Association Between Body Mass Index and Quality of Split Bowel Preparation

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BACKGROUND & AIMS: **Little is known about the association between obesity and bowel preparation. We investigated whether body mass index (BMI) is an independent risk factor for inadequate bowel preparation in patients who receive split preparation regimens.**

METHODS: **We performed a retrospective study of data from 2163 consecutive patients (mean age, 60.6 ± 10.5 y; 93.8% male) who received outpatient colonoscopies in 2009 at the Veterans Affairs Medical Center in Indianapolis, Indiana. All patients received a split preparation, categorized as adequate (excellent or good, based on the Aronchick scale) or inadequate. We performed a multivariable analysis to identify factors independently associated with inadequate preparation.**

RESULTS: **Bowel preparation quality was inadequate for 44.2% of patients; these patients had significantly higher mean BMIs than patients with adequate preparation (31.2 ± 6.5 vs 29.8 ± 5.9, respectively; $P < .0001$) and Charlson comorbidity scores (1.5 ± 1.6 vs 1.1 ± 1.4; $P < .0001$). Independent risk factors for inadequate preparation were a BMI of 30 kg/m^2 or greater (odds ratio [OR], 1.46; 95% confidence interval [CI], 1.21−1.75; $P < .0001$), use of tobacco (OR, 1.28; 95% CI, 1.07−1.54; $P = .0084$) or narcotics (OR, 1.28; 95% CI, 1.04−1.57; $P = .0179$), hypertension (OR, 1.30; 95% CI, 1.07−1.57; $P = .0085$), diabetes (OR, 1.38; 95% CI, 1.12−1.69; $P = .0021$), and dementia (OR, 3.02; 95% CI, 1.22−7.49; $P = .0169$).**

CONCLUSIONS: **BMI is an independent factor associated with inadequate split bowel preparation for colonoscopy. Additional factors associated with quality of bowel preparation include diabetes, hypertension, dementia, and use of tobacco and narcotics. Patients with BMIs of 30 kg/m^2 or greater should be considered for more intensive preparation regimens.**

Keywords: Colonoscopy Preparation; Colorectal Cancer Screening; Overweight; Adenoma Detection.

Colonoscopy is a powerful tool for colorectal cancer prevention because it allows for the detection and removal of precursor adenomatous polyps. The effectiveness of colonoscopy depends on several factors, foremost of which is the adequacy of visualization of the colonic mucosa, allowing a thorough inspection for colon neoplasms. Studies have shown that a poor bowel preparation is associated with lower adenoma detection rates.[1,2]

Despite the importance of preparation quality, there is no widely accepted definition of the precise characteristics of an adequate bowel preparation. The US Multi-Society Task Force on Colorectal Cancer, and the American Society for Gastrointestinal Endoscopy/American College of Gastroenterology Taskforce on Quality in Endoscopy stated that an adequate preparation is one in which polyps greater than 5 mm can be visualized reliably.[3,4] A 2010 meta-analysis showed that about 25% of patients do not achieve adequate preparation quality with polyethylene glycol–based bowel preparations.[5] Tailored preparation regimens certainly would be beneficial in these patients, if they could be identified before their procedure.

Obesity is one risk factor among several that is associated with unsatisfactory bowel preparation,[6] although whether this applies to split-dose regimens is uncertain. Split-dose preparations, in which a portion of the preparation is given on the day of the examination, are essential for adequate preparation quality and have become the standard in clinical practice.[7–9] Split-dose preparations increase the proportion of adequate preparation quality, increase patient compliance, and improve patient tolerance.[10] Other variables associated with inadequate bowel preparation are male sex, older age, constipation, diabetes, dementia, history of stroke, cirrhosis, use of tricyclic agents, and unfavorable socioeconomic conditions.[11–15] However, it is also not clear if these risk factors are pertinent to split-dose preparations.

Abbreviations used in this paper: BMI, body mass index; CI, confidence interval; CPRS, computerized patient record system; OR, odds ratio; VAMC, Veterans Affairs Medical Center.

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Our aim was to determine whether body mass index (BMI) is an independent risk factor for inadequate preparation in patients who receive a split preparation regimen.

Materials and Methods

Population Description

This retrospective cross-sectional study was conducted at the Richard L. Roudebush Veterans Affairs Medical Center (VAMC) in Indianapolis, Indiana, a tertiary-care academic VAMC affiliated with Indiana University. Consecutive patients who underwent a colonoscopy between January 1, 2009, and December 31, 2009, were considered for inclusion. The study was approved by the Indiana University Institutional Review Board and the Roudebush VAMC Research and Development Board. Patients were identified by querying the VA computerized patient record system (CPRS). Subjects were eligible for inclusion if they underwent elective outpatient colonoscopy during the study period. In the event that a patient underwent more than one colonoscopy, only the first procedure was included. Exclusion criteria consisted of patients with a prior colon resection; colonoscopies that were repeated within the study period owing to prior poor bowel preparation; colonoscopies performed emergently, in hospitalized patients, after a 2-day bowel preparation, or in underweight patients (BMI <18.5 mg/m^2, because these patients may be more likely to have underlying physical or psychological comorbidities that could preclude successful completion of the preparation and introduce unknown confounders to the analysis); and incomplete colonoscopies for reasons other than inadequate preparation (cecum not reached as a result of factors not related to bowel preparation).

Bowel Preparation Description

All patients received a polyethylene glycol–based split bowel preparation. The standard bowel preparation was a split 4 L of Colyte (Alaven Pharmaceutical, Marietta, GA); 2 to 3 L were consumed the evening before the procedure (along with 20 mg of bisacodyl), and the remaining 1 to 2 L were taken 4 hours before the colonoscopy. Two alternative split preparations also were used: MoviPrep (Salix Pharmaceuticals, Raleigh, NC), with 1 L consumed the evening before the examination, and the second liter 4 hours ahead of the colonoscopy; or MiraLax (Merck, Whitehouse Station, NJ), with 119 g consumed the evening before the test (along with 10 mg of bisacodyl) and another 119 g taken 4 hours before undergoing the colonoscopy.

Data Collection

The VA CPRS electronic medical records include demographic and clinical information. Our colonoscopy reports are generated using the Provation system (Provation MD; Provation Medical, Minneapolis, MN) and recorded in CPRS. Patient data collected included demographic variables such as age, sex, race, ethnicity, weight, height, and BMI; comorbidities such as coronary artery disease, congestive heart failure, diabetes mellitus, hypertension, stroke, dementia, cirrhosis, comorbidity count, and comorbidity burden using the Charlson comorbidity score[16]; pertinent medication use such as narcotics, calcium channel blockers, iron supplements, anticonvulsants, and medications with anticholinergic properties (antispasmodics, antipsychotics, tricyclic agents, and antiparkinsonian drugs); tobacco and alcohol use (excessive alcohol use was based on a history of alcoholism, recurrent binge drinking, or consuming regularly >2 drinks/d); and type of bowel preparation used. Colonoscopy data collected included procedure indication, family history of colon cancer, bowel preparation type and quality, and findings. Preparation quality was assessed subjectively at our institution by each individual endoscopist according to the Aronchick scale, as follows: excellent, good, fair, poor, or unsatisfactory.[17] Colonoscopy findings recorded included the presence of polyps, number, size, location, and histology. The recommended follow-up colonoscopy interval was recorded, including whether the interval was shortened as a result of the preparation quality.

Statistical Analysis

Subjects were categorized into 2 groups based on their colonoscopy preparation quality: adequate preparation (excellent or good preparation on the Aronchick scale) or inadequate preparation (fair, poor, or unsatisfactory preparation). Student *t* tests and the Fisher exact test were used to compare both groups. BMI was categorized as normal (18.5–24.9 kg/m^2); overweight (25–30 kg/m^2), or obese (>30 kg/m^2). Logistic regression was used to model the association of BMI with inadequate preparation quality, and BMI was treated both as a continuous and a categoric variable. From each model, receiver operator characteristic curves were generated and the area under the curve was measured to help determine an optimal BMI cutoff value. Multivariable logistic regression analysis was performed to determine factors independently associated with inadequate preparation quality, with candidate variables having univariate *P* values less than .20. Multivariable logistic regression also was used to obtain and compare estimates of the adenoma detection rate for adequate and inadequate preparation quality, after adjusting for the terms in the final model on inadequate preparation quality.

Results

During the study period, 3124 subjects underwent colonoscopy, of whom 700 (22.4%) were excluded for the following reasons: hospitalized status or emergent procedure (n = 256; 36.6%), incomplete colonoscopy (unrelated to preparation) (n = 21; 3.0%), repeat colonoscopy as a result of poor preparation earlier in 2009 (n = 71; 10.1%), colonoscopy after a 2-day preparation (n = 155; 22.1%), subjects not undergoing a split preparation (n = 8; 1.1%), prior colon resection (n = 168; 24.0%), and being underweight (BMI <18.5 kg/m^2) (n = 21; 3.0%). An additional 261 subjects were excluded because the preparation quality was not documented in the colonoscopy report (n = 41), BMI data were unavailable (n = 209), and medical records were incomplete (n = 11). Overall, 2163 subjects were included in the analysis. All colonoscopies were performed by 1 of 7 staff endoscopists.

Basic Characteristics

The mean age of subjects in the study cohort was 60.6 $\pm$ 10.5 years; 93.8% were male; 82.5% were Caucasian. The mean Charlson score was 1.3 $\pm$ 1.5. A total of 381 patients (17.6%) had

Table 1. Characteristics of Patients With Adequate and Inadequate Preparation Quality

Characteristics	All subjects (N = 2163)	Adequate preparation quality (n = 1207)	Inadequate preparation quality (n = 956)	*P* value
Male sex, n (%)	2008 (93.8)	1110 (93.0)	898 (94.9)	.0701
Age, *y*, mean ± SD	60.6 ± 10.5	60.2 ± 10.8	61.1 ± 10.0	.0430
Race, n (%)				.3045
White	1587 (82.5)	876 (81.7)	711 (83.5)	
Non-white	336 (17.5)	196 (18.3)	140 (16.5)	
Hispanic, n (%)	12 (0.7)	6 (0.6)	6 (0.75)	.7749
BMI, n (%)				<.0001
Normal	381 (17.6)	233 (19.3)	148 (15.5)	
Overweight	774 (35.8)	473 (39.2)	301 (31.5)	
Obese	1008 (46.6)	501 (41.5)	507 (53.0)	
BMI, kg/m^2, mean ± SD	30.4 ± 6.2	29.8 ± 5.9	31.2 ± 6.5	<.0001
Tobacco use, n (%)	848 (39.4)	447 (37.2)	401 (42.2)	.0209
Alcohol use, n (%)				.0297
Excessive	191 (8.9)	105 (8.8)	86 (9.1)	
Social	704 (32.9)	422 (35.3)	282 (29.9)	
No use	1244 (58.2)	669 (55.9)	575 (61.0)	
Family history of CRC, n (%)	205 (9.6)	119 (9.9)	87 (9.2)	.6057
Colonoscopy indication, n (%)				.0209
Screening	746 (34.6)	446 (37.0)	300 (31.4)	
Surveillance	737 (34.1)	401 (33.3)	336 (35.2)	
Diagnostic	675 (31.3)	357 (29.7)	318 (33.4)	
Constipation	22(1.0)	11(0.9)	11 (1.2)	
Preparation type, n (%)				.5976
Colyte	1953 (91.1)	1098 (91.5)	855 (90.6)	
MoviPrep	45 (2.1)	26 (2.2)	19 (2.0)	
MiraLax	146 (6.8)	76 (6.3)	70 (7.4)	

CRC, colorectal cancer.

a normal BMI; 774 (35.8%) were overweight and 1008 (46.6%) were obese. Colonoscopy was performed for colorectal cancer screening in 746 patients (34.6%) and for surveillance in 737 patients (34.1%); the remaining 675 cases (31.3%) were diagnostic colonoscopies, including 22 procedures performed to evaluate constipation (1.0%). Most patients received a split Colyte preparation (n = 1953; 91.1%), 45 subjects (2.1%) received MoviPrep, and 146 subjects (6.8%) received a MiraLax preparation.

Preparation quality was characterized as excellent in 26 subjects (1.2%), good in 1181 subjects (54.6%), fair in 680 subjects (31.4%), poor in 246 subjects (11.4%), and unsatisfactory in 30 subjects (1.4%). When the preparation variable was dichotomized, there were 1207 subjects (55.8%) with adequate preparation quality and 956 (44.2%) with inadequate preparation quality. There was no statistically significant difference between the 2 groups for sex, race, ethnicity, family history of colorectal cancer, or bowel preparation type. There were minor differences between both groups for age, tobacco use, and alcohol use. The proportion of patients who were undergoing colonoscopy for diagnostic indications was slightly higher in the inadequate preparation quality group (Table 1).

Univariate Analysis

The mean BMI in the group of patients with inadequate bowel preparation quality was significantly higher than in the adequate preparation quality group: 31.2 ± 6.5 kg/m^2 vs 29.8 ± 5.9 kg/m^2 ($P < .0001$) (Table 1). Among subjects with inadequate bowel preparation quality, 53.0% were obese as compared with 41.5% of those with adequate preparation quality ($P < .0001$). Subjects with inadequate bowel preparation quality also had significantly more comorbidities and a higher mean Charlson score compared with those with adequate preparation quality. When specific comorbidities were assessed, those with inadequate preparation quality had higher rates of coronary artery disease, congestive heart failure, diabetes, hypertension, and dementia. In addition, more subjects with inadequate preparation quality were using narcotics or calcium channel blockers (Table 2).

Univariate logistic regression found that obese patients had a significantly higher risk for inadequate preparation quality compared with both overweight subjects and subjects with a normal BMI (Table 3). Similarly, BMI treated as a continuous variable was associated significantly with inadequate preparation quality. Use of a BMI cut-off point of 30 kg/m^2 maximized the area under the curve at 0.558 (odds ratio [OR], 1.59; 95% confidence interval [CI], 1.34–1.89; $P < .0001$).

Multivariate Results

Multivariable logistic regression analysis found that a BMI of 30 kg/m^2 or greater was an independent risk factor for inadequate bowel preparation quality (OR, 1.46; 95% CI, 1.21–1.75; $P < .0001$). In addition to BMI, hypertension, diabetes, dementia, tobacco use, and narcotics were independent risk factors for inadequate bowel preparation quality (Table 4). The multivariate logistic regression analysis was run with and without preparation type (Colyte vs MoviPrep vs MiraLax) in the model. Including the type of preparation taken by the patient in the model had no clinically important or statistically significant changes in the ORs for the independent variables.

Table 2. Comorbidities and Medications Use in Patients With Adequate and Inadequate Preparation Quality

Comorbidities and medications	All subjects (N = 2163)	Adequate preparation quality (n = 1207)	Inadequate preparation quality (n = 956)	*P* value
Comorbidities				
Coronary artery disease, n (%)	428 (20.3)	209 (17.8)	219 (23.5)	.0015
Congestive heart failure, n (%)	124 (5.9)	58 (5.0)	66 (7.1)	.0403
Diabetes, n (%)	638 (30.2)	307 (26.0)	331 (35.5)	<.0001
Hypertension, n (%)	1403 (65.5)	737 (61.7)	666 (70.3)	<.0001
Dementia, n (%)	27 (1.3)	9 (0.8)	18 (1.9)	.0198
Stroke, n (%)	100 (4.8)	48 (4.1)	52 (5.6)	.1217
Cirrhosis, n (%)	53 (2.5)	24 (2.1)	29 (3.1)	.1247
Number of comorbidities, mean ± SD	1.0 ± 1.1	0.9 ± 1.1	1.2 ± 1.2	<.0001
Charlson index, mean ± SD	1.3 ± 1.5	1.1 ± 1.4	1.5 ± 1.6	<.0001
Pertinent medications				
Narcotics, n (%)	556 (25.7)	285 (23.6)	271 (28.3)	.0132
Calcium channel blockers, n (%)	339 (15.7)	170 (14.1)	169 (17.7)	.0237
Anticholinergics, n (%)	428 (19.8)	224 (18.6)	204 (21.3)	.1151
Iron supplements, n (%)	121 (5.6)	64 (5.3)	57 (6.0)	.5112
Anticonvulsants, n (%)	69 (3.2)	31 (2.6)	38 (4.0)	.0839

Procedure Outcomes

There was no significant difference in the polyp detection rate or adenoma detection rate between the 2 groups (an adenoma detection rate of 50.2% in the adequate preparation quality group, and an adenoma detection rate of 48.2% in the inadequate preparation quality group; $P = .35$), after adjusting for BMI, tobacco and narcotic use, hypertension, diabetes, and dementia. However, there was a significant impact of preparation quality on aborted procedures and follow-up intervals. No procedures (0%) were aborted in patients with adequate preparation quality, whereas 60 colonoscopies (6.3%) were aborted among those with inadequate preparation quality ($P < .0001$). Further, the follow-up colonoscopy interval was shortened specifically as a result of preparation quality in 6 patients with adequate preparation (0.5%) as compared with 554 patients (58.5%) with inadequate preparation quality ($P < .0001$). The mean follow-up interval was almost twice as long after an adequate preparation as compared with inadequate preparation quality: 56.7 ± 64.1 months vs 30.2 ± 48.2 months ($P < .0001$).

Discussion

In this study, we found that obesity is an independent risk factor for inadequate bowel preparation quality in patients who receive split-dose regimens. A BMI of 30 kg/m^2 or greater was an independent risk factor for inadequate preparation quality. Independent of obesity, we also found that tobacco use, narcotic medications, hypertension, diabetes, and dementia were associated with inadequate preparation.

Our results are consistent with previous studies that evaluated risk factors for inadequate preparation quality[6,11–15,18] (Table 5). Some variation likely is related to different study designs, study populations, definitions of inadequate preparation quality, and, most importantly, the fact that our study strictly assessed split-dose bowel preparation. An indication of constipation was found to be associated with an increased likelihood of inadequate preparation quality in the study by Ness et al,[11] but not in our study, or the studies by Lebwohl et al[14] and Borg et al.[6] Evaluating for most socioeconomic factors was not applicable to our study because it was conducted at a VAMC; unmarried status and Medicaid insurance were the main socioeconomic predictors in other studies.[14,15] Similarly, we were not able to assess male sex because our cohort consisted largely of men. Consistent with our findings, Borg et al[6] found that a BMI of 30 kg/m^2 or greater was an independent predictor of inadequate bowel preparation (OR, 1.35; 95% CI, 1.09–1.68; $P = .006$). In a recent Australian study, sodium picosulfate bowel preparation was assessed prospectively in 99 patients, 36% of whom were obese.[19] There was no difference in good preparation quality between obese and nonobese patients (89% vs 90%, respectively; $P > .99$), and the investigators concluded that a sodium picosulfate preparation is an excellent bowel preparation solution for obese patients.

Our study had several strengths. In this study, all included subjects received a split-dose bowel preparation. The sample in our study was large and the study population was homogeneous. The study was conducted in the VA system, which represents the largest single provider of health care in the United States, and is the second largest payor for health services after Medicare.

Table 3. Univariate Logistic Regression of Association of BMI and Inadequate Bowel Preparation Quality

BMI	OR	95% CI	*P* value
BMI, *kg/m^2*, continuous	1.04	1.02–1.05	<.0001
Overweight vs normal BMI	1.00	0.78–1.28	.9887
Obese vs normal BMI	1.59	1.25–2.03	.0001
Obese vs overweight	1.59	1.32–1.92	<.0001

Table 4. Independent Risk Factors for Inadequate Bowel Preparation Quality

Risk factor	OR	95% CI	*P* value
BMI ≥30 kg/m^2	1.46	1.21–1.75	<.0001
Tobacco use	1.28	1.07–1.54	.0084
Narcotics use	1.28	1.04–1.57	.0179
Hypertension	1.30	1.07–1.57	.0085
Diabetes	1.38	1.12–1.69	.0021
Dementia	3.02	1.22–7.49	.0169

NOTE. Results are from the final multivariable logistic regression model.

Table 5. Studies Evaluating Risk Factors for Inadequate Bowel Preparation Quality

Study	Study design	Country	Patients, N	Preparation type	Split preparation, %	Inadequate preparation definition	Inadequate preparation quality prevalence, %	Independent risk factors for inadequate preparation quality
Current study	Retrospective; outpatients only	United States	2163	Polyethylene glycol, 100%	100	Aronchick scale: fair, poor, or unsatisfactory	44.2	BMI $\geq$30 kg/m^2 Diabetes Hypertension Dementia Tobacco use Narcotic medications
Borg et al,[6] 2009	Retrospective; outpatients and inpatients	United States	1588	Polyethylene glycol, 87%; sodium phosphate, 11.5%	Not described	Composite score: Aronchick scale + follow-up interval + adequacy of mucosa visualization	39.3	BMI $\geq$25 kg/m^2 BMI $\geq$30 kg/m^2 Diabetes Dementia Smoking Narcotic medications Antidepressants No alcohol consumption Male sex Inpatient status
Ness et al,[11] 2001	Prospective; outpatients and inpatients	United States	649	Polyethylene glycol, 48.8%; sodium phosphate, 51.2%	51.2 (all sodium phosphate preparations)	Marginal (unsatisfactory visualization) or poor (unsatisfactory visualization + incomplete procedure)	21.7	Dementia Previous stroke Cirrhosis Constipation Tricyclic agents Male sex Inpatient status
Athreya et al,[12] 2010	Prospective; outpatients only; AM vs PM examination	Australia	325	Sodium picosulfate	46 (PM examination group)	Poor (solid and liquid washable stool), very poor (large stool amount or not washable), or aborted examination	N/A: scored for each colon segment separately	Constipation (specifically in the descending colon) PM colonoscopies

Chung et al,[13] 2009	Prospective; outpatients and inpatients	Korea	362	Polyethylene glycol, 100%	N/A: entire preparation in AM on examination day	4-point scale (modified Aronchick scale): fair or poor	28.2	Diabetes Age >60 y Colorectal resection Appendectomy Hysterectomy
Lebwohl et al,[14] 2010	Retrospective; outpatients and inpatients	United States	10,921	Polyethylene glycol, "vast majority"	"Vast majority NOT split"	Aronchick scale: fair or poor	21.9	Age >60 y Male sex Inpatient status Unmarried status Medicaid insurance
Nguyen et al,[15] 2010	Retrospective; outpatients only	United States	300	Polyethylene glycol, 100%	Not described	No defined scale: inadequate or poor in report	15	Diabetes ≥8 prescription drugs Older age Prior abdominal surgery Unmarried status Medicaid insurance Interpreter requirement
Hassan et al,[18] 2012	Prospective; outpatients only	Italy	2811	Polyethylene glycol, 75%; sodium phosphate, 5%; sennosides/other, 20%	12.3	4-point scale (modified Aronchick scale): fair or poor	33	Higher BMI Diabetes Cirrhosis Parkinson disease Older age Male sex Previous colorectal surgery

Our study also had limitations. This study was retrospective in design, and 261 subjects (10.8%) were excluded because of relevant missing data. However, our final cohort included more than 2000 subjects, and although we were unable to compare those excluded subjects with the analyzed cohort, there is no reason to suspect that they would differ significantly. Our study was also a single-center study from an academic VA medical center; thus, the generalizability of our results could be questioned, although they agree with the published literature in other populations. In addition, we recognize that the determination of preparation quality can vary significantly among endoscopists, particularly the definition of a fair preparation. Further, the colonoscopy reports did not routinely specify if preparation quality ultimately was documented based on the assessment before or after lavage and suction. Although the use of the Boston bowel preparation scale has less interobserver variability,[20] it is more cumbersome and reflects clinical practice less than the Aronchick scale,[17] which is used at our institution. Finally, the overall rate of inadequate preparation quality was higher in our study compared with other studies, reflecting some characteristics of our cohort, specifically, a strong male predominance and older age, and possibly the inclusion in the inadequate preparation group of fair preparations, a determination that is variable and subjective among endoscopists.

The effectiveness of colonoscopy depends largely on the quality of bowel preparation. In a recent study by Lebwohl et al,[21] the adenoma miss rate as a result of suboptimal bowel preparation ranged between 35% and 42%. With an estimated 25% of patients or more not achieving adequate preparation quality for their colonoscopy,[1,5,22] this represents a considerable barrier to optimizing colorectal cancer screening and surveillance, and a primary reason for aborting procedures and/or repeating them at a shorter interval than guidelines recommend.[2,23] The importance of an adequate bowel preparation quality in obese patients is particularly important in light of the increasing incidence of obesity in the United States and worldwide, as well as the increased prevalence of colonic adenomas among obese patients, which was confirmed in 2 recent meta-analyses.[24,25] Recognizing other predictors of inadequate bowel preparation is similarly important to tailor the preparation based on the assessment of all potential factors that could limit the success of a standard bowel preparation. A more intensive preparation regimen could be considered in patients with a BMI of 30 kg/m^2 or greater. Measures to improve the preparation quality include a double dose of polyethylene glycol over 2 days; the choice of an alternative product; the addition of another cathartic, longer period of dietary restriction (low-residue diet and clear liquid diet); as well as patient education endeavors to optimize understanding and compliance. According to a report by the Centers for Disease Control and Prevention, the burden of obesity on health care spending continues to increase, accounting for 9.1% of the annual medical spending in 2008 (about $147 billion dollars in that year).[26] Rex et al[27] showed that imperfect bowel preparation increases colonoscopy costs by 12% to 22%, given aborted examinations, as well as completed examinations with suboptimal preparation requiring a shortened follow-up period. Improving the effectiveness of colonoscopy in obese patients could contribute to reducing health care cost increments, by reducing the frequency of aborted and/or repeated procedures owing to inadequate preparation quality, and, importantly, by decreasing the incidence of colorectal cancer in obese patients.

In conclusion, BMI is an independent risk factor for inadequate colonoscopy preparation quality among patients using split bowel preparations. Diabetes, hypertension, dementia, tobacco use, and narcotic medications are additional risks factors that help identify patients who also are likely to require tailored preparations. A BMI of 30 kg/m^2 or greater should prompt consideration of a more intensive preparation regimen. Future efforts are necessary to establish and validate better preparation regimens, particularly in patients with a high BMI and in those with multiple predictors of unsatisfactory preparation. Improved bowel preparation results can lead to more rational and economic use of health care resources for the prevention and early detection of colorectal cancer.

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Conflicts of interest

The authors disclose no conflicts.

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