Prevalence of and Factors Associated with Fecal Incontinence: Results from a Population-Based Survey

Stacy B. Menees, MD, MSCRDSA[1,2,*], **Christopher V. Almario, MD, MSHPM**[3,4,5,6,*], **Brennan M.R. Spiegel, MD, MSHS**[3,4,5,6], and **William D. Chey, MD**[1]

[1]Division of Gastroenterology, Michigan Medicine, Ann Arbor, MI

[2]Division of Gastroenterology, Department of Internal Medicine, Ann Arbor Veterans Affairs Medical Center, Ann Arbor, MI

[3]Cedars-Sinai Center for Outcomes Research and Education (CS-CORE), Los Angeles, CA

[4]Division of Digestive and Liver Diseases, Cedars-Sinai Medical Center, Los Angeles, CA

[5]Division of Health Services Research, Cedars-Sinai Medical Center, Los Angeles, CA

[6]Division of Informatics, Cedars-Sinai Medical Center, Los Angeles, CA

Abstract

Background & Aims—Fecal incontinence (FI) is characterized by uncontrolled passage of solid or liquid stool. We aimed to determine the prevalence and severity of FI in a large sample of United States (US) residents.

Methods—A representative sample of US residents were recruited in October 2015 to complete the National Gastrointestinal (GI) Survey; a mobile app called MyGiHealth was used to systematically collect data on GI symptoms. FI was defined as accidental leakage of solid or liquid

CORRESPONDENCE: William D. Chey, MD, AGAF, FACG, FACP, RFF, Timothy T. Nostrant Collegiate Professor of Gastroenterology & Nutrition Sciences, Director, GI Physiology Laboratory, Director, Digestive Disorders Nutrition & Lifestyle Program, Medical Director, Michigan Bowel Control Program, Division of Gastroenterology, Michigan Medicine, 3912 Taubman Center, SPC 5362, Ann Arbor, MI 48109-5362, Phone: 734-936-4775, wchey@umich.edu.
*These authors share first co-authorship.

stool. Severity of FI was determined by responses to the National Institutes of Health FI PROMIS questionnaire. Multivariable regression models were used to identify factors associated with FI prevalence and severity.

Results—Among 71,812 individuals who completed the National GI Survey, 14.4% reported FI in the past; of these, 33.3% had FI within the last 7 days. Older age, male sex, and Hispanic ethnicity increased the likelihood of having FI within the past week. Individuals with Crohn's disease, ulcerative colitis, celiac disease, irritable bowel syndrome, or diabetes were more likely to report FI. Non-Hispanic blacks and Hispanics and individuals with Crohn's disease, celiac disease, diabetes, HIV/AIDS, or chronic idiopathic constipation had more severe symptoms of FI than individuals without these features.

Conclusions—In a large population-based survey, 1 in 7 people reported previous FI. FI is age-related and is more prevalent among individuals with inflammatory bowel disease, celiac disease, irritable bowel syndrome, or diabetes than people without these disorders. Proactive screening for FI among these groups is warranted.

Keywords

IBS; incidence; epidemiology; risk factors

INTRODUCTION

Fecal incontinence (FI) is a disorder characterized by the uncontrolled passage of solid or liquid stool. It is a distressing problem for patients and is associated with poor quality of life and social isolation.[1–5] Patients are rarely forthcoming with their symptoms as it is embarrassing to discuss or thought by patients to be an inevitable part of aging.[6] Additionally, physicians may be less likely to inquire about FI symptoms. Dunivan et al. found a prevalence of FI in a cross-sectional survey of health maintenance organization patients of 36.2%, but only 2.7% carried a medical diagnosis.[7]

Due to different definitions and populations sampled, the prevalence of FI varies widely in the literature, ranging from 2.2% to 20.7%.[8–13] The most recent report from the U.S. National Health and Nutrition Examination Survey (NHANES) looked at the prevalence of FI from 2005-2010.[8] Ditah et al. reported an overall prevalence of 8.4% (at least one episode of FI in the last 30 days) in non-institutionalized U.S. adults aged 20 years and older, which remained stable over 5 years.[8] The authors also found a 1.1% prevalence of having at least one FI episode per week.

With our aging population, it is important to continue to understand the burden of FI as it has been shown to be more prevalent with aging.[9, 14] The U.S. Census Bureau projects that the population aged 65 to 84 years will more than double to 89 million by 2050 and the population aged 85 years and older will more than triple to 19 million by that time as well.[15] Therefore, the aim of this study was to determine the prevalence and severity of FI in a large, representative sample of community-dwelling Americans.

MATERIALS AND METHODS

Study Design, Data Source, and Study Population

To evaluate the burden of gastrointestinal (GI) illness within the U.S., our group conducted the National GI Survey in October 2015 among community-dwelling Americans.[16–18] This study was approved by the Cedars-Sinai Institutional Review Board (Pro41586).

The National GI Survey was based on *MyGiHealth*, a mobile app that systematically collects GI symptom information using a computer algorithm called AEGIS (Automated Evaluation of GI Symptoms). We describe the AEGIS algorithm in detail elsewhere.[19] Briefly, AEGIS first asked individuals which among eight GI symptoms they have recently experienced, including: (i) FI; (ii) abdominal pain; (iii) bloat/gas; (iv) diarrhea; (v) constipation; (vi) heartburn/reflux; (vii) disrupted swallowing; and (viii) nausea/vomiting. These symptoms are based on the National Institutes of Health (NIH) Patient Reported Outcomes Measurement Information System (PROMIS) framework of GI symptoms.[20–22] For each reported GI symptom, AEGIS guided patients through the corresponding GI PROMIS questionnaires to measure symptom severity as compared to population norms. Afterwards, AEGIS guided respondents through questions drawn from a library of over 300 symptom attributes measuring the timing, severity, frequency, location, quality, bother, and character of their GI symptoms, along with relevant comorbidities and demographics.

We partnered with Cint®, a survey research firm, to recruit a representative sample of Americans for the National GI Survey. Quotas for age, sex, and region of the country (Northeast, South, Midwest, and West) were in place to ensure a population-based sample. Potential respondents were sent an email through Cint research panels inviting them to complete an online survey. The email included a link to the survey along with the following templated text, which was subject to editing from individual research panels: "Based on the information stored in your [research panel] profile, we believe we have a survey that you will qualify & earn from. The survey takes approximately 15 minutes and if you successfully complete it, your account will be credited with [incentive]." Users who clicked the link were then brought to the survey home page asking them to complete a "GI Survey"; no specific mentions of FI were made on the initial screen. Participant recruitment occurred in October 2015, and all individuals 18 years old were included.

Of note, the Cint platform utilizes a reward system based on marketplace points. The number of points awarded is driven by the length of interview. On reaching a certain redemption level, panelists can redeem their rewards through different online payment partners linked to Cint. The size of the redemption is based on the number of points earned. Panelists can choose to receive their rewards in cash sent to their bank accounts or they can shop online with participating merchants or make payments to a charity. Incentive levels have been set to encourage long-term participation and to discourage professional respondents who seek to take surveys only to obtain payment.

Outcomes

While the overarching goal of the National GI Survey was to examine the distribution of all GI symptoms in the U.S., the focus of the current study was on FI, with its prevalence

serving as the primary outcome. All survey respondents were asked: "Select any symptom(s) you experienced in the past week" and "Please check any of these GI symptom(s) that you have EVER experienced." Answer options for both questions included FI (i.e., bowel incontinence [have an accident or soil underclothes]) along with the seven other GI PROMIS symptoms (abdominal pain, bloat/gas, diarrhea, constipation, heartburn/reflux, disrupted swallowing, and nausea/vomiting) and a "none of these" option. Individuals who selected FI in either question were considered to have had FI, and were guided through the questions listed in Supplement Table 1.

Our secondary outcome was FI severity, as measured by NIH PROMIS scores. As GI PROMIS employs a 7-day recall period, only those who had FI in the past week were directed through the corresponding FI PROMIS questionnaire (Supplement Table 1).[18, 23] GI PROMIS scores are reported on a percentile scale from 0 (asymptomatic) to 100 (severely symptomatic).

Covariates

Participants were asked extensively about their demographics and past medical history. Demographic information elicited on this questionnaire included age, gender, race/ethnicity, education, marital and employment status, and income level. They were also asked to identify comorbid conditions that had been "diagnosed by a doctor and can affect the gastrointestinal system," including Crohn's disease, ulcerative colitis, celiac disease, diabetes, HIV/AIDS, irritable bowel syndrome (IBS), or chronic idiopathic constipation (CIC).

Statistical Analysis

All statistical analyses were performed in Stata 13.1 (StataCorp LP, College Station, TX). We used post-stratification to adjust for over- and under-sampling of subgroups in the National GI Survey. Specifically, population weights based on latest U.S. Census data for age, sex, and race/ethnicity were applied to the sample data in order to produce population estimates.[24, 25] In Supplement Table 2 we provide the weights used in the analyses, stratified by the various age, sex, and racial/ethnic groups.

A two-tailed p-value of less than .05 was considered statistically significant. In bivariate analyses, categorical variables were compared using the chi-squared test. For multivariable analyses, we performed population-weighted (PW) regression models to adjust for potentially confounding factors and to calculate adjusted p-values and odds ratios (OR) and 95% confidence intervals (CI). These regression models were performed on our outcomes, adjusted by all demographic and medical comorbidity variables described above. We used multivariable logistic, ordinal logistic, and linear regression models for binary, ordinal, and continuous outcomes, respectively.

RESULTS

Study Cohort

Overall, 1.3 million individuals were invited to complete the National GI Survey, of whom 124,674 (9.4%) accessed the survey. Of those who accessed the survey, 71,812 (57.6%) completed the survey and were included in the study. Demographic information detailing the study cohort is listed in Table 1.

FI Prevalence Among Overall Cohort

We found that 10,033 (PW 14.4%) respondents had experienced FI, among whom 3094 (PW 33.3%) reported stool leakage within the past week. The latter individuals were actively symptomatic given that GI PROMIS identifies patients with a problem within the week of questioning. Table 2 presents findings from the regression analyses on FI prevalence. Increasing age and concomitant diarrhea and constipation were associated with increased odds for FI. We also found that those with Crohn's disease, ulcerative colitis, celiac disease, diabetes, and IBS were all more likely to report having had episodes of stool leakage. Males had increased odds for having FI within the past week, but no difference was seen between males and females regarding prevalence of prior FI experience. On the other hand, non-Hispanic blacks and Asians were 37% (95% CI 26% to 46%) and 32% (95% CI 16% to 45%) less likely, respectively, to report prior FI when compared to non-Hispanic whites.

FI Severity as Determined by PROMIS Scores for Those Who Experienced FI in the Past 7 Days

We found that 3094 individuals reported FI within the past week, and they were guided through the FI PROMIS questionnaire to determine the severity of their symptoms compared to population norms. Their responses to the individual FI PROMIS questions are shown in Supplement Table 3.

In Table 3, we present the findings from multivariable linear regression on FI PROMIS scores. Among symptomatic individuals, non-Hispanic blacks and Latinos had more severe FI when compared to non-Hispanic whites. Increasing levels of household income were also associated with higher PROMIS scores. We also found that those with concomitant diarrhea within the past week, Crohn's disease, celiac disease, diabetes, HIV/AIDS, and CIC had significantly higher FI PROMIS scores. Conversely, those with higher levels of educational attainment had lower FI severity. We found no significant associations between FI PROMIS scores and age, gender, marital status, employment status, recent constipation, ulcerative colitis, and IBS.

FI Characteristics for Those Who Ever Experienced FI

Table 4 presents the FI characteristics with stratification by gender, among those who reported ever experiencing FI (n=9327; data missing from 706). Here, PW 40.9% of respondents reported experiencing FI at least once a month. The majority of individuals (PW 59.9%) noted only a small amount of stool leakage with FI episodes, while PW 19.0% and PW 7.5% had moderate and large leakage of stool, respectively. For PW 13.6%, the amount of leakage was variable. Urgency prior to FI events was common as more than half of

respondents either usually or always had urgency. However, PW 10.1% stated that they never had a warning. Use of pads or diapers was not common, as nearly two-thirds of respondents said they never used barrier protection. More than half of individuals stated that FI did not or rarely interfered with activities; conversely PW 15.5% had significant (i.e., quite a bit or very much) interference with their daily activities related to FI. We found that prior anal injury was relatively uncommon, as only 12.0% reported such trauma.

Males reported more frequent FI episodes and accidental FI when passing gas vs. females, even after adjusting for confounding factors. We also found that FI interfered with daily activities more so for males when compared to females. Males were also more likely to report prior anus injury. On the other hand, we noted that females were more likely to have urgency prior to stool leakage events and to use barrier protection because of FI. No differences were seen in amount of stool leakage per FI event between men and women.

DISCUSSION

In the largest population-based GI survey of community-dwelling Americans, we found that FI is common. One in 7 respondents reported previously experiencing FI, while 1 in every 20 had an FI event within the past week. Additionally, this disorder interfered with daily activities in 34% of people, with men more likely to report interference with their lives when compared to women.

With over 3,000 and 10,000 individuals who had reported FI within the last week and ever experiencing FI, respectively, we have been able to identify race/ethnicity factors that were associated with increased or decreased odds of FI. Specifically, we found an increased likelihood of FI with Latinos as compared to non-Hispanic whites in those individuals who had reported FI within the past week. Only one other study has found Hispanic ethnicity to impact the prevalence of FI which is contrary to our finding.[26] In a population-based study of women between the ages of 40 to 69, Varma et al. found that Latina women were 40% less likely to have FI compared to non-Latina whites. The authors postulated that there may have been a reporting bias as Latina women in this study were actually more likely to have urinary incontinence compared to non-Latina whites. Additionally, we found that African-Americans are less likely to have ever experienced FI, and Asians also have lower odds for both reporting FI within the past week and ever experiencing FI. Compared to non-Hispanic white women in other studies, African-American women are less likely to have FI.[27–29] In other pelvic organ prolapse disorders including rectocele, cystocele and uterine prolapse, African-American women demonstrate the lowest risk for prolapse as compared to white women.[30, 31] For Asian women, our finding of a lower likelihood of FI is also congruent with the data for other pelvic floor disorders including urinary incontinence and uterine prolapse.[30, 32]

Our results also confirm prior findings of factors associated with FI prevalence. There is an age-related increase in FI within the past seven days and ever experiencing FI, with the highest prevalence in patients aged 65 years and greater. Increasing age is the most common risk factor for FI among all prevalence studies.[8, 9, 33–36] Age-related effects may be explained by a confluence of decreased mobility[37], comorbidities leading to poorer health

status[38], or thinning of the external anal sphincter.[39] Male gender is associated with a higher likelihood of experiencing FI within the past week, but is not significant in ever experiencing FI. The presumption that FI is more common in women is due to the impact of childbirth on the pelvic floor; however, we found males more likely to report FI within the past week. Other population-based studies have shown no difference between genders.[9, 36, 40] Lastly, the presence of diabetes is associated with increased risk of recent as well as prior FI. Diabetes is an established risk factor thought to be secondary to irreversible autonomic neuropathy.[41, 42] However, Russo et al. also demonstrated that acute hyperglycemia can inhibit external anal sphincter function and decrease rectal compliance.[43] Therefore, reinforcing the need for optimal blood glucose control in diabetic patients with FI is crucial as it may yield better control of symptoms.

The presence of concomitant diarrhea is the strongest risk factor for FI within the last week and ever experiencing FI. Diarrhea or loose stool is a commonly reported risk factor when queried in other FI population-based studies.[9, 14, 33, 34, 44] Constipation within the last week is also a noted risk factor for recent and prior FI. A recent Dutch population-based survey found that constipated participants were 2.7 times more likely to suffer FI than non-constipated participants (95% CI, 1.8-4.0).[45] Other GI diseases including celiac disease, Crohn's disease, ulcerative colitis, and IBS are all independent risk factors for FI in the past seven days and ever experiencing FI, even when controlled for the presence of diarrhea. The diagnosis of celiac disease is a strong risk factor for FI with 16.9% having FI within the last week and 33.7% ever experiencing FI. No other work has been done to assess FI in celiac disease. Data regarding FI among those with inflammatory bowel disease (IBD) and IBS is slightly more established. In IBD, Norton et al. demonstrated that FI affects at least 24% of a random sample of members from a national Crohn's and Colitis organization.[46] This is consistent with our data, with up to 22% of IBD patients having FI within the last week and up to 41% ever having FI. Population-based studies in women by Bharucha et al. showed a 1.9 to 4.8 increased likelihood of FI with IBS.[33, 47] Our findings are similar, as those with IBS have 1.7 and 2.1 increased odds for having FI within the past week and ever experiencing FI, respectively, compared to those without IBS. With these findings, it is important for practitioners to be proactive in screening for FI in patients with concomitant diarrhea or constipation, celiac disease, IBD, and IBS.

Few studies have looked at factors associated with FI symptom severity. Using the NIH FI PROMIS scale, we found no differences in FI symptom severity between gender or age groups. Conversely, in a study of 2800 women in Olmsted County, Bharucha et al. found age per decade to be associated with increasing symptom severity.[33] Our study is the first to find differences among racial/ethnic groups regarding FI severity, as Latinos and African-Americans have more severe symptom scores versus non-Hispanic whites. There are significant differences in FI symptom severity among those participants with co-morbid illnesses. The presence of diabetes is associated with more severe symptoms of FI. This finding corresponds to an earlier study of 231 women with FI, where the presence of diabetes (p=.004) was associated with an increase in their measure of symptom severity using the Fecal Incontinence Severity Index.[48] The most severe FI symptoms are seen among participants with HIV/AIDS, celiac disease, Crohn's disease and CIC. FI severity among these diseases are novel findings and must be corroborated with future studies.

However, our findings are reminders to be vigilant and proactive in screening patients for FI with these diseases.

In comparing FI between men and women, we found significant differences in their presentation. We found that men are more likely to report increased frequency of stool leakage episodes compared to women. This finding varies from the prior NHANES studies by Whitehead et al. and Ditah et al. where no gender difference was found for the frequency of FI. Our findings may differ by the way the data was collected. Our data was collected electronically instead of through health interviews. This process may have provided a sense of anonymity for the participant, decreasing embarrassment, thus increasing the likelihood of disclosure of FI for the participant. Men are also more likely to have accidental FI when passing gas and less likely to have urgency prior to FI when compared to women. These findings suggest gender-related differences among the etiologies causing FI. Continence is a highly integrated physiologic process that depends on the seamless functioning of a number of factors including mental function, colonic transit, stool volume and consistency, rectal compliance, anal sphincter complex function, and anorectal sensation and reflexes. Our findings suggest that men may be more likely to have abnormal sampling reflex as the contents (gas, liquid, or stool) in the rectum come into contact with the epithelial lining of the upper anal canal.[49] Whereas for women, their likelihood of having urge-related loss points to a deficit of the external anal sphincter or rectal sensation/compliance problem. Lastly, we found that men are less likely to use pads or diapers for protection and more likely to report that FI interferes with their daily activities. These findings support the theory that women may experience less interference in their lifestyle because they are willing to use absorbent products due to their history of using feminine hygiene products. Previously, men have been found to be less likely to wear an absorbent product, either due to embarrassment or unawareness.[50] Ensuring education for men about the different types of absorbent products available for FI could improve their quality of life.

This study has significant strengths and potential limitations. This study is the largest U.S. population-based study of participants with bowel incontinence. We have information on more than 71,000 participants, with over 3000 and 10,000 individuals who had reported FI within the last week and ever experiencing FI. Data from the two other U.S. population studies included 4,308 and 14,759 individuals, among whom 335 and 1238 had FI, respectively, making our study the largest of its kind.[8, 9] Another strength is the use of the NIH GI PROMIS questionnaires which were rigorously developed under NIH oversight and are a valid and reliable way to assess severity of FI.[23] One limitation of this study, may be how the data was acquired. The data for this study was acquired via an Internet-based survey, so there could be concerns about generalizability with the worries of accessibility to the Internet, particularly among elderly individuals who do not possess basic computing skills. However, data from the Pew Research Institute reports that nearly two-thirds of those 65 years old use the Internet.[51] Nursing home residents also could have been included in this survey provided they had Internet access. Nonetheless, our electronic survey may have underestimated FI prevalence with the possible exclusion of older individuals without regular access to the Internet. It may also have selected for functionality and/or independence among the older adult population, again biasing toward an under-reporting of FI prevalence. On the other hand, our description of the study as a "GI Survey" to potential

respondents may have led to overestimation of the FI prevalence. However, FI was 1 of 8 options in the GI symptom screener questions, and there is unlikely to be differential FI prevalence between survey responders and non-responders with GI symptoms. Additionally, we cannot give any detail on what type of stool consistency is associated with bowel incontinence. Lastly, our study is a cross-sectional survey, therefore we cannot determine causal associations.

In conclusion, in this large population-based survey of community-dwelling Americans, we found that FI is common, as 1 in 7 respondents reported previously experiencing FI, while 1 in every 20 had an FI event within the past week. FI is an age-related disorder and is prevalent among those with Crohn's disease, ulcerative colitis, celiac disease, IBS, diabetes, and concomitant constipation and diarrhea. Additionally, we found that those with recent diarrhea, Crohn's disease, celiac disease, diabetes, HIV/AIDS, and CIC have significantly more severe FI symptoms. Proactive screening for FI in these populations are warranted.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

ABBREVIATIONS

FI	fecal incontinence
DM	diabetes mellitus
GI	gastrointestinal
IBD	inflammatory bowel disease
IBS	irritable bowel syndrome
NHANES	National Health and Nutrition Examination Survey
NIH	National Institutes of Health
PROMIS	Patient Reported Outcomes Measurement Information System
PW	population-weighted

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TABLE 1

National GI Survey participant demographics (N=71,812)

Variable	n	Actual %	Population-weighted % [a]
Age:			
18-24 y	12,419	17.3%	14.0%
25-45 y	37,055	51.6%	40.0%
45-64 y	20,468	28.5%	30.0%
65 y	1870	2.6%	16.0%
Gender:			
Female	42,696	59.5%	51.0%
Male	29,116	40.5%	49.0%
Race/ethnicity:			
Non-Hispanic whites	50,943	70.9%	62.0%
Non-Hispanic blacks	6353	8.9%	12.0%
Latinos	8255	11.5%	18.0%
Asians	3914	5.5%	6.0%
Other	2347	3.3%	2.0%
Education level:			
Did not graduate high school	2862	4.0%	4.2%
High school graduate	15,295	21.3%	21.5%
Some college	22,282	31.0%	30.9%
College graduate	24,020	33.5%	32.7%
Graduate degree	7353	10.2%	10.7%
Marital status:			
Single	19,120	26.6%	24.5%
Divorced, separated, or widowed	8592	12.0%	16.1%
Married or long term relationship	44,100	61.4%	59.4%
Employment status:			
Unemployed	24,680	34.4%	40.3%
Employed or full-time student	47,132	65.6%	59.7%
Total household income:			
$0 to 50,000	35,725	49.8%	50.0%
$50,001 to 100,000	22,226	31.0%	30.7%
$100,001 to 200,000	7582	10.6%	10.3%
$200,001	1110	1.6%	1.7%
Prefer not to say	5169	7.2%	7.4%
Diarrhea within past week	15,976	22.3%	20.2%
Constipation within past week	15,030	20.9%	19.7%

Variable	n	Actual %	Population-weighted % [a]
Crohn's disease [b]	553	0.8%	0.8%
Ulcerative colitis [b]	627	0.9%	1.1%
Celiac disease [b]	755	1.1%	0.9%
Diabetes [b]	4508	6.3%	8.6%
HIV/AIDS [b]	233	0.3%	0.4%
Irritable bowel syndrome [b]	2958	4.1%	3.8%
Chronic idiopathic constipation [b]	276	0.4%	0.4%

[a] Population weights based on latest U.S. Census data for age, sex, and race/ethnicity were applied to the sample data in order to produce population estimates. See Supplement Table 2 for weights used in analyses.[25, 26]

[b] Self-reported physician diagnosis.

TABLE 2

Predictors of having FI within the past 7 days and having ever experienced FI among overall cohort.

Variable	FI within past 7 days (n=3094)	OR [95% CI] [a]	Ever experienced FI (n=10,033) [b]	OR [95% CI] [a]
Age:				
18-24 y	333 (2.7%)	reference	1147 (9.2%)	reference
25-45 y	1459 (4.1%)	1.36 [1.17-1.59]	5013 (13.2%)	1.29 [1.18-1.40]
45-64 y	1171 (5.6%)	2.00 [1.67-2.40]	3521 (16.1%)	1.72 [1.55-1.91]
65 y	131 (6.9%)	2.79 [1.88-4.14]	352 (18.3%)	2.18 [1.71-2.78]
Gender:				
Female	1806 (4.5%)	reference	6170 (14.8%)	reference
Male	1288 (5.1%)	1.23 [1.07-1.41]	3863 (13.9%)	1.02 [0.94-1.11]
Race/ethnicity:				
Non-Hispanic whites	2253 (4.8%)	reference	7784 (15.7%)	reference
Non-Hispanic blacks	189 (3.3%)	0.85 [0.67-1.09]	523 (9.8%)	0.63 [0.54-0.74]
Latinos	430 (6.3%)	1.42 [1.10-1.84]	1017 (15.1%)	1.00 [0.83-1.20]
Asians	122 (2.7%)	0.69 [0.55-0.88]	385 (9.6%)	0.68 [0.55-0.84]
Other	100 (5.5%)	1.22 [0.87-1.71]	324 (15.3%)	1.00 [0.83-1.20]
Education level:				
Did not graduate high school	102 (3.7%)	reference	255 (9.5%)	reference
High school graduate	663 (4.6%)	1.06 [0.76-1.46]	1822 (11.8%)	1.03 [0.79-1.34]
Some college	979 (4.8%)	0.99 [0.71-1.38]	3212 (14.8%)	1.26 [0.96-1.64]
College graduate	1033 (4.9%)	1.03 [0.72-1.48]	3568 (15.6%)	1.35 [1.02-1.79]
Graduate degree	317 (5.1%)	1.00 [0.67-1.49]	1176 (16.3%)	1.39 [1.04-1.87]
Marital status:				
Single	658 (4.0%)	reference	2152 (11.4%)	reference
Divorced, separated, or widowed	520 (6.4%)	1.12 [0.82-1.52]	1512 (17.7%)	1.19 [1.01-1.40]
Married or long term relationship	1916 (4.7%)	0.85 [0.68-1.06]	6369 (14.7%)	0.95 [0.86-1.06]
Employment status:				
Unemployed	1221 (5.5%)	reference	3731 (15.7%)	reference
Employed or full-time student	1873 (4.3%)	0.90 [0.74-1.08]	6302 (13.4%)	0.89 [0.80-0.99]
Total household income:				
$0 to 50,000	1586 (4.8%)	reference	4880 (13.8%)	reference
$50,001 to 100,000	971 (4.8%)	0.97 [0.83-1.14]	3358 (15.6%)	1.05 [0.95-1.16]
$100,001 to 200,000	390 (5.4%)	1.14 [0.95-1.38]	1248 (16.7%)	1.18 [1.05-1.32]
$200,001	52 (9.3%)	2.28 [1.04-4.99]	154 (17.7%)	1.34 [0.85-2.11]
Prefer not to say	95 (2.5%)	0.59 [0.30-1.15]	393 (8.8%)	0.72 [0.55-0.94]
Diarrhea within past week:				
No	1206 (2.7%)	reference	4912 (9.4%)	reference

Variable	FI within past 7 days (n=3094)	OR [95% CI] [a]	Ever experienced FI (n=10,033) [b]	OR [95% CI] [a]
Yes	1888 (13.1%)	5.14 [4.53-5.83]	5121 (33.8%)	4.46 [4.12-4.82]
Constipation within past week:				
No	1925 (4.0%)	reference	6695 (12.3%)	reference
Yes	1169 (8.1%)	1.66 [1.47-1.88]	3338 (22.8%)	1.66 [1.51-1.83]
Crohn's disease [c]:				
No	2969 (4.7%)	reference	9802 (14.2%)	reference
Yes	125 (22.1%)	3.16 [2.20-4.55]	231 (41.2%)	2.63 [1.95-3.54]
Ulcerative colitis [c]:				
No	2995 (4.6%)	reference	9791 (14.1%)	reference
Yes	99 (17.9%)	2.51 [1.08-5.86]	242 (37.0%)	2.44 [1.42-4.20]
Celiac disease [c]:				
No	2982 (4.7%)	reference	9782 (14.2%)	reference
Yes	112 (16.9%)	3.47 [2.50-4.83]	251 (33.7%)	2.84 [2.19-3.69]
Diabetes [c]:				
No	2640 (4.3%)	reference	8938 (13.5%)	reference
Yes	454 (9.4%)	1.49 [1.16-1.92]	1095 (23.3%)	1.45 [1.23-1.70]
HIV/AIDS [c]:				
No	3066 (4.8%)	reference	9967 (14.3%)	reference
Yes	28 (9.7%)	1.05 [0.42-2.66]	66 (23.8%)	1.55 [0.86-2.80]
Irritable bowel syndrome [c]:				
No	2680 (4.4%)	reference	8953 (13.3%)	reference
Yes	414 (14.8%)	1.73 [1.39-2.14]	1080 (40.1%)	2.14 [1.69-2.71]
Chronic idiopathic constipation [c]:				
No	3049 (4.7%)	reference	9952 (14.3%)	reference
Yes	45 (18.2%)	1.98 [0.84-4.66]	81 (30.2%)	1.20 [0.63-2.28]

Data are presented an n (population-weighted %).

CI, confidence interval; FI, fecal incontinence; OR, odds ratio.

[a] The survey-weighted logistic regression model included all variables listed in the table above.

[b] Either had FI in the past 7 days or had previously experienced FI in the past.

[c] Self-reported physician diagnosis.

TABLE 3

Factors associated with FI severity for subjects who had FI in the past 7 days by multivariable linear regression.

Variable	FI PROMIS Score (0-100 scale)	P value [a]
Age:		
18-24 y	54.6 [51.3-57.9]	reference
25-45 y	56.8 [55.3-58.3]	.47
45-64 y	53.0 [51.2-54.8]	.19
65 y	49.5 [44.6-54.4]	.05
Gender:		
Female	53.3 [51.9-54.8]	reference
Male	55.3 [53.4-57.2]	.26
Race/ethnicity:		
Non-Hispanic whites	52.9 [51.6-54.2]	reference
Non-Hispanic blacks	56.1 [52.7-59.6]	.03
Latinos	58.6 [54.9-62.3]	.02
Asians	52.2 [46.7-57.6]	.50
Other	56.5 [52.0-61.0]	.23
Education level:		
Did not graduate high school	63.0 [56.8-69.3]	reference
High school graduate	53.7 [51.4-56.0]	.03
Some college	51.5 [49.4-53.6]	.005
College graduate	55.1 [53.0-57.2]	.02
Graduate degree	58.6 [54.9-62.4]	.21
Marital status:		
Single	54.7 [51.2-57.2]	Reference
Divorced, separated, or widowed	54.5 [52.0-57.0]	.26
Married or long term relationship	54.1 [52.6-55.6]	.42
Employment status:		
Unemployed	53.9 [52.1-55.8]	reference
Employed or full-time student	54.6 [53.0-56.1]	.14
Total household income:		
$0 to 50,000	52.7 [51.2-54.2]	reference
$50,001 to 100,000	55.4 [53.3-57.5]	.02
$100,001 to 200,000	58.6 [55.5-61.7]	.002
$200,001	64.1 [53.6-74.7]	.06
Prefer not to say	45.9 [36.9-54.9]	.12
Diarrhea within past week:		

Variable	FI PROMIS Score (0-100 scale)	P value [a]
No	52.2 [50.2-54.2]	reference
Yes	55.9 [54.5-57.3]	<.001
Constipation within past week:		
No	54.2 [52.7-55.6]	reference
Yes	54.6 [52.6-56.5]	.59
Crohn's disease [c]:		
No	53.8 [52.6-55.0]	reference
Yes	68.5 [63.6-73.4]	<.001
Ulcerative colitis [c]:		
No	54.1 [53.0-55.3]	reference
Yes	59.5 [49.0-70.0]	.56
Celiac disease [c]:		
No	53.6 [52.4-54.8]	reference
Yes	72.2 [67.7-76.7]	<.001
Diabetes [c]:		
No	53.8 [52.6-55.1]	reference
Yes	56.9 [53.6-60.2]	.04
HIV/AIDS [c]:		
No	54.1 [52.9-55.3]	reference
Yes	76.8 [70.5-83.1]	.001
Irritable bowel syndrome [c]:		
No	54.3 [53.1-55.6]	reference
Yes	54.0 [50.9-57.1]	.61
Chronic idiopathic constipation [c]:		
No	54.1 [52.9-55.3]	reference
Yes	68.8 [62.1-75.4]	<.001

Data are presented as survey-weighted mean [95% CI].

CI, confidence interval; FI, fecal incontinence; PROMIS, Patient Reported Outcome Measurement Information System" as abbreviations in the footer.

[a]The survey-weighted linear regression model included all variables listed in the table above.

[b]Self-reported physician diagnosis.

TABLE 4

FI characteristics among those who ever experienced FI and stratification by gender.

Variable	Overall (n=9327) [a]	Female (n=5844)	Male (n=3483)	Ordinal OR [95% CI] [b]
FI frequency:				1.25 [1.11-1.41]
Less than once per month	5743 (59.1%)	3747 (61.9%)	1996 (56.2%)	
Once a month	1043 (11.2%)	596 (10.1%)	447 (12.4%)	
2-3x per month	1275 (15.4%)	744 (14.6%)	531 (16.2%)	
Once a week	466 (5.6%)	256 (4.8%)	210 (6.4%)	
More than once per week	597 (6.3%)	391 (6.7%)	206 (5.9%)	
Daily	203 (2.4%)	110 (2.0%)	93 (2.8%)	
Amount of stool leakage:				0.99 [0.87-1.12]
Small	5825 (59.9%)	3752 (60.2%)	2073 (59.7%)	
Moderate	1701 (19.0%)	988 (18.3%)	713 (19.8%)	
Large	572 (7.5%)	289 (6.1%)	283 (9.0%)	
Variable	1229 (13.6%)	815 (15.5%)	414 (11.6%)	
Urgency prior to FI events:				0.71 [0.63-0.79]
Never	970 (10.1%)	591 (9.9%)	379 (10.3%)	
Rarely	1828 (21.6%)	1029 (18.4%)	799 (24.9%)	
Sometimes	1421 (15.7%)	801 (14.0%)	620 (17.5%)	
Usually	2551 (25.4%)	1680 (27.6%)	871 (23.1%)	
Always	2557 (27.2%)	1743 (30.2%)	814 (24.2%)	
Accidental FI when passing gas:				1.29 [1.16-1.43]
Never	1029 (10.9%)	739 (13.4%)	290 (8.3%)	
Rarely	3732 (38.4%)	2343 (37.2%)	1389 (39.5%)	
Sometimes	3433 (38.0%)	2101 (37.4%)	1332 (38.7%)	
Usually	883 (10.0%)	508 (9.5%)	375 (10.5%)	
Always	250 (2.7%)	153 (2.5%)	97 (3.0%)	
Pad or diaper use:				0.74 [0.65-0.85]
Never	6106 (63.0%)	3744 (60.0%)	2362 (66.1%)	
Rarely	1107 (11.7%)	745 (12.2%)	362 (11.2%)	
Sometimes	1185 (14.6%)	742 (15.7%)	443 (13.4%)	
Usually	492 (6.2%)	298 (6.4%)	194 (6.1%)	
Always	437 (4.5%)	315 (5.7%)	122 (3.3%)	
FI interference with daily activities:				1.26 [1.11-1.42]
Not at all	3604 (37.1%)	2375 (39.3%)	1229 (34.9%)	
A little bit	2737 (28.9%)	1656 (26.8%)	1081 (31.0%)	
Somewhat	1619 (18.6%)	976 (18.9%)	643 (18.1%)	
Quite a bit	855 (9.8%)	514 (9.5%)	341 (10.0%)	

Variable	Overall (n=9327) [a]	Female (n=5844)	Male (n=3483)	Ordinal OR [95% CI] [b]
Very much	512 (5.7%)	323 (5.5%)	189 (6.0%)	
Prior anus injury:				1.53 [1.30-1.80]
No	7958 (84.1%)	5095 (86.7%)	2863 (81.4%)	
Yes	1023 (12.0%)	557 (9.9%)	466 (14.2%)	
Unsure	346 (3.9%)	192 (3.5%)	154 (4.4%)	

Data are presented an n (population-weighted %).

CI, confidence interval; FI, fecal incontinence; OR, odds ratio.

[a] Of the 10,033 who previously experienced FI, data were missing from 706 individuals.

[b] Females served as the reference group. The survey-weighted ordinal logistic regression model adjusted for age, gender, race/ethnicity, education level, marital status, employment status, household income, diarrhea within past week, constipation within past week, and presence of Crohn's disease, ulcerative colitis, celiac disease, diabetes, HIV/AIDS, irritable bowel syndrome, and chronic idiopathic constipation.