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Risk Factors for Inadequate Colonoscopy Bowel Preparations in African Americans and Whites at an Urban Medical Center

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Abstract

Objectives—Poor bowel preparation leads to inadequate examinations and shorter surveillance intervals for colorectal cancer screening. Previous studies regarding risk factors for inadequate preparation have not included large numbers of African Americans. Our aim was to determine the prevalence of inadequate bowel preparation on initial and follow-up colonoscopy in a large, racially diverse patient population.

Methods—Colonoscopies performed during a 1-year period were analyzed retrospectively. Factors including age, sex, race, and start time were recorded. Patient ZIPcodes were linked to census data to estimate education and income. For examinations with inadequate bowel preparations, we collected data on recommendations and the preparation quality of follow-up procedures.

Results—We included 3741 patients (40.2% African American). Of these, 66.9% had adequate bowel preparation and 33.1% had inadequate bowel preparation. African Americans had the highest prevalence of inadequate preparations at 43.0%. African American race was a predictor of inadequate bowel preparation, despite controlling for education and income. Age, male sex, and procedure taking place after 12 PM also were risk factors for inadequate preparation. Receipt of specific preparation instructions on the endoscopy report did not affect preparation quality on follow-up examination. Our study found a high rate (33.1%) of inadequate bowel preparations, and African American race was found to be an independent risk factor for inadequate preparation. We validated previously reported risk factors including age, male sex, and later procedure time. Finally, we noted high rates of inadequate preparation on follow-up examinations.

Conclusions—Improving the quality of colonoscopy bowel preparation is important for colorectal cancer prevention, especially in high-risk populations such as African Americans.

Keywords

bowel preparation; colon cancer screening; colonoscopy; African Americans

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Colorectal cancer (CRC) is the second leading cause of cancer mortality in the United States, with African Americans having the highest CRC incidence and mortality of all US populations.¹ Although colonoscopy is considered the gold standard for CRC screening, its efficacy is dependent on the quality of the procedure, most notably bowel preparation. Suboptimal bowel preparations have been shown to lead to missed adenomatous polyps,² the precursor for CRC. Poor bowel preparation also has been associated with longer procedure times and a decreased rate of intubating the cecum.³ Moreover, inadequate bowel preparation results in canceled or aborted procedures and repeated examinations or earlier surveillance intervals.^{2,3}

Inadequate bowel preparation has been reported in 15% to 48% of all colonoscopies in a variety of patient populations.^{2,4-10} Previous studies have identified risk factors associated with an inadequate colonoscopy preparation, including older age,^{4,5} male sex,^{4,8} afternoon procedure time,⁵ Medicaid insurance,^{4,10} single status,^{4,10} use of an interpreter,¹⁰ and inpatient status.^{4,8} Most of these studies, however, have not included a large number of African Americans who are at high risk for CRC. Moreover, little is known about the impact of quality measures, including bowel preparation on CRC burden in African Americans. The aim of this study, therefore, was to estimate the prevalence of and risk factors associated with inadequate colonoscopy preparation in a diverse urban population.

Methods

All outpatient colonoscopies performed at our urban medical institution between October 2008 and October 2009 by board-certified gastroenterologists were retrospectively reviewed. Our institution is a tertiary care center with a diverse, urban patient population. The unit has a large open-access colonoscopy practice, with referrals from primary care, surgery, gynecology, and oncology. Although individual preparation types for each patient were not recorded, the general practice during the study period was a clear liquid diet, one bottle of magnesium citrate, and a single four-liter dose of polyethylene glycol the day before the procedure. Split-dose preparations were not standard practice during this study period.

Our practice uses the Aronchick scale¹¹ for grading bowel preparation as part of our electronic reporting system (Provation, Minneapolis, MN). Bowel preparations are graded as poor, fair, good, and excellent, as well as adequate or inadequate. For this study, we defined adequate preparations as those recorded as excellent, good, or adequate. Inadequate preparations were those recorded as fair, poor, or inadequate.

Available patient demographics were collected including age, sex, race, and ZIPcode. Race was recorded as non-Hispanic white, African American, other (Hispanic, Asian, or more than one race), or unknown. ZIPcodes were linked to the 2000 US Census Bureau data (<http://www.census.gov>) to obtain median household income and median education level using methodologies described elsewhere.¹² Procedure details also were collected, including indication, start time (categorized as before 12 PM or after 12 PM), and endoscopist experience (grouped in 5-year intervals). For procedures with inadequate preparations, we further explored follow-up recommendations provided by the endoscopist and, for those

patients who underwent a repeat procedure before October 2011, the quality of the preparation on the follow-up colonoscopy.

The study was approved by the University of Chicago institutional review board. Adequacy of bowel preparation was coded as a dichotomous variable (0 and 1). Pearson χ^2 , Fisher exact statistics, or logistic regression was used for bivariate analyses based on the data distributions. Generalized estimating equations logistic models¹³ for inadequate bowel preparations were used to account for clustering by endoscopists to determine potential risk factors. Statistical significance was set at 0.05. PASW Statistics version 18.0 (IBM SPSS Statistics, Armonk, NY) was used for statistical analyses. The statistically significant predictors of inadequate bowel preparations were reported in the final model.

Results

During the study period, 3741 colonoscopies were performed by 25 endoscopists. Our study population included 58.1% female and 41.9% male patients. There were 2551 (68.2%) procedures scheduled before 12 PM and 1190 (31.8%) after 12 PM. Overall, our population was 40.2% African American, 42.9% non-Hispanic white, 4.1% other (Hispanic or Asian), and 12.8% unknown. The indications for the colonoscopy included average-risk CRC screening (30.3%), history of polyps (22.3%), bleeding or anemia (15.9%), inflammatory bowel disease (8.0%), diarrhea (7.2%), abdominal pain (4.8%), history of CRC (4.5%), abnormal imaging (1.8%), and weight loss (1.2%).

Overall, 2501 (66.9%) colonoscopies had an adequate bowel preparation and 1240 (33.1%) had an inadequate bowel preparation (Table 1). Univariate analysis revealed that patient demographics and procedural characteristics were significantly different between the two preparation groups. Individuals with inadequate bowel preparations were more likely to be older, African American, and had later procedure times than individuals with adequate bowel preparations. Moreover, the inadequate bowel preparation group had fewer years of education (based on census data); lower household median incomes (based on census data); history of CRC, bleeding or anemia, abnormal imaging, and weight loss; and lower rates of inflammatory bowel disease.

We used the generalized estimating equations logistic model for inadequate bowel preparations to account for clustering by endoscopists to verify potential risk factors (Table 2). Age remained significantly associated with an inadequate bowel preparation (odds ratio [OR] 1.01 [95% confidence interval [CI] 1.00–1.02, $P < 0.001$). Male sex was a statistically significant higher risk than female sex for inadequate bowel preparation (OR 1.25 [95% CI 1.07–1.45, $P = 0.005$]). Race was significantly associated with inadequate preparation, with a 50% increase in risk for African Americans (OR 1.56 [95% CI 1.29–1.88], $P < 0.001$). Inadequate bowel preparations were more likely for individuals whose education ended at the 12th grade and patients with a lower household income (OR 1.43 [95% CI 1.11–1.85], $P = 0.006$ and OR 0.94 [95% CI 0.90–0.98, $P = 0.004$], respectively). Procedures performed after 12 PM also were noted to be predictors of an inadequate bowel preparation (OR 1.34 [95% CI 1.15–1.57], $P < 0.001$). A significant predictor of adequate bowel preparation in

our study was procedures performed by endoscopists with more years of experience (OR 0.94 [95% CI 0.94–0.95], $P < 0.001$).

Of the 1240 patients with inadequate bowel preparations, 742 (59.9%) were given a specific follow-up interval, with the majority in the 3- to 5-year category (Fig.). In the follow-up period to October 2011, 204 (16.5%) patients returned for a repeat colonoscopy. Of the patients with a repeat procedure, 89 (43.6%) still had an inadequate preparation. Receipt of specific preparation instructions on the endoscopy report did not affect preparation quality on the follow-up examination ($P = 0.56$).

Discussion

Inadequate bowel preparations have significant consequences both in terms of efficacy of CRC screening and increased burden on the US healthcare system. Much attention has been focused on types of bowel preparation regimens, with relatively less research on patient and procedural factors associated with inadequate bowel preparations. In particular, little information exists on the adequacy of bowel preparations in the African American population, which has the highest incidence of CRC in the United States.¹ Understanding the role of preparation quality in this high-risk yet understudied population is important because adequacy of bowel preparation may play a role in cancer disparities. More important, bowel preparation is potentially a modifiable risk factor with directed interventions as demonstrated in a number of studies.^{14–16}

In the diverse urban patient population of the United States, the prevalence of inadequate bowel preparations is 33% and is among the highest rates reported in the literature. One study in a Department of Veterans Affairs population found inadequate preparation (defined as inadequate, poor, or fair) in up to 48% of patients,⁷ although most other studies report rates of inadequate preparation of between 15% and 30%. Specifically, among African Americans, we found the highest prevalence of inadequate preparations in our study groups, at 43%. In the logistic regression analysis, African American race was among the strongest risk factors for an inadequate preparation, with a 50% increased risk compared with non-Hispanic white patients. Because race could be confounded by other risk factors, we used ZIPcodes to link to US Census data on education and median household income in a previously validated methodology.¹² Even when controlling for education and income using this proxy methodology, race remained a significant risk factor. It is possible that additional factors such as insurance status, literacy, or comorbidities not available in the present study account for this elevated risk in African Americans. The only other study to include a large number of African Americans did not find race to be an independent risk factor for poor bowel preparation but did find Medicaid insurance status (23% of the Medicaid participants were African American) to be a significant positive predictor.⁴ We did not have access to insurance status in this study. The only other study to include 163 nonwhite subjects did not find an association with race; however, this study was limited by its small sample size.⁶ Prospective studies in an African American population should include these characteristics to determine their role in bowel preparation quality in this population.

We found similar risk factors for inadequate preparation as reported in previous studies. These include age, sex, and later procedure times.^{4,5} Our results underscore the importance of using bowel-cleansing regimens that improve afternoon procedures such as split-dose or same-day protocols. Although we did not have data on individual bowel regimens, our practice during the study period was single-dose polyethylene glycol preparations the evening before the procedure, a finding that may explain our results. We acknowledge that split-dose preparations are being used more frequently; however, this practice is not universal in our open-access endoscopy unit, which limits our ability to investigate differences between single- and split-dose preparations retrospectively. We are prospectively evaluating single- versus split-dose regimens in our patient population to address this question. Because some data were not available in this retrospective study, we did not evaluate marital status, inpatient procedures, or comorbidities that have been identified as risk factors.² Based on the results in this study,^A we have initiated methods at our own institution to improve patient education regarding bowel preparation. Open-access patients are required to watch an instructional video explaining the bowel preparation process.

For patients with inadequate preparations on initial colonoscopy, we noted that nearly 40% of them were not given specific follow-up instructions. In the remaining patients, a range of follow-up recommendations were given by endoscopists. There are no standards for follow-up recommendations based on bowel preparation, which could explain our results. For patients who returned for a follow-up procedure through October 2011 (between 2 and 3 years from initial colonoscopy), 44% of their preparations were still deemed inadequate. There was no difference in preparation quality among procedures in which the endoscopist made specific recommendations regarding a different preparation strategy. Alternate strategies for improving bowel preparation among these patients should be explored, given the high rate of inadequate preparations on follow-up colonoscopy.

Finally, endoscopists with more experience were found to be a positive predictor of an adequate bowel preparation in our study, a factor that was not included in previous studies. There are a few possible explanations for this finding. First, our results may reflect a relatively small sample size of endoscopists. It is also possible that more experienced endoscopists have a different patient population as a result of referred patterns. Finally, it is possible that physicians with more experience may grade preparation quality less stringently and/or spend more time cleaning the colon. Future studies should consider bowel preparation ratings by trainees and attending endoscopists at different points in their careers to determine the impact of endoscopists' characteristics on bowel preparation quality.

Our study has a number of limitations. This was a retrospective study and some data such as type of preparation used by each patient and completeness of bowel preparation were not available. Moreover, because we did not have information on individual education and household income, we used a proxy method by linking ZIPcodes to US Census data, which could result in inaccurate estimates. In addition, we used a standard bowel preparation grading system that relies on subjective criteria; however, we believe this more accurately

^A“This study” meaning ref 2 or the present study? Please clarify.

reflects routine clinical practice. Finally, our study was performed at a single academic institution, which may limit generalization to other populations.

Conclusions

We studied a large African American population to determine risk factors for inadequate bowel preparation for colonoscopy. Despite adjusting for potential confounding factors, including education and income from US Census data, African American race remained a predictor of inadequate preparation. Future prospective studies should include African Americans to elucidate additional reasons such as insurance status, health literacy, and comorbidities for inadequate bowel preparation in this population. We also confirmed reported risk factors for inadequate preparations, including age, sex, and time of procedure after 12 PM. We found a range of follow-up recommendations given for individuals with inadequate preparations and that the rate of inadequate preparation on repeat examination is high. Finally, we found that endoscopists with more years of experience recorded higher rates of adequate bowel preparations. Understanding modifiable risk factors for inadequate bowel preparation may lead to interventions to improve the quality of colonoscopy, especially in high-risk populations.

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Brief Description

Poor bowel preparation for colonoscopy screening leads to inadequate detection of polyps. Although some risk factors have been identified, little is known about the rate of inadequate bowel preparations, particularly in African Americans.

Key Points

- In our urban academic medical center, African Americans had the highest rates of inadequate bowel preparation of all racial groups. These rates are among the highest reported to date in the literature.
- African American race was one of the strongest independent risk factors for inadequate bowel preparation, even when controlling for education and income.
- In addition to African American race, older age, male sex, and procedure taking place after 12 PM also were risk factors for inadequate preparation in our population.

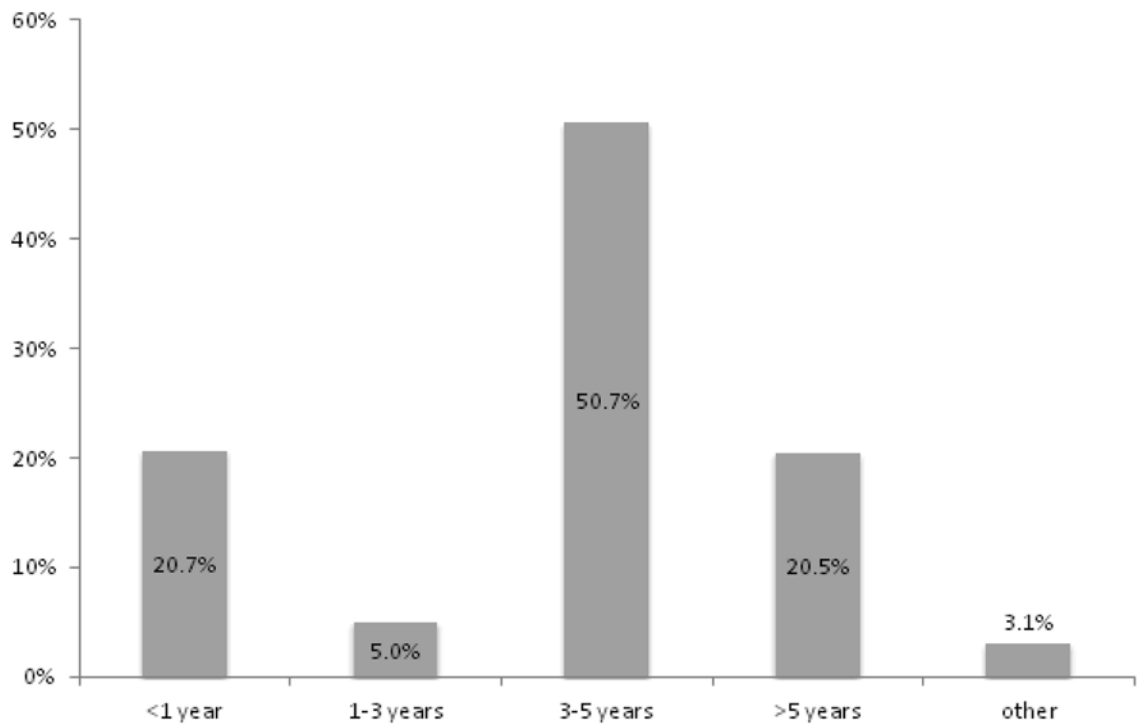


Fig. Distribution of follow-up recommendations made for individuals who had inadequate preparations on index colonoscopy. Of the 1240 patients with inadequate bowel preparations, 742 (59.9%) were given a specific follow-up interval, with the majority in the 3- to 5-year category.

Table 1

Patient and procedure characteristics of adequate vs inadequate bowel preparation

	Adequate	Inadequate	P
Total (%)	2501 (66.9)	1240 (33.1)	
Median age, y (range)	56.0 (16–93)	58.5 (17–95)	<0.001
Sex (%)			
Female	1467 (67.4)	708 (32.6)	0.379
Male	1034 (66.0)	532 (34.0)	
Race (%)			
African American	857 (57.0)	647 (43.0)	<0.001
White	1195 (74.5)	410 (25.5)	
Other*	109 (70.3)	46 (29.7)	
Unknown	340 (71.3)	137 (28.7)	
Education (%) [†]			
12th grade	227 (57.9)	165 (42.1)	<0.001
>12th grade	2155 (67.4)	1040 (32.6)	
Median household income, \$ (range) [†]	40,279 (0–200,001)	36,334 (0–138,525)	<0.001
Procedure start time			
Before 12 PM	1799 (70.5)	752 (29.5)	<0.001
After 12 PM	702 (59.0)	488 (41.0)	
Personal history of cancer			
No	2404 (67.3)	1169 (32.7)	0.012
Yes	97 (57.7)	71 (42.3)	
Inflammatory bowel disease			
No	2258 (65.6)	1183 (34.4)	<0.001
Yes	243 (81.0)	57 (19.0)	
Bleeding or anemia			
No	2129 (67.7)	1016 (32.3)	0.014
Yes	372 (62.4)	224 (37.6)	
Weight loss			
No	2479 (67.1)	1217 (32.9)	0.016
Yes	22 (48.9)	23 (51.1)	
Abnormal imaging			
No	2465 (67.1)	1210 (32.9)	0.035
Yes	36 (54.5)	30 (45.5)	

* Other includes Hispanic and Asian American.

[†] Education and household income estimated by ZIPcodes linked to census data.

Table 2

Predictors of inadequate bowel preparation from GEE logistic regression analysis

	95% confidence interval			<i>P</i>
	Odds ratio	Lower	Upper	
Age, y	1.01	1.00	1.02	<0.001
Sex				
Female	1 (ref)			
Male	1.25	1.07	1.45	0.005
Race				
White	1 (ref)			
African American	1.56	1.29	1.88	<0.001
Other*	0.99	0.67	1.47	0.979
Unknown	0.98	0.77	1.25	0.873
Education				
>12th grade	1 (ref)			
<12th grade	0.71	0.40	1.24	0.228
12th grade	1.43	1.11	1.85	0.006
Household income	0.94	0.90	0.98	0.004
Procedure time				
Before 12 PM	1 (ref)			
After 12 PM	1.34	1.15	1.57	<0.001
Endoscopist experience, y	0.94	0.94	0.95	<0.001

GEE, generalized estimating equation.

* Other includes Hispanic and Asian American.