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Relation of Bowel Habits to Fecal Incontinence in Women

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Abstract

BACKGROUND—Though most women with fecal incontinence (FI) have anorectal dysfunctions, a majority have intermittent symptoms. Variations in bowel habits and daily routine may partly explain this.

AIM—To compare bowel habits and daily routine between controls and FI, and between continent and incontinent stools among women with FI.

METHOD—Using a mailed questionnaire, we identified 507 women with FI among 5,300 women in Olmsted County, MN. Bowel habits were compared among 127 randomly selected controls and 154 women with self-reported FI, who did (“active” FI, N = 106) or did not (“inactive” FI, N = 48) have an incontinent episode during a 2-wk bowel diary period.

RESULTS—Independent risk factors for FI were: rectal urgency (odds ratio [OR] for inactive FI vs controls 5.6, 95% confidence interval [CI] 2.3–13.3; and OR for active FI vs inactive FI 2.0, 95% CI 0.9–4.3) and a sense of incomplete evacuation (OR for inactive FI vs controls 3.5, 95% CI 1.4–8.8; and OR for active FI vs inactive FI 2.2, 95% CI 1.1–4.9). Similar results were found for stool frequency and form. Among incontinent women, incontinent stools (*versus* continent stools) were less formed, more likely to occur at work, and to be preceded by rectal urgency.

CONCLUSIONS—Bowel patterns, rectal urgency, and daily routine influence the occurrence of FI. Stool characteristics explained 46% of the likelihood for incontinence episodes, emphasizing that anorectal sensorimotor dysfunctions must also contribute to FI in women.

INTRODUCTION

Clinical guidelines recommend assessment and management of anorectal dysfunctions and bowel disturbances in fecal incontinence (FI) (1). Though clinicians recognize that diarrhea predisposes to FI, most pathophysiological studies have focused on anorectal dysfunctions; the contribution of bowel disturbances to FI is less well characterized (2). However, among community-based studies from Australia and the United States the four that were evaluated in this issue, demonstrated that chronic diarrhea was a risk factor for FI (3–6). Moreover, a multivariate analysis that incorporated bowel disturbances and risk factors for anal and perianal traumas (*e.g.*, vaginal delivery) assessed by a questionnaire suggested that the symptom of

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CONFLICT OF INTEREST **Guarantor of the article:** Adil E. Bharucha, M.D. **Specific author contributions:** Adil E. Bharucha: planning the experiment, conducting the study, and drafting the manuscript; Barbara M. Seide: conducting the study; Alan R. Zinsmeister: analyzing the data and drafting the manuscript; and L. Joseph Melton: planning the experiment and drafting the manuscript. **Potential competing interests:** None.

rectal urgency was the strongest risk factor, and was associated with a fivefold increase in risk for FI among women in the community (5). However, questionnaire-based assessments require respondents to focus on their predominant symptoms over a defined period, typically between 3 and 12 months. So framed, these questions may not adequately assess for variability in bowel habits, and they are also prone to recall bias. Indeed, people tend to exaggerate their bowel habits and overestimate their bowel frequencies (7,8). Bowel diaries may overcome some limitations of questionnaires, and provide additional insights into disordered bowel habits in functional gastrointestinal disorders (9). Moreover, it remains unclear why most women with FI have infrequent symptoms. A questionnaire-based study suggested that 79% of women with FI in Olmsted County, MN, had symptoms no more than once a week (10). This question is important because it has implications in the role of bowel management in FI. Our hypothesis was that intermittent bowel disturbances (*e.g.*, softer and/or frequent stools) and circumstances surrounding the daily routine explain when FI occurs. Therefore, we used bowel diaries to assess the relationship among bowel habits, daily routine, and FI among women in the community.

METHODS

Study Design

The institutional review board of Mayo Clinic approved this study. We previously mailed a validated questionnaire to an age-stratified random sample of 5,300 women in Olmsted County. There were 2,800 respondents (53%), and 507 had FI as defined by accidental leakage of liquid or solid stool not related to a short-term diarrheal illness (*e.g.*, the flu) in the 12 preceding months. Thus, the overall age-adjusted prevalence of FI in the past year was 12.1 per 100 (95% confidence interval [CI] 11.0–13.1) (10). Thereafter, 200 randomly selected women with “idiopathic” FI (*i.e.*, not due to an organic condition, such as inflammatory bowel disease or a central nervous system [CNS] illness [*e.g.*, stroke]), and 200 women matched by age and medical record number, which reflects the date of an initial encounter with a health-care provider in Olmsted County, were invited to participate in a case-control study. From this group, 154 women with self-reported FI (age 60 ± 1 yr [mean $\pm$ standard error of the mean, SEM]), and 124 controls who did not report FI during the 12 months prior to participation (age 61 ± 1 yr) took part in a case-control study during which subjects were asked to record the details of every (*i.e.*, continent or incontinent) bowel movement in detailed diaries for 2 wk. For every continent or incontinent bowel movement, subjects recorded the circumstances, activities, bowel symptoms prior to defecation, the relationship of bowel movements to meals, the need to strain during defecation, stool form quantified by the Bristol scale (11), and satisfaction after defecation (*e.g.*, a sense of incomplete evacuation). Subjects also recorded the duration for which they deferred defecation after perceiving the desire to defecate and the time required to defecate.

Statistical Analysis

For each subject, the data (*e.g.*, stool frequency and form, proportion of bowel habits occurring within 60 min after a meal, bowel movements associated with rectal urgency, and straining-to-begin and to-end defecation) were first averaged per day, and then over the entire diary duration. Variability in stool frequency over the diary period was summarized by the coefficient of variation. On days when subjects had two or more bowel movements, within-day variation in stool form was assessed by calculating the difference between the maximum and minimum Bristol stool form scores; these values were averaged over the entire study duration for each subject. Day-to-day variation was assessed by calculating the proportion (%) of all bowel movements over the diary period recorded for each type (*i.e.*, 1 [*i.e.*, hard pellets] through 7 [*i.e.*, watery diarrhea]) on the Bristol stool form score. This day-to-day variation was then summarized as the maximum proportionate stool form score (*i.e.*, the highest proportion over

all stool form categories recorded by each subject); higher values (maximum = 100) indicated that a larger proportion of stools were of the same stool form, implying less variability.

The association of these parameters with subject status (*i.e.*, controls, women with “active” FI, and women with “inactive” FI) was assessed using logistic regression. “Active” and “inactive” refers to FI women who did or did not record an episode of FI during the bowel diary duration, respectively. As explained in the results, some controls also recorded isolated episodes of FI during the bowel diary duration; however, to be conservative, these individuals were included in the control group for analysis. These analyses examined bowel characteristics and circumstances surrounding all (*i.e.*, continent and incontinent) bowel movements in controls and FI by considering a 3-group-dependent variable in the models with controls as the comparison category. Odds were estimated for women with “active” and “inactive” FI using a generalized logit link function. Univariate and multiple predictor variable logistic regression models were examined. Odds ratios (OR) are reported with 95% confidence intervals (CI) computed from the estimated model coefficients and their standard errors. In these models, stool form and frequency were used in the original scale, whereas other variables (*e.g.*, urgency and incomplete evacuation) were dichotomized as normal or abnormal, based on the 90th percentile for control subjects to ensure that the models converged. Among women with active FI, the paired *t*-tests or signed-rank tests were used to assess the association between bowel movement type (continent *vs* incontinent) and bowel characteristics.

RESULTS

Characteristics of Women With FI

One hundred six of 154 women with FI reported one or more episodes of FI in their 2-wk diary period; these women (*i.e.*, “active” FI) had 4.4 ± 0.3 days with FI. Sixteen percent of all bowel movements were associated with FI, characterized as mild (*i.e.*, staining of undergarments [62%]), moderate (*i.e.*, soiling of underclothes [22%]), or severe (*i.e.*, requiring change of outerwear [16%]). By definition, women with “inactive” FI ($N = 48$) did not have any episodes of FI over the 2-wk period.

In contrast, only 10 of 124 controls (defined as women without self-reported FI) had one or more incontinent episodes, and these comprised 1.6 ± 0.3 incontinent days. Among controls, 8% of all bowel movements were associated with FI (*i.e.*, staining [75%], soiling [3%], or requiring change of outerwear [22%]). Compared with control subjects who did not record any incontinent episodes in the diary duration, control women who had one or more episodes had more frequent bowel movements (1.7 ± 0.2 stools/day *vs* 1.3 ± 0.3 stools/day), less formed stools (Bristol score of 3.7 ± 0.2 *vs* 2.6 ± 0.1), and less variability in stool form as evidenced by a lower maximum proportionate stool form score of $50.7 \pm 4.4\%$ *versus* $64.3 \pm 1.8\%$ for controls who had no incontinent episodes.

Comparison of Bowel Habits in Controls, Women With Active FI, and Women With Inactive FI

Table 1 compares bowel habits among control women, women with active FI, and women with inactive FI. Because only a small proportion of controls had infrequent incontinent episodes, all controls (*i.e.*, those who did or did not have FI during the diary period) were combined for analyses. Compared with controls, women with inactive and, to a greater extent, active FI had more frequent and looser stools, more frequently reported urgency before defecation, and a sense of incomplete evacuation after defecation. Both within-day and day-to-day variabilities were higher in FI than those in controls. The difference between maximum and minimum stool form scores calculated on each day was greater in active FI (1.40 ± 0.08) than that in controls (0.84 ± 0.08) or in inactive FI (1.00 ± 0.11). The day-to-day variability, assessed by maximum

proportionate stool form score, was $63.2 \pm 1.7\%$ in controls, $54.1 \pm 2.4\%$ in inactive FI, and $50.0 \pm 1.8\%$ in active FI, suggesting that a higher proportion of all bowel movements had the same stool form in controls compared with that in FI.

Univariate analysis suggested that several factors were associated with an increased risk of inactive FI compared with those in controls: stool frequency (OR 2.1, 95% CI 1.1–4.1), stool form score (OR 1.8, 95% CI 1.2–2.8), day-to-day variations in stool frequency (OR 1.02, 95% CI 1.00–1.05), day-to-day variations in stool form (*i.e.*, maximum proportionate stool form score: OR 11.6, 95% CI 1.9–71.8), rectal urgency (OR 7.3, 95% CI 3.2–16.6), and the sense of incomplete evacuation after defecation (OR 3.8, 95% CI 1.6–9.1) (Table 1). These risk factors and, in addition, within-day variation in stool form, straining-to-begin and to-end defecation, and anal digitation were also significant, and yielded even greater odds for active FI *versus* controls. For example, for the maximum proportionate stool form score, the OR for subjects with active FI *versus* controls was 45.9 (95% CI 9.9–214.0). In contrast, the duration for which defecation was deferred and the time spent during defecation were not risk factors for active or inactive FI.

The distribution of activities preceding FI was comparable among controls, active FI, and inactive FI. In all three groups, more than 75% of bowel movements occurred at rest or while women were engaged in household chores, presumably when they were close to a toilet (Table 1). In contrast, less than 10% of incontinent bowel movements occurred while women were exercising or traveling.

In the multiple logistic regression model (Table 2), stool frequency, form, rectal urgency, and the sense of incomplete evacuation were independent risk factors for active FI *versus* controls, as well as for inactive FI (those with 95% CIs that do not include 1.0). These variables explained 46% of the variation (log likelihood) in the model. The sense of incomplete evacuation was the only factor that significantly discriminated between active and inactive FI.

Comparison of Bowel Habits in Continent and Incontinent Stools

Table 3 compares bowel habits between continent and incontinent stools among women with “active” FI. Women had fewer stools (*i.e.*, 1.3 ± 0.1 bowel movements/day *vs* 1.5 ± 0.1 bowel movements/day) on days when they did, than on days when they did not, have FI. In contrast, stool form scores were higher, reflecting less formed stools on incontinent than on continent days. Expressed differently, a higher proportion of incontinent ($62 \pm 4\%$) than that of continent ($35 \pm 3\%$) bowel movements were associated with abnormal (*i.e.*, loose) stools, as defined by the 90th percentile value for Bristol stool form score (*i.e.*, 3.5) among asymptomatic women in this study. More than 70% of continent and incontinent bowel movements occurred at rest or while women were engaged in household chores. The only significant association with circumstances preceding FI was that incontinent bowel movements occurred more frequently at work (*i.e.*, $13 \pm 2\%$ *vs* $9 \pm 2\%$). Incontinent bowel movements were also more often preceded by rectal urgency ($57 \pm 3\%$ *vs* $30 \pm 2\%$), and followed by a sense of incomplete evacuation ($41 \pm 4\%$ *vs* $34 \pm 3\%$).

DISCUSSION

Clinical observations and questionnaire-based epidemiological studies suggest that disordered bowel habits, particularly diarrhea and rectal urgency, are risk factors for FI (3–6). Using detailed bowel diaries, our observations indicate that four bowel symptoms (*i.e.*, average stool frequency, average stool form, rectal urgency, and the sense of incomplete evacuation) explained 46% of the variation between controls and FI, thereby confirming that disordered bowel habits are strong risk factors for FI. As controls that recorded isolated episodes of FI in

a bowel diary were retained in the control group for analysis, this conservative approach may potentially attenuate identified differences between controls and FI.

Though loose stools can cause rectal urgency, these observations confirm previous studies (5,12), demonstrating that rectal urgency was an independent and stronger risk factor for FI than loose stools (*i.e.*, functional diarrhea). While rectal urgency has been attributed to anal sphincter defects, even patients with normal sphincter anatomy can have rectal urgency (13). Recent studies suggest that the symptom of rectal urgency may reflect an irritable rectum characterized by an exaggerated contractile response, an increased perception of rectal distention, and/or a reduced rectal capacity (*i.e.*, a smaller reservoir) (14,15).

Stool frequency and form were independent risk factors for “active” FI *versus* controls, perhaps suggesting that a spectrum of bowel disturbances is associated with FI. Thus, in addition to diarrhea (*i.e.*, loose stools with or without increased frequency), an evacuation disorder, perhaps manifest by frequent stools with normal consistency, may also pre-dispose to FI. Indeed, compared to controls, women with FI more frequently reported straining-to-begin defecation and a sense of incomplete evacuation after defecation. Both symptoms may reflect pelvic floor dysfunction, and the latter may also suggest rectal hypersensitivity. Incomplete rectal evacuation has been associated not only with fecal seepage in men with high anal sphincter pressures (16,17), but also in women with FI and weak anal pressures (15). Because retained rectal contents are prone to leak, particularly in patients with anal sphincter weakness, rectal evacuation should be assessed in FI. Current biofeedback therapy protocols for FI include measures to improve anal sphincter contraction and endurance, to restore rectal sensation, and to improve coordination between rectal perception and anal sphincter contraction (18). Our findings suggest that measures to rehabilitate rectal evacuation should also be considered in patients with impaired rectal evacuation.

Though patients often report FI in association with unpredictable and intermittent diarrhea, our data suggest that variation in stool frequency over a 2-wk period was not a strong risk factor for FI. Within-day and day-to-day variations in stool form were significant risk factors for FI in the univariate analysis, but day-to-day variation in stool form did not remain a risk factor for FI after adjusting for average stool form in the multivariate analysis. Because only 231 subjects had two or more bowel movements on at least 1 day during the diary period, within-day variation in stool frequency was not included in the multivariate model.

Previous studies have not evaluated the risk factors for incontinent bowel movements *per se* in women with FI. Because a majority of women with FI have infrequent symptoms, we sought to assess if disordered bowel habits and the circumstances preceding FI can explain when FI occurs in women with this symptom. As is intuitively obvious, particularly in the context of anal weakness, incontinent stools were less formed than continent stools. Indeed, even healthy subjects retained a larger volume of a more viscous (*i.e.*, 10,000 cPois at 37 °C) than a less viscous (*i.e.*, 100 cPois at 37 °C) substance infused in the rectum (19). However, the average Bristol stool form score for incontinent bowel movements in our study was 4, which reflects soft, yet formed stools. Moreover, a majority (~75%) of incontinent episodes occurred while subjects were at rest or engaged in household chores, presumably when they were relatively close to a toilet. However, women with incontinent episodes reported that they deferred defecation for an average of 7 min. Though this figure is comparable with controls, it suggests that some episodes of FI may be preventable if women promptly heed the call to defecate. A higher proportion of incontinent compared with continent bowel movements occurred at work, underscoring the need to provide accessible toilets to women with FI.

In summary, these observations, derived from a population comprised predominantly of Caucasian women, document that disordered bowel habits and rectal urgency are significant

risk factors not only for FI, but also for incontinent bowel movements in women with FI. They are also consistent with the contribution of disordered anorectal continence and evacuation mechanisms to FI. From a therapeutic perspective, however, they reinforce the importance of dietary measures and pharmacological approaches (*i.e.*, to treat rectal urgency and diarrhea) for managing FI (2).

STUDY HIGHLIGHTS

What Is Current Knowledge

- Although bowel disturbances, particularly diarrhea and rectal urgency, are recognized risk factors for fecal incontinence (FI), the extent to which bowel disturbances, particularly within-day or day-to-day variations in bowel habits, predispose to FI in the general population is not well understood.
- Most women with FI in the community have infrequent symptoms. However, the determinants of incontinent stools among women with FI in the community are unknown.

What Is New Here

- Rectal urgency, a sense of incomplete evacuation, stool frequency, and form, as assessed by detailed bowel diaries, were independent risk factors for FI among women in the community.
- Among incontinent women, incontinent stools were generally formed. However, compared with continent stools, incontinent stools were more likely to be less formed, occur at work, and be preceded by rectal urgency.

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Table 1
Distribution of Bowel Habit Risk Factors by Fecal Incontinence Status and Univariate Odds Ratios (for FI Subgroup) Among Olmsted County, Minnesota, Women

	Controls	Fecal Incontinence		Univariate Odds Ratio (95% CI) Versus Controls	
		Inactive	Active	Inactive FI	Active FI
Number of subjects	124	48	106		
Stool frequency (per day)	1.4 ± 0.0	1.5 ± 0.1	1.8 ± 0.1	2.1 (1.1, 4.1) *	3.8 (2.1, 6.6) *
Stool frequency (CV, %)	29.5 ± 1.6	37.5 ± 2.9	37.6 ± 1.5	1.02 (1.00, 1.05)	1.03 (1.01, 1.04) *
Stool form (Bristol Score)	2.7 ± 0.1	3.1 ± 0.1	3.4 ± 0.1	1.8 (1.2, 2.8) *	2.9 (2.0, 4.2) *
Maximum proportionate stool form score	63.2 ± 1.7	54.1 ± 2.4	50.0 ± 1.8	11.6 (1.9, 71.8) *	45.9 (9.9, 213.7) *
Postprandial bowel habits (%)	30.8 ± 2.0	33.6 ± 3.0	32.3 ± 1.8	1.8 (0.4, 8.6)	1.4 (0.4, 4.7)
Activity status prior to bowel movement (%)					
Rest	41.6 ± 2.4	44.7 ± 3.5	44.8 ± 2.2	1.7 (0.4, 6.3)	1.7 (0.6, 4.7)
Household chores	35.9 ± 2.1	33.1 ± 3.4	33.5 ± 2.1	0.6 (0.1, 2.6)	0.6 (0.2, 2.0)
Outdoors	5.1 ± 1.0	2.0 ± 0.9	4.0 ± 0.8	0 (0, 1.4)	0.3 (0, 4.7)
Work	10.8 ± 1.8	12.9 ± 2.7	10.1 ± 1.5	1.8 (0.3, 10.3)	0.8 (0.2, 3.5)
Exercise	3.5 ± 0.7	4.0 ± 1.3	3.1 ± 0.6	2.1 (0, 122.5)	0.5 (0, 16.8)
Traveling [‡]	2.3 ± 0.4	3.4 ± 1.0	3.5 ± 0.5	1.8 (0.6, 4.8)	1.6 (0.7, 3.6)
More than 1 factor [‡]	0.9 ± 0.3	0 ± 0	1.0 ± 0.5	NE [‡]	1.1 (0.5, 2.6)
Symptoms prior to defecation (%)					
Straining to begin [‡]	8.1 ± 1.6	10.2 ± 2.3	12.6 ± 1.8	2.2 (0.9, 5.5)	2.6 (1.3, 5.5) *
Straining to end [‡]	0.9 ± 0.3	3.0 ± 1.5	4.2 ± 1.2	1.6 (0.6, 4.3)	2.3 (1.1, 4.9) *
Urgency [‡]	6.2 ± 1.1	24.2 ± 3.3	34.5 ± 2.3	7.3 (3.2, 16.6) *	18.1 (8.8, 37.2) *
Anal digitation [‡]	0.4 ± 0.2	0.5 ± 0.5	1.9 ± 0.7	0.6 (0.1, 5.9)	4.6 (1.5, 14.3) *
Duration for which defecation was deferred (min)	8.7 ± 0.8	7.1 ± 1.2	6.8 ± 0.8	1.0 (1.0, 1.0)	1.0 (1.0, 1.0)
Duration of defecation (min)	3.7 ± 2.3	3.0 ± 0.3	3.6 ± 0.3	0.9 (0.7, 1.0)	1.0 (0.9, 1.0)
Sense of incomplete evacuation (%) [‡]	10.1 ± 1.7	19.2 ± 3.6	35.0 ± 2.8	3.8 (1.6, 9.1) *	9.3 (4.6, 18.9) *

CV = coefficient of variation;

Variables indicated with

* $P < 0.05$.

[‡]NE = not estimable due to small response rate.

[‡]were dichotomized for use in the corresponding models based on the 90th percentile value for controls. The 90th percentile values for these variables were 10.0%, 0.0%, 22.2%, 1.1%, 21.1%, 0.0%, and 28.6%, for traveling, more than one factor, straining to begin defecation, straining to end defecation, urgency, anal digitation, and the sense of incomplete evacuation, respectively.

Table 2
Multiple Variable Analysis of Bowel Habit Risk Factors for Fecal Incontinence Among Olmsted County, Minnesota, Women

Variable (N)	Odds Ratios (95% CI) for Inactive FI Versus Controls	Odds Ratios (95% CI) for Active FI Versus Controls	Odds Ratios (95%) for Active Versus Inactive FI
Rectal urgency [†]	5.6 (2.3, 13.3) [*]	11.0 (4.9, 24.6) [*]	2.0 (0.9, 4.3)
Sense of incomplete evacuation [†]	3.5 (1.4, 8.8) [*]	7.8 (3.3, 18.2) [*]	2.2 (1.1, 4.9) [*]
Daily stool frequency	1.9 (0.9, 3.9)	3.2 (1.7, 6.2) [*]	1.7 (1.0, 3.3)
Stool form	1.7 (1.0, 2.8)	2.3 (1.4, 3.7) [*]	1.3 (0.8, 2.1)

Variables indicated with

This model explained 46% of the variance between controls and FI.

^{*} $P<0.05$.

[†] were dichotomized based on the 90th percentile value for controls in the model.

Table 3

Comparison of Bowel Habits Between Incontinent and Continent Stools Among Olmsted County, Minnesota, Women With Fecal Incontinence

	Continent Bowel Movements	Incontinent Bowel Movements
Stool frequency (per day)	1.5 ± 0.1	1.3 ± 0.1 [‡]
Stool form (Bristol score)	3.2 ± 0.1	4.2 ± 0.1 [‡]
Proportion of abnormal (i.e., loose) stools	35 ± 3	62 ± 4 [‡]
Relationship of bowel habits to meals	2.0 ± 2.0	34.0 ± 3.0
Relationship of bowel habits to activity		
At rest	45.0 ± 2.5	41.5 ± 3.0
During household chores	35.9 ± 2.5	31.5 ± 3.0
Outdoors	3.5 ± 0.9	4.8 ± 1.1
At work	8.6 ± 1.6	13.4 ± 2.2 [†]
During exercise	2.7 ± 0.7	3.3 ± 0.9
While traveling	3.2 ± 0.6	4.8 ± 1.1
Events or symptoms prior to defecation		
Straining to begin	14.2 ± 2.2	6.8 ± 1.5 [‡]
Straining to end	4.6 ± 1.3	2.9 ± 1.1 [*]
Urgency	30.0 ± 2.3	57.1 ± 3.4 [‡]
Anal digitation	1.9 ± 0.7	1.6 ± 0.7
Duration for which defecation was deferred	6.7 ± 0.8	6.2 ± 0.9 [†]
Duration of defecation	3.7 ± 0.3	3.4 ± 0.2
Sense of incomplete evacuation after defecation	33.9 ± 2.9	40.5 ± 3.5

Values are mean ± SEM in percentages unless stated otherwise

^{*} $P = 0.052$

[†] $P < 0.05$

[‡] $P = 0.0001$ for tests of association between bowel habits and continence status.