screening in patients with at least five comorbidities could also be attributed to not enough time being spent with the patient. According to the American Geriatric Society, general and family practitioners tend to spend less time with patients, regardless of patient complexity, if they have an increased volume of patients during the week [12]. Patients with multiple chronic diseases frequently require more time than PCP have available, and with physicians prioritizing patient's acute issues, there are obvious delays in ordering appropriate preventative services, such as CRC screening, when acute issues require prompt attention [13]. Another possible explanation for lower screening rates in patients with more than five comorbidities is the consideration of risk-benefit ratios in elderly patients who inherently have more comorbid diagnoses than younger patients; the perceived benefit of screening may be lower than the perceived risk in this population. Additionally, a potential reason for the lack of screening adherence in patients with obesity is fear of embarrassment or endoscopy related pain, a finding supported in women but not men in a study of 8,550 database respondents [7]. Furthermore, a previous study of 122 physicians who analyzed anonymous medical charts [14] suggested that physicians may have negative attitudes toward and discriminate against patients who are obese. The implementation of electronic medical record prompts may be a solution to improve the rate of PCPs ordering CRC screening. One study [15] identified a significant increase in

cervical cancer screenings after implementing these prompts and we believe this may be a simple solution for improving prescribing patterns for CRC screening by PCPs. Further efforts are warranted to increase patient follow up as well as to decrease physician burnout when caring for patients with more than five comorbidities.

The difference in CRC screening use among patients without comorbid conditions may be a reflection of poor follow up or low perceived risk of cancer. These patients may have a lower perceived risk of CRC cancer and therefore are less likely to seek out physician follow up and screening; this variable was supported by a study of 1,160 women from Kim et al. who noted that poor self perceived health was associated with a reduced likelihood of receiving cancer screenings [16].

The importance of recognizing the interactions between multiple organ systems and comorbidities is a characteristic developed and strengthened in the osteopathic medical profession. These interactions and the need to recognize the patient as a whole are key in primary care medical practice and reflect the importance of the PCP in primary and secondary (screening) prevention of CRC [17]. Therefore, the importance of physicians, particularly PCP, in addressing disparities in CRC screening should be further promoted. This study builds upon prior literature [4, 5, 18] to emphasize the importance of the interrelation of social, medical, and psychological challenges in modern medicine, which is a key tenet of osteopathic medicine.

Current USPSTF guidelines recommend screening all individuals aged 50 years or older [19]. However, this guideline is currently under review and other organizations, such as the American Cancer Society and U.S. Multisociety Task Force of Colorectal Cancer (MSTF), which is composed of the American College of Gastroenterology and American Gastroenterological Association, have taken a more aggressive approach to CRC screening. For instance, the American Cancer Society recommends that all patients aged 45 or older be screened [20] and the MSTF recommends screening Black patients aged 45 years or older as well as all other races beginning at age 50 years [21]. These guidelines apply to patients with and without comorbidities, so further efforts should be made to continue evidence based medical care in patients who require CRC screening. Although CRC incidence is decreasing overall [1, 22], the incidence in patients younger than 50 years is increasing, which helps explain the recent changes in guidelines by multiple societies [22]. We believe adherence to the more aggressive guidelines will ultimately improve CRC morbidity and mortality in this younger population.

Limitations

Our study had several limitations. First, we utilized a cross sectional design, which does not allow for cause-effect statements. Second, our study may have been limited by response bias. The use of a self reported survey may have resulted in respondents reporting more cancer screenings than have actually occurred. However, the large sample size may have reduced the likelihood of these limitations impacting our results. A strength of this study was the use of a large, representative sample as well as robust sampling techniques.

Conclusions

Our study aimed to assess differences in CRC screening utilization between healthier individuals with no reported comorbidities compared with those who reported comorbidities. Notably, patients with all types of comorbidities were significantly more likely to have been screened for CRC, as were those with one or more comorbid conditions compared with those with zero comorbidities. Interestingly, a negative effect was seen amongst individuals with five or more reported comorbid conditions; we saw screening rates decline as medical history became more extensive, possibly due to physician burnout and patient complexity. Any type of CRC screening is beneficial for reducing cancer morbidity and mortality, and screening should be strongly considered in patients meeting recommended guidelines. Additionally, early detection and prevention of CRC through screening reduces cost of care. Further efforts are warranted to discover disparities in CRC screening usage.

Ethical approval: Institutional Review Board approval for the distribution and collection of the Behavioral Risk Factor Surveillance System questionnaire is granted by the respective state departments of health each year. Data extracted for this study were deidentified and publicly available and therefore did not meet requirements for additional IRB approval or clinical trial registration.

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