

Observational Study

Beverage intake preference and bowel preparation laxative taste preference for colonoscopy

Adeyinka O Laiyemo, Clinton Burnside, Maryam A Laiyemo, John Kwagyan, Carla D Williams, Kolapo A Idowu, Hassan Ashktorab, Angesom Kibreab, Victor F Scott, Andrew K Sanderson

Adeyinka O Laiyemo, Hassan Ashktorab, Angesom Kibreab, Victor F Scott, Andrew K Sanderson, Department of Medicine, Howard University College of Medicine, Washington, DC 20060, United States

Clinton Burnside, Carla D Williams, Kolapo A Idowu, Howard University Cancer Center, Washington, DC 20060, United States

Maryam A Laiyemo, Department of Biological Sciences, College of Arts and Sciences, Howard University, Washington, DC 20060, United States

John Kwagyan, Georgetown-Howard Universities Center for Clinical and Translations Science, Washington, DC 20060, United States

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Correspondence to: Adeyinka O Laiyemo, MD, MPH, Division of Gastroenterology, Department of Medicine, Howard University College of Medicine, 2041 Georgia Avenue, NW, Washington, DC 20060, United States. adeyinka.laiyemo@howard.edu
Telephone: +1-202-8657186
Fax: +1-202-8654607

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Abstract

AIM: To examine whether non-alcoholic beverage intake preferences can guide polyethylene glycol (PEG)-based bowel laxative preparation selection for patients.

METHODS: We conducted eight public taste test sessions using commercially procured (A) unflavored PEG, (B) citrus flavored PEG and (C) PEG with ascorbate (Moviprep). We collected characteristics of volunteers including their beverage intake preferences. The volunteers tasted the laxatives in randomly assigned orders and ranked the laxatives as 1st, 2nd, and 3rd based on their taste preferences. Our primary outcome is the number of 1st place rankings for each preparation.

RESULTS: A total of 777 volunteers completed the study. Unflavored PEG was ranked as 1st by 70 (9.0%), flavored PEG by 534 (68.7%) and PEG with ascorbate by

173 (22.3%) volunteers. Demographic, lifestyle characteristics and beverage intake patterns for coffee, tea, and carbonated drinks did not predict PEG-based laxative preference.

CONCLUSION: Beverage intake pattern was not a useful guide for PEG-based laxative preference. It is important to develop more tolerable and affordable bowel preparation laxatives for colonoscopy. Also, patients should taste their PEG solution with and without flavoring before flavoring the entire gallon as this may give them more opportunity to pick a pattern that may be more tolerable.

Key words: Bowel preparation; Laxatives; Colonoscopy; Taste tests; Colon cancer; Screening

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Core tip: There is a need to improve patients' experience with bowel preparation process in order to optimize both colonoscopy uptake. Polyethylene glycol (PEG) is the most widely used laxative but many patients do not readily tolerate it because of its taste. We evaluated whether beverage intake preference pattern can be a useful guide for predicting tolerability of bowel preparation laxative in multiple public taste tests. Our study suggested that no demographic or lifestyle factors predicted bowel preparation taste preference for PEG-based preparations. We recommend that patients should taste PEG formulation before flavoring it to assist them in choosing a more tolerable pattern of ingestion.

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INTRODUCTION

Colorectal cancer (CRC) remains a leading cause of cancer-related deaths^[1] despite evidence from case-control^[2-4], cohort^[5] and randomized control studies^[6-8] that screening reduces the risk of death from the disease because a large proportion of age-eligible adults in the United States have not been screened^[9,10]. This is a major public health problem. Although there are multiple acceptable options for CRC screening^[11], colonoscopy is the only modality for surveillance, diagnostic and therapeutic purposes.

Colonoscopy requires a full bowel preparation using oral laxative agents. However, a substantial percentage of patients do not readily tolerate their bowel laxatives for colonoscopy. Inadequate bowel preparation wastes limited endoscopic resources in addition to patients' and

providers' time and reduces the enthusiasm for repeat screening among patients^[12]. Furthermore, inadequate endoscopy has been associated with subsequent colorectal cancer^[13] underscoring the importance of achieving a high quality preparation for colonoscopy.

Given that the palatability of substances varies among people, we postulated that beverage intake preferences may be a useful guide to personalize bowel preparation recommendations for patients. We tested this hypothesis by conducting public taste tests among volunteers to correlate their beverage intake patterns to their preferred bowel preparations' taste.

MATERIALS AND METHODS

Public taste tests

The study was approved by the Institutional Review Board of Howard University (IRB-12-MED-17). We conducted eight public taste test sessions at Howard University Hospital lobby from July 2012 to March 2013. The objective of the taste test was to determine participants' preferences for 3 commercially procured preparations of polyethylene glycol-(PEG) 3350 used for bowel preparation for colonoscopy. These were: (1) Unflavored PEG; (2) citrus flavored PEG; and (3) PEG with sodium ascorbate and ascorbic acid (Moviprep[®], Raleigh, NC).

The study was open to any volunteer (visitors, ambulatory care patients, students, and staff) if they were at least 18 years old. The study was explained to each participant and written informed consent was obtained. Each participant completed an intake form providing information on their demographic characteristics (age, sex, self identified race, highest education attained, income, marital status and self reported weight and height), lifestyle choices (smoking status and alcohol intake) and their non-alcoholic beverage intake preferences and patterns for coffee, tea and carbonated drinks (soda). Subsequently, volunteers tasted and drank 10 cc (equivalent to 2 teaspoons) of each laxative in randomly selected order (ABC, BCA, CAB) and rated the laxatives based on their preferences in an ordinal fashion with the preferred laxative rated as 1st, then 2nd for the next preferred and 3rd for the least preferred laxative. We offered confectioneries to each volunteer on completion of their participation in the study.

Exposure and outcome assessment

Information on how each volunteer prefers to drink coffee was collected with five options: (1) I do not drink coffee; (2) Without milk/cream; without sugar/sweetener; (3) Without milk/cream; with sugar/sweetener; (4) With milk/cream; without sugar/sweetener; and (5) With milk/cream; with sugar/sweetener. Similar information was obtained for tea intake. They were also asked if they drink regular carbonated drinks (soda), diet soda, and whether they prefer the taste of diet soda to regular soda. Our primary outcome was the number of 1st place ranking for each laxative preparation.

Table 1 Association of demographic and lifestyle characteristics with bowel preparation taste preference

Characteristics	n	Preferred unflavored PEG (n = 70)		Preferred flavored PEG (n = 534)		Preferred moviprep (n = 173)	
		n (%)	OR (95%CI)	n (%)	OR (95%CI)	n (%)	OR (95%CI)
Age ≥ 50 yr							
No	421	32 (7.6)	Reference	283 (67.2)	Reference	106 (25.2)	Reference
Yes	356	38 (10.6)	1.45 (0.89-2.38)	251 (70.5)	1.17 (0.86-1.58)	67 (18.8)	0.69 (0.49-0.97)
Sex							
Male	340	21 (6.2)	Reference	242 (71.2)	Reference	77 (22.7)	Reference
Female	432	48 (11.1)	1.90 (1.11-3.24)	288 (66.7)	0.81 (0.60-1.10)	96 (22.2)	0.98 (0.69-1.37)
Race							
Non-blacks	120	12 (10.0)	Reference	83 (69.2)	Reference	25 (20.8)	Reference
Blacks	657	58 (8.8)	0.87 (0.45-1.68)	451 (68.7)	0.98 (0.64-1.49)	148 (22.5)	1.10 (0.69-1.78)
Marital status							
Unmarried	455	38 (8.4)	Reference	314 (69.0)	Reference	103 (22.6)	Reference
Married	169	13 (7.7)	0.91 (0.47-1.76)	110 (65.1)	0.84 (0.57-1.22)	46 (27.2)	1.28 (0.85-1.91)
College education							
No	418	41 (9.8)	Reference	299 (71.5)	Reference	78 (18.7)	Reference
Yes	343	27 (7.9)	0.79 (0.47-1.31)	228 (66.5)	0.79 (0.58-1.07)	88 (25.7)	1.50 (1.06-2.12)
Yearly income < \$25000							
No	437	33 (7.6)	Reference	302 (69.1)	Reference	102 (23.3)	Reference
Yes	268	29 (10.8)	1.49 (0.88-2.51)	181 (67.5)	0.93 (0.67-1.29)	58 (21.6)	0.91 (0.63-1.31)
BMI							
< 25 kg/m ²	223	18 (8.1)	Reference	150 (67.3)	Reference	55 (24.7)	Reference
25-29 kg/m ²	258	25 (9.7)	1.22 (0.65-2.30)	172 (66.7)	0.97 (0.66-1.42)	61 (23.6)	0.95 (0.62-1.44)
≥ 30 kg/m ²	275	26 (9.5)	1.19 (0.63-2.23)	199 (72.4)	1.27 (0.87-1.87)	50 (18.7)	0.68 (0.44-1.05)
History of smoking							
No	485	38 (7.8)	Reference	334 (68.9)	Reference	113 (23.3)	Reference
Yes	286	32 (11.2)	1.48 (0.90-2.43)	195 (68.2)	0.97 (0.71-1.33)	59 (20.6)	0.86 (0.60-1.22)
Alcohol							
No	311	26 (8.4)	Reference	216 (69.5)	Reference	69 (22.2)	Reference
Yes	457	42 (9.2)	1.11 (0.66-1.85)	312 (68.3)	0.95 (0.69-1.29)	103 (22.5)	1.02 (0.72-1.44)
Health history							
Diabetes							
No	661	51 (8.8)	Reference	453 (68.5)	Reference	150 (22.7)	Reference
Yes	107	11 (10.3)	1.19 (0.60-2.35)	76 (71.0)	1.13 (0.72-1.76)	20 (18.7)	0.78 (0.47-1.32)
Hypertension							
No	521	48 (9.2)	Reference	341 (65.5)	Reference	132 (25.3)	Reference
Yes	248	22 (8.9)	0.96 (0.57-1.63)	188 (75.8)	1.65 (1.17-2.33)	138 (15.3)	0.53 (0.36-0.79)

Missing data: sex = 5; marital status = 153; education = 16; income = 72; BMI = 21; smoking status = 6; alcohol = 9; diabetes = 9; hypertension = 8. PEG: Polyethylene glycol; BMI: Body mass index.

Statistical analysis

We calculated the percentages of volunteers who preferred each laxative's taste and compared the characteristics of participants who selected each laxative as 1st vs those who did not. Missing variables were set to missing without the use of dummy variables. We used logistic regression models to compare the characteristics of volunteers who chose each laxative as 1st to the rest of the volunteers and calculated odds ratios (OR) and 95%CI. We performed similar analyses and compared the pattern of beverage intake for coffee, tea, and soda with those who did not drink these beverages. We evaluated the predictive accuracy of the models by calculating the area under the receiver operating characteristics curve (AUC). We used Stata[®] statistical software version 11.2 (College Station, Texas) for our analyses.

RESULTS

A total of 777 volunteers completed the taste test. The mean age of volunteers was 45.1 years (range 18-83

years), 432 (56.0%) women and 657 (84.6%) blacks. Seventy (9.0%) participants preferred unflavored PEG as first choice, 534 (68.7%) preferred flavored PEG while 173 (22.3%) preferred PEG with ascorbate.

Overall, no demographic or lifestyle characteristics adequately predicted the preference for any bowel laxative. Volunteers who were older than 50 years (OR = 0.69; 95%CI: 0.49-0.97) and those with hypertension (OR = 0.53; 95%CI: 0.36-0.79) were less likely to prefer PEG with ascorbate as first choice. Although those with hypertension were more likely to prefer flavored PEG (OR = 1.65; 95%CI: 1.17-2.23) but the predictive accuracy was low (AUC = 0.55). Volunteers with college education were more likely to prefer PEG with ascorbate (OR = 1.50; 95%CI: 1.06-2.12), but the predictive accuracy was also low (AUC = 0.55). Similarly, women were more likely to prefer unflavored PEG (OR = 1.90; 95%CI: 1.11-3.24), albeit with low predictive accuracy (AUC = 0.57) (Table 1). The coffee, tea and carbonated drinks intake pattern of volunteers were not associated with laxative taste preferences (Table 2).

Table 2 Association of beverage intake preferences with bowel preparation taste preference

Beverage intake	n	Preferred unflavored PEG (n = 70)		Preferred flavored PEG (n = 534)		Preferred Moviprep (n = 173)	
		n (%)	OR (95%CI)	n (%)	OR (95%CI)	n (%)	OR (95%CI)
Coffee intake pattern							
Don't drink coffee	265	22 (8.3)	Reference	183 (69.1)	Reference	60 (22.6)	Reference
No milk, no sugar	41	4 (9.8)	1.19 (0.39-3.66)	27 (65.9)	0.86 (0.43-1.73)	10 (24.4)	1.10 (0.51-2.38)
With sugar, no milk	42	2 (4.8)	0.55 (0.13-2.44)	34 (81.0)	1.90 (0.84-4.29)	6 (14.3)	0.57 (0.23-1.42)
With milk, no sugar	65	9 (13.9)	1.78 (0.78-4.06)	42 (64.6)	0.82 (0.46-1.45)	14 (21.5)	0.94 (0.49-1.81)
With milk, with sugar	336	31 (9.2)	1.12 (0.63-1.99)	230 (68.5)	0.97 (0.69-1.38)	75 (22.3)	0.98 (0.67-1.44)
Tea intake pattern							
Don't drink tea	138	14 (10.1)	Reference	96 (69.6)	Reference	28 (20.3)	Reference
No milk, no sugar	89	6 (6.7)	0.64 (0.24-1.73)	63 (70.8)	1.06 (0.59-1.90)	20 (22.5)	1.14 (0.60-2.18)
With sugar, no milk	336	30 (8.9)	0.87 (0.44-1.69)	240 (71.4)	1.09 (0.71-1.69)	66 (19.6)	0.96 (0.59-1.57)
With milk, no sugar	25	2 (8.0)	0.77 (0.16-3.62)	16 (64.0)	0.78 (0.32-1.90)	7 (28.0)	1.53 (0.58-4.02)
With milk, with sugar	153	14 (9.2)	0.89 (0.41-1.94)	96 (62.8)	0.74 (0.45-1.20)	43 (28.1)	1.54 (0.89-2.65)
Carbonated drinks							
Regular soda intake							
No	269	27 (10.0)	Reference	180 (66.9)	Reference	62 (23.1)	Reference
Yes	482	41 (8.5)	0.83 (0.50-1.39)	336 (69.7)	1.14 (0.83-1.57)	105 (21.8)	0.93 (0.65-1.33)
Diet soda intake							
No	493	43 (8.7)	Reference	336 (68.2)	Reference	114 (23.1)	Reference
Yes	218	19 (8.7)	1.00 (0.57-1.76)	155 (71.1)	1.15 (0.81-1.63)	44 (20.2)	0.84 (0.57-1.24)
Prefers the taste of diet soda to regular soda							
No	582	47 (8.1)	Reference	402 (69.1)	Reference	133 (22.9)	Reference
Yes	111	13 (11.7)	1.51 (0.79-2.89)	76 (68.5)	0.97 (0.63-1.51)	22 (19.8)	0.83 (0.50-1.38)

PEG: Polyethylene glycol.

DISCUSSION

In this large study of volunteers in public taste tests, demographic, lifestyle and beverage intake patterns of volunteers did not predict their taste preferences for the studied bowel laxatives commonly used in the preparation process for colonoscopy. This suggests that these characteristics are not clinically useful to guide the selection of laxatives for colonoscopy. It is unclear why beverage intake patterns of our participants did not predict their preferences for bowel laxatives examined in this study. However, we speculate that beverage intake patterns are probably more unique to the individuals and can be varied in composition more readily than the limited taste range of the bowel laxatives. It will be important to develop better tasting and more acceptable bowel preparation laxatives and make them available and affordable to all patients.

Improving bowel preparation experience of patients is an important step to enhance uptake of CRC screening using colonoscopy. Previous interventions have involved reduction in the salt content and flavoring of the solutions by manufacturers. For those with low socio-economic status, these newer products are often not accessible because they are generally not considered to be "preferred brands" and are either not covered by their third party payers or covered with substantially higher co-pays. Bowel preparations containing PEG is the predominant laxative used in the preparation process for colonoscopy but salty taste and large volume of these solutions limit their tolerability. PEG is generally covered by health insurance and is relatively inexpensive. The effect of flavoring of PEG on patients' tolerability is uncertain. In a taste test involving 5 PEG preparations

tasted by 100 subjects, Diab *et al*^[14] reported that the majority of subjects preferred the flavored products while 22% rated unflavored PEG as their first choice. Furthermore, Hayes *et al*^[15] reported that flavoring PEG (Colyte[®]) solution did not improve bowel preparation as compared to unflavored PEG.

An approach to ameliorate this challenge will be for manufacturers to provide free samples of their laxatives for patients to try at their endoscopists' offices. However, this may not be a viable option particularly as the relationship of pharmaceutical industries with care providers is under close scrutiny in many institutions and provision of free "test" samples medications has been abolished in many institutions. Therefore, it is imperative to develop palatable bowel preparation laxatives and make them affordable.

A notable strength of our study is that we studied the taste preference of a large number of volunteers. However, a limitation of our study is that we drew our inference from preferences that were based on tasting a small volume of laxatives by participants. However, if a small volume of a solution tastes really bad, it is highly unlikely that a large volume of it will be tolerable. Nonetheless, we acknowledge that it is conceivable that the sheer volume of solution to actually consume for colonoscopy preparation may further influence the overall experience of patients. Although our study was open to the general public, it was conducted at a single institution. Furthermore, the majority of our participants were black and the experience of other race-ethnicities may be different since beverage intake patterns and preferences may vary based on social characteristics.

In conclusion, the demographic characteristics, lifestyle choices and beverage intake preferences

of volunteers in this large taste test did not predict preferences for PEG-based bowel preparation laxatives to be a clinically useful guide to improve the experience of patients undergoing CRC screening. There is a need to develop palatable and affordable bowel preparation laxatives.

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Abstracts from this study were presented at the Digestive Diseases Week in May 2013 in Orlando, Florida and at the American College of Gastroenterology meeting in San Diego in October 2013.

COMMENTS

Background

There is a great need to improve the bowel preparation process in order to increase colon cancer screening uptake. The current study evaluated whether the beverage intake pattern for coffee, tea and carbonated drinks can guide the preference of volunteers for polyethylene glycol (PEG)-based bowel preparation for colonoscopy.

Research frontiers

Adequacy of bowel preparation for screening colonoscopy is a quality measure. This underscores the need to improve bowel preparation quality during colonoscopy, and overall bowel preparation experience of the population when undergoing colonoscopy.

Innovations and breakthroughs

The current study examined whether personalized uniqueness of beverage intake of coffee, tea and carbonated drinks can be useful to guide the selection of PEG-based bowel preparation laxative for patients. This has not been investigated previously.

Applications

To summarize the practical applications of their research findings, so that readers may understand the perspectives by which this study will affect the field and future research. Beverage intake preferences for coffee, tea and carbonated drinks did not predict the preferences for PEG-based bowel preparation laxative among volunteers. This suggests that taste preference is probably too unique and individuals should probably taste the unflavored PEG-based laxative prior to flavoring during the bowel preparation process.

Terminology

Bowel preparation is the process of ensuring that the colon is free of stool during colonoscopy and involves the consumption of laxatives. It is important to tolerate the laxatives, which of often consumed in large volumes, to achieve optimal bowel cleansing.

Peer-review

Better tolerable bowel preparation would increase the rates of screening colonoscopy and therefore benefit the public.

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