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Fecal Incontinence in U.S. Adults: Epidemiology and Risk Factors

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For the Pelvic Floor Disorders Network

Abstract

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Background & Aims—The study aims were to estimate the prevalence of different types and frequencies of fecal incontinence (FI), describe demographic factors, and identify risk factors.

Methods—The National Health and Nutrition Examination Survey (NHANES) assesses health status in the civilian non-institutionalized U.S. population. The validated Fecal Incontinence Severity Index was added to NHANES in 2005-2006. Participants were 2,229 women and 2,079 men aged 20 or older. FI was defined as accidental leakage of solid, liquid or mucus at least once in the preceding month. Sampling weights were used to obtain prevalence estimates for the national population. Multivariate logistic regression identified independent risk factors.

Results—The estimated prevalence of FI in non-institutionalized U.S. adults is 8.3% (CI 7.1, 9.5) and consists of liquid stool in 6.2%, solid stool in 1.6%, and mucus in 3.1%. It occurs at least weekly in 2.7%. Prevalence is similar in women (8.9%) and men (7.7%), and increases with age from 2.6% in 20-29 year-olds up to 15.3% in participants aged 70 and over. FI is not significantly associated with race/ethnicity, education, income, or marital status after adjusting for age. Independent risk factors in women are advancing age, loose or watery stools, more than 21 stools per week, multiple chronic illnesses, and urinary incontinence. Independent risk factors in men are age, loose or watery stools, poor self-rated health, and urinary incontinence.

Conclusions—FI is a prevalent, age-related disorder. Chronic diarrhea is a strong modifiable risk factor which may form the basis for prevention and treatment.

Introduction

Fecal incontinence (FI) can have a devastating impact on quality of life[1, 2]; its effects may include embarrassment, social isolation, and even loss of employment[3]. It is believed to be a frequent cause of referral to a nursing home[4]. However, patients with FI often do not report this to their health care providers[5], and the prevalence of FI is poorly documented.

Fecal incontinence is commonly defined as the involuntary loss of solid or liquid feces or mucus[6] and definitions can include consistency of stool and frequency of occurrence. Data on national rates of FI and anal incontinence are currently limited by variability in definitions, lack of inclusion of a wide range of age groups, and under-representation of minorities.

In order to obtain national prevalence estimates for FI, the Pelvic Floor Disorders Network submitted a validated FI severity scale for inclusion in the National Health and Nutrition Examination Survey (NHANES) 2005-06. In a prior publication[7] we reported the overall prevalence of FI and its association with age, race, education, family income, and body mass index in adult women. However, the previous report was limited: it did not include data on men or compare the sexes; did not address important risk factors such as usual stool consistency, physical activity, and health status; and did not apply multivariate regression to distinguish “true” risk factors from associations that may be due to correlations among variables. The previous report also did not report on the prevalence of different types (mucus, solid, liquid) or frequencies of FI, which may have different impacts on quality of life. The objective of this study were to provide a comprehensive description of FI in adult men as well as women and to describe demographic and other risk factors associated with FI after multivariate adjustment.

Methods

The NHANES program consists of annual cross-sectional, national health surveys conducted by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention. Demographic, socioeconomic, and health interview data are collected in the home followed by physical examinations, interviews, and laboratory assessments in mobile examination centers (MEC). Questions on topics considered to be sensitive for the participant,

such as fecal incontinence, are administered by an interviewer in a private room in the MEC. The NHANES 2005-06 over-sampled persons 60 years of age and older, blacks, Mexican Americans, and low-income white persons to provide more reliable estimates for these groups. The NCHS Ethics Review Board approved the survey protocols and informed consent was obtained from all participants.

The Bowel Health questionnaire includes questions from the Fecal Incontinence Severity Index[8], which asks about the frequency of accidental bowel leakage during the last month separately for gas, mucus, liquid, and solid stool. Frequency is assessed as 2 or more times a day, once a day, 2 or more times a week, once a week, 1 to 3 times a month, or never. For this study, FI was defined as any involuntary loss of mucus, liquid, or solid stool during the last 30 days; this definition of FI does not include gas. The Bowel Health questionnaire also asked survey participants how often they usually have bowel movements. For data analysis, their responses were merged into 3 ranges: <3/week, 3-21/week, and >21/week.

The validated Bristol Stool Scale[9] was used to determine the participant's usual stool consistency. This scale consists of 7 descriptions of stool characteristics and includes pictures of each stool type to aid participants in classifying their stools (http://www.cdc.gov/nchs/data/nhanes/nhanes_05_06/MECCAPI_handcards_0506.pdf) The Bristol Stool Scale may be used to classify individual bowel movements[10] or to describe typical stool consistency[11]. For the NHANES survey, participants were asked, "What is your usual or most common stool type?" Judgments of usual stool consistency have been shown to correlate r=0.57 with objective measures of whole gut transit time[12]. For this study, we pooled stool type ratings 1 and 2 (hard and lumpy), ratings 3-5 (normal consistencies), and ratings 6 and 7 (mushy and watery).

Age was categorized as 20 to 29 years, 30 to 39 years, 40 to 54 years, 55 to 69 years, and 70 years and older. Based on self-reported information, participants were classified into Mexican American and other Hispanic, non-Hispanic white, non-Hispanic black, and other race/ethnicity groups. Marital status was classified as widowed, separated, or divorced; married or cohabitating with a partner; and never married. Education was defined as having less than a high school education, a high school diploma (including GED), or additional education beyond high school. Income was represented by the Poverty Income Ratio (PIR), which varies by family size and composition (www.census.gov/hhes/www/poverty/definitions.html#ratio). For this study, participants were classified as at or above the poverty threshold versus below the threshold. The body mass index (BMI) was calculated as measured weight (kg)/ height (m^2); overweight was defined by a BMI of 25.0-29.9, and obesity was defined by a BMI ≥30. Vigorous physical activity was defined as activity done for at least 10 minutes in the last 30 days causing heavy sweating or large increases in breathing or heart rate; moderate physical activity was defined as activity done for at least 10 minutes causing only light sweating or a slight to moderate increase in breathing or heart rate. Pregnancy status was assessed by participant self-report and/or a urine pregnancy test.

Diabetes mellitus was defined as a positive response to any of three questions: (a) "Have you ever been told by a doctor or other health professional that you have diabetes or sugar diabetes?" (b) "Are you now taking insulin?" (c) "Are you now taking diabetic pills to lower your blood sugar?" Chronic illnesses were ascertained by 10 separate questions of the form: "Have you ever been told by a doctor that you have [Arthritis/ Congestive heart failure/ Coronary heart disease/ Angina or angina pectoris/ Heart attack/ Stroke/ Emphysema/ Chronic bronchitis/ Any liver condition/ Cancer or malignancy]?" The cumulative number of positive responses to these 10 questions was divided into three categories: 0, 1, and 2 or more. Self-described general health status was defined by the question "Would you say that in general your health is excellent, very good, good, fair, or poor?" Responses to this question were

aggregated into two ranges: excellent, very good, or good health status versus fair or poor health.

Urinary incontinence (UI) was assessed using the Incontinence Severity Index[13,14], which consists of two questions: "How often do you have urinary leakage? Would you say never, less than once a month, a few times a month, a few times a week, or every day and/or night?" (responses coded 1-5) and "How much urine do you lose each time? Would you say drops, small splashes, or more?" (responses coded 1-3). This questionnaire is scored by multiplying responses to the two questions, and scores of 3 or greater are classified as at least moderately severe UI[14, 15]. In this study, urinary incontinence was defined as a score of at least 3.

Data for adults 20 years of age and older from the NHANES 2005-06 were used in the analysis. SAS Survey Procedures (Research Triangle Institute, Research Triangle Park, North Carolina) was used to calculate all prevalence estimates and 95% confidence intervals of the estimates, incorporating the design effect, appropriate sample weights, stratification, and clustering of the complex NHANES sample design. The examination sample weights adjust for unequal probabilities of selection and non-response, and are post-stratified to population control totals for each sampling subdomain. Prevalence estimates (percents) for the national population and 95% confidence intervals are reported separately for women, men, and both women and men combined. Estimates with relative standard errors greater than 30% are identified as statistically unreliable.

The Wald Chi-square test was used to test the association between measures of FI and each demographic and other risk factor individually. Logistic regression was used to adjust for the potential confounding effect of age. All risk factors found to be significantly associated with FI in age-adjusted bivariate analyses were combined into multivariate logistic regression models which were executed separately for women and men. Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) are used to describe associations between risk factors and FI in bivariate analyses (adjusted for age) and in multivariate analyses (adjusted for all covariates). Comparisons are considered significant if $p < 0.05$.

Results

The household interview was completed by 4,773 (71.0%) of the 6,719 adults aged 20 years and older who were selected to participate in the NHANES 2005-06. Of these, 465 (9.7%) did not complete the MEC health examination components which included the Bowel Health questionnaire; however, no subjects declined to complete only the questions on FI. The 2,079 males and 2,229 females who completed the Bowel Health questionnaire provided the data for this study. The demographics of the sample are described in Table 1. All age groups were well represented. Hispanics constituted 23.0% and non-Hispanic blacks were 22.1% of the sample.

An estimated 8.3% (CI 7.1, 9.5) of non-institutionalized adults in the United States report FI at least once during the last 30 days; this estimate corresponds to 18 million people as of April 1 to July 1, 2006. FI was found to be equally common in women (8.9%; CI 7.2, 10.5) and men (7.7%; CI 6.0, 9.4; p=0.31).

Liquid stool incontinence was the most common type of FI as shown in Table 2 and was reported equally often by women and men (p=0.69). Solid stool incontinence was more likely to be reported by women than by men (p=0.038). Incontinence of more than one consistency was reported by 26.1% (CI 21.1, 31.0) of participants with FI.

Most participants with FI reported that it occurred one to three times per month (Table 2). However, 2.8% (CI 1.9, 3.7) of women and 2.6% (CI 1.7, 3.4) of men had FI at least once a

week. A frequency of one or more FI episodes per day was reported by 0.9% (CI 0.6, 1.2) or 90 people out of a thousand.

The NHANES provided an opportunity to assess how prevalence estimates would be affected by including accidental loss of gas in the definition, which would correspond to the definition of anal incontinence[16]. Leakage of gas at least once in the last month was reported by 51.0% (CI: 45.7, 56.3) of women and 46.2% (CI: 42.4, 49.9) of men, and daily leakage of gas was reported by 20.5% (CI: 17.6, 23.4) of women and 24.0% (CI: 20.7, 27.3) of men.

As shown in Figure 1, there was a linear progression in the prevalence of FI with age for both women and men ($p<0.01$ for both). For women and men combined, prevalence increased from 2.6% (CI 1.5, 3.8) at 20-29 years of age up to 15.3% (CI 11.5, 19.0) in participants aged 70 and over. However, FI was not significantly associated with race/ethnicity, marital status, education, or family income for women or men after adjusting for age (data not shown).

Table 3 lists candidate risk factors that were significantly associated with FI in either women or men when tested individually; associations are expressed as age-adjusted odds ratios and 95% confidence intervals. This table also shows the final multivariate models for women and men. Supplemental tables S1 and S2 (see journal website) provide estimates of the prevalence of FI by all risk factors considered in this study.

Participants who reported that their bowel movements were usually mushy or watery were substantially more likely to report FI compared to participants with normal stool consistency (Figure 2) even after multivariate adjustment for other risk factors. For women, the findings for stool frequency paralleled those for stool consistency: having more than 21 bowel movements per week was significant in the final model. However, after multivariate adjustment this relationship did not hold for men.

The inability to engage in physical activity was significantly associated with FI in women but not men (Table 3). In the bivariate analyses, engaging in vigorous physical activity appeared to be protective in women, but this association did not survive multivariate adjustment. Similarly, in bivariate analyses obesity (BMI ≥ 30) was associated with a higher prevalence of FI compared to normal or low weight (BMI <25) in women, but this association was no longer significant after multivariate adjustment.

Women with chronic illnesses were at increased risk of FI, but this association was not significant for men. However, in men (but not women) self-reported poor health was significantly associated with FI.

In women, the prevalence of FI increased with increasing numbers of vaginal deliveries from 5.9% (CI 3.2, 8.6) in women with no vaginal deliveries to 15.1% (CI 11.9, 18.3) in women with 4 or more vaginal deliveries ($p<0.0001$; Supplemental Table S2). However, number of vaginal deliveries was no longer significantly associated with FI after adjustment for age ($p=0.09$) and other risk factors ($p=0.57$).

FI was significantly associated with UI in men; for women, the bivariate association between UI and FI was significant, but after multivariate adjustment, this association was no longer significant in women ($p=0.054$; see Table 3). Both UI and FI were reported by 2.7% (CI 1.9, 3.6) of women and 1.1% (CI 0.7, 1.5) of men in the non-institutionalized population. The overall prevalence of UI and FI occurring together (women and men combined) was 1.9% (CI 1.5, 2.4).

Discussion

Efforts to develop prevention and treatment strategies for FI have been hampered by lack of reliable information on its prevalence and characteristics[17]. This study of a nationally representative sample of U.S. adults shows that FI at least once in the last month is very common, affecting 8.3% of non-institutionalized adults. FI occurs at least weekly in 2.7% (CI 2.1, 3.2) of the population and is a daily occurrence in 0.9%. The most common type of FI consists of the loss of liquid stools, followed by loss of mucus. Incontinence for solid stool at least once in the past month is reported by 1.6% of the population.

This study has limitations. First, prevalence estimates were limited to non-institutionalized individuals, and because the prevalence of FI is higher in nursing homes than in the community, the overall prevalence of FI is likely underestimated, especially among older participants. Secondly, the volume of stool lost, in addition to the frequency and type of stool lost, may influence the impact of FI on quality of life[18], and volume of incontinence was not assessed. Finally, some possible risk factors of FI such as hemorrhoids and rectal prolapse were not assessed.

FI is frequently reported to be more common in the elderly[19, 20], and this is often attributed to the confounding of age with poorer health status and with other risk factors such as mobility restriction. This survey confirms a strong association between FI and age, with the prevalence of FI increasing from 2.6% at ages 20-30 years up to 15.3% in people aged 70 or older. However, this effect of aging does not appear to be explained by poorer health in older participants: multivariate regression analysis showed age to be a strong predictor of FI after adjusting for the number of chronic illnesses, overall health status, and physical activity level. The mechanisms that could explain this effect of age on the prevalence of FI are unknown.

Women were found in some prior studies[21, 22] to have a higher prevalence of FI than men, and the speculation has been that sex differences occur because obstetrical injuries are a major risk factor for FI. However, in this survey of the whole adult lifespan, there was no significant difference in the prevalence of FI between women and men. In univariate analysis the number of vaginal deliveries was associated with increased prevalence of FI in women, but after adjustment for age and other risk factors, number of vaginal deliveries was not found to be a significant independent predictor of FI. Other studies which included a broad range of ages[23-25] have also failed to find a sex difference in FI prevalence or an effect of obstetrical injury[26]. This suggests that obstetrical injuries, while important because they are potentially preventable, are not the most common causes of FI in women. In addition, even though there have been some reports of differential rates of obstetric injuries by racial/ethnic group, no differences in rates of FI by race were noted here.

An aim of this study was to identify modifiable risk factors which can be incorporated into prevention or treatment strategies. Our data confirm previous reports of an association between FI and diarrhea[27, 28] and suggest that treating diarrhea may be an effective method for treating or preventing FI. There are studies showing that the treatment of diarrhea-associated FI with loperamide[29] or fiber supplements[30] is effective at least short-term, although more research to identify long term effective treatments is needed.

Previous authors have reported an association between poor overall health and FI[31, 32]. The number of chronic illnesses and self-described health status are correlated, and in multivariate regression analyses which adjust for this correlation, the number of chronic illnesses was found to be significantly associated with FI in women, while in men it was self-reported poor or fair health status that was a significant predictor of FI.

Urinary incontinence was significantly associated with FI, as others have shown[33,34]. The association is believed to be related to the common innervation of both the external anal and external urethral sphincters by sacral nerves, the interactions between afferents from the rectum and bladder at the level of the spinal cord[35], and the exposure of the rectum and bladder to the same traumas because both are located close together in the pelvis.

This study provides robust estimates of the prevalence of FI through the use of a nationally representative survey of the U.S. population. We have shown that incontinence for solid or liquid stool or mucus affects about 18 million non-institutionalized adults in the U.S. throughout the adult lifespan. This study also confirms that the regular occurrence of mushy or watery stools is a strong risk factor for FI and suggests that the detection and treatment of diarrhea may be an effective method for reducing the prevalence and severity of FI.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Reference List

1. Handa VL, Zyczynski HM, Burgio KL, Fitzgerald MP, Borello-France D, Janz NK, Fine PM, Whitehead W, Brown MB, Weber AM. The impact of fecal and urinary incontinence on quality of life 6 months after childbirth. Am J Obstet Gynecol 2007;197:636. [PubMed: 18060960]
2. Bharucha AE, Zinsmeister AR, Locke GR, Seide BM, McKeon K, Schleck CD, Melton LJ. Prevalence and burden of fecal incontinence: a population-based study in women. Gastroenterol 2005;129:42–49.
3. Norton NJ. The perspective of the patient. Gastroenterol 2004;126:S175–S179.
4. Cheskin, LJ.; Schuster, MM. Fecal incontinence. In: Hazzard, WR.; Andres, R.; Bierman, EL.; Blass, JP., editors. Principles of Geriatric Medicine and Gerontology. Vol. 2. New York: McGraw Hill; 1990. p. 1143-1145.
5. Whitehead WE. Diagnosing and managing fecal incontinence: if you don't ask, they won't tell. Gastroenterol 2005;129:6.
6. Bharucha AE, Wald A, Enck P, Rao S. Functional anorectal disorders. Gastroenterol 2006;130:1510–1518.
7. Nygaard I, Barber MD, Burgio KL, Kenton K, Meikle S, Schaffer J, Spino C, Whitehead WE, Wu J, Brody DJ. Prevalence of symptomatic pelvic floor disorders in US women 3. JAMA 2008;300:1311–1316. [PubMed: 18799443]
8. Rockwood TH, Church JM, Fleshman JW, Kane RL, Mavrantonis C, Thorson AG, Wexner SD, Bliss D, Lowry AC. Patient and surgeon ranking of the severity of symptoms associated with fecal incontinence: the fecal incontinence severity index. Dis Colon Rectum 1999;42:1525–1532. [PubMed: 10613469]
9. Lewis SJ, Heaton KW. Stool form scale as a useful guide to intestinal transit time. Scandinavian Journal of Gastroenterology 1997;32:920–924. [PubMed: 9299672]
10. Degen LP, Phillips SF. How well does stool form reflect colonic transit? GUT 1996;39:109–113. [PubMed: 8881820]
11. Heaton KW, O'Donnell LJ. An office guide to whole-gut transit time. Patients' recollection of their stool form. J Clin Gastroenterol 1994;19:28–30. [PubMed: 7930429]

12. Heaton KW, O'Donnell LJ. An office guide to whole-gut transit time. Patients' recollection of their stool form. J Clin Gastroenterol 1994;19:28–30. [PubMed: 7930429]
13. Sandvik H, Espuna M, Hunskaar S. Validity of the incontinence severity index: comparison with pad-weighing tests. Int Urogynecol J Pelvic Floor Dysfunct 2006;17:520–524. [PubMed: 16547687]
14. Sandvik H, Seim A, Vanvik A, Hunskaar S. A severity index for epidemiological surveys of female urinary incontinence: comparison with 48-hour pad-weighing tests. Neurourol Urodyn 2000;19:137–145. [PubMed: 10679830]
15. Sandvik H, Espuna M, Hunskaar S. Validity of the incontinence severity index: comparison with pad-weighing tests. Int Urogynecol J Pelvic Floor Dysfunct 2006;17:520–524. [PubMed: 16547687]
16. Norton, C.; Christiansen, J.; Butler, U.; Harari, D.; Nelson, R.; Pemberton, JH., et al. Anal Incontinence. In: Abrams, P.; Cardozo, L.; Khoury, S.; Wein, A., editors. Incontinence. Volume 2 -- Management. Vol. 2002. Plymouth: Health Books; 2002.
17. Landefeld CS, Bowers BJ, Feld AD, Hartmann KE, Hoffman E, Ingber MJ, King JT Jr, McDougal WS, Nelson H, Orav EJ, Pignone M, Richardson LH, Rohrbaugh RM, Siebens HC, Trock BJ. National Institutes of Health State-of-the-Science Statement: Prevention of Fecal and Urinary Incontinence in Adults. Ann Intern Med. 2008
18. Bharucha AE, Zinsmeister AR, Locke GR, Schleck C, McKeon K, Melton LJ. Symptoms and quality of life in community women with fecal incontinence. Clin Gastroenterol Hepatol 2006;4:1004–1009. [PubMed: 16630766]
19. Melville JL, Fan MY, Newton K, Fenner D. Fecal incontinence in US women: a population-based study. Am J Obstet Gynecol 2005;193:2071–2076. [PubMed: 16325618]
20. MacLennan AH, Taylor AW, Wilson DH, Wilson D. The prevalence of pelvic floor disorders and their relationship to gender, age, parity and mode of delivery. BJOG 2000;107:1460–1470. [PubMed: 11192101]
21. MacLennan AH, Taylor AW, Wilson DH, Wilson D. The prevalence of pelvic floor disorders and their relationship to gender, age, parity and mode of delivery. BJOG 2000;107:1460–1470. [PubMed: 11192101]
22. Nelson R, Norton N, Cautley E, Furner S. Community-based prevalence of anal incontinence. JAMA 1995;274:559–561. [PubMed: 7629985]
23. Perry S, Shaw C, McGrother C, Matthews RJ, Assassa RP, Dallosso H, Williams K, Brittain KR, Azam U, Clarke M, Jagger C, Mayne C, Castleden CM. Prevalence of faecal incontinence in adults aged 40 years or more living in the community. GUT 2002;50:480–484. [PubMed: 11889066]
24. Nakanishi N, Tatara K, Nakajima K, Takabayashi H, Takahashi S, Naramura H, Ikeda K. Urinary and fecal incontinence in a community-residing elderly population: prevalence, correlates and prognosis. Nippon Koshu Eisei Zasshi 1997;44:192–200. [PubMed: 9175410]
25. Kalantar JS, Howell S, Talley NJ. Prevalence of faecal incontinence and associated risk factors; an underdiagnosed problem in the Australian community? Med J Aust 2002;176:54–57. [PubMed: 11936284]
26. Bharucha AE, Zinsmeister AR, Locke GR, Seide BM, McKeon K, Schleck CD, Melton LJ III. Risk factors for fecal incontinence: a population-based study in women. Am J Gastroenterol 2006;101:1305–1312. [PubMed: 16771954]
27. Goode PS, Burgio KL, Halli AD, Jones RW, Richter HE, Redden DT, Baker PS, Allman RM. Prevalence and correlates of fecal incontinence in community-dwelling older adults. J Am Geriatr Soc 2005;53:629–635. [PubMed: 15817009]
28. Kalantar JS, Howell S, Talley NJ. Prevalence of faecal incontinence and associated risk factors; an underdiagnosed problem in the Australian community? Med J Aust 2002;176:54–57. [PubMed: 11936284]
29. Palmer KR, Corbett CL, Holdsworth CD. Double-blind cross-over study comparing loperamide, codeine and diphenoxylate in the treatment of chronic diarrhea. Gastroenterol 1980;79:1272–1275.
30. Bliss DZ, Jung HJ, Savik K, Lowry A, LeMoine M, Jensen L, Werner C, Schaffer K. Supplementation with dietary fiber improves fecal incontinence. Nurs Res 2001;50:203–213. [PubMed: 11480529]
31. Goode PS, Burgio KL, Halli AD, Jones RW, Richter HE, Redden DT, Baker PS, Allman RM. Prevalence and correlates of fecal incontinence in community-dwelling older adults. J Am Geriatr Soc 2005;53:629–635. [PubMed: 15817009]

32. Nakanishi N, Tatara K, Shinsho F, Murakami S, Takatorige T, Fukuda H, Nakajima K, Naramura H. Mortality in relation to urinary and faecal incontinence in elderly people living at home. Age Ageing 1999;28:301–306. [PubMed: 10475868]

33. Goode PS, Burgio KL, Halli AD, Jones RW, Richter HE, Redden DT, Baker PS, Allman RM. Prevalence and correlates of fecal incontinence in community-dwelling older adults. J Am Geriatr Soc 2005;53:629–635. [PubMed: 15817009]

34. Melville JL, Fan MY, Newton K, Fenner D. Fecal incontinence in US women: a population-based study. Am J Obstet Gynecol 2005;193:2071–2076. [PubMed: 16325618]

35. Pezzone MA, Liang R, Fraser MO. A model of neural cross-talk and irritation in the pelvis: implications for the overlap of chronic pelvic pain disorders. Gastroenterol 2005;128:1953–1964.

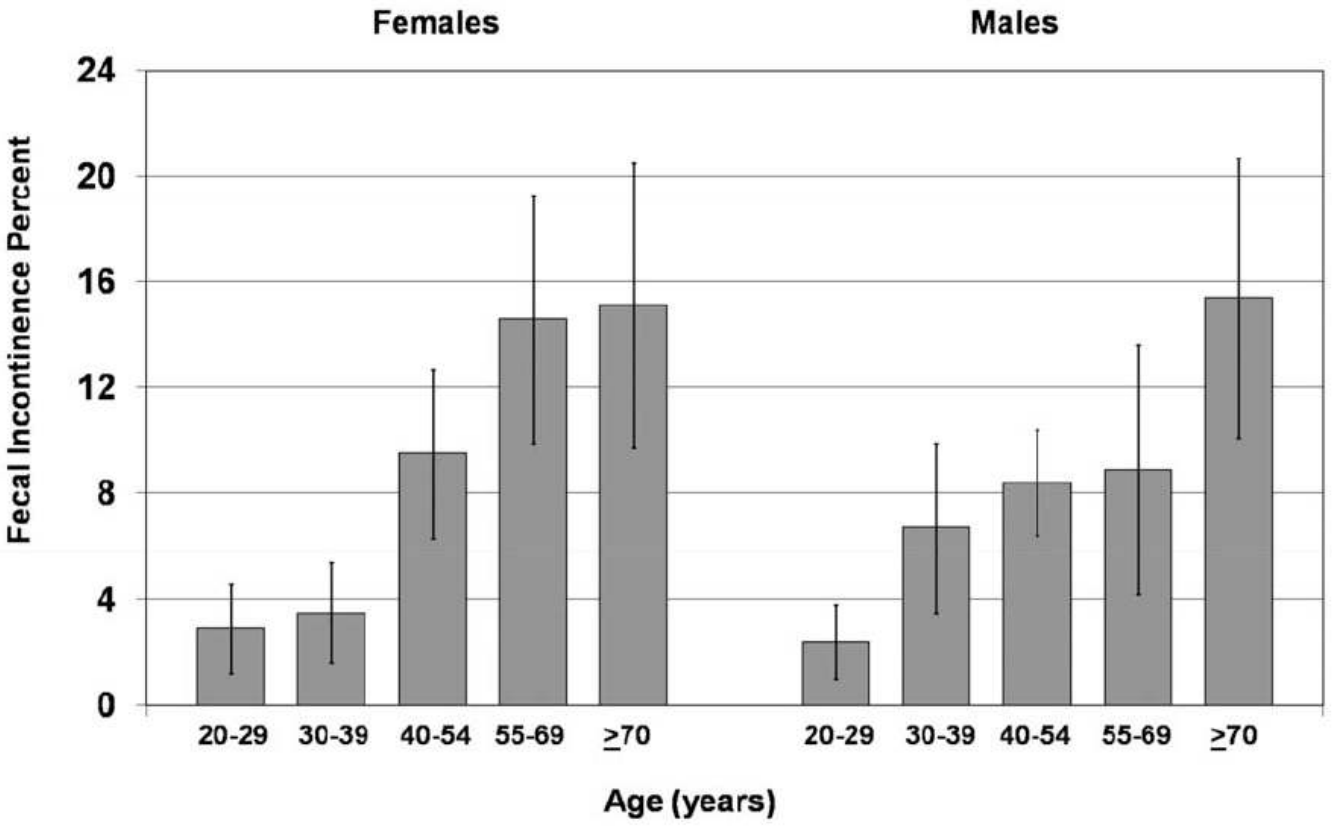

Figure 1.
Prevalence of fecal incontinence by age group in females and males. Bars represent 95% confidence intervals.

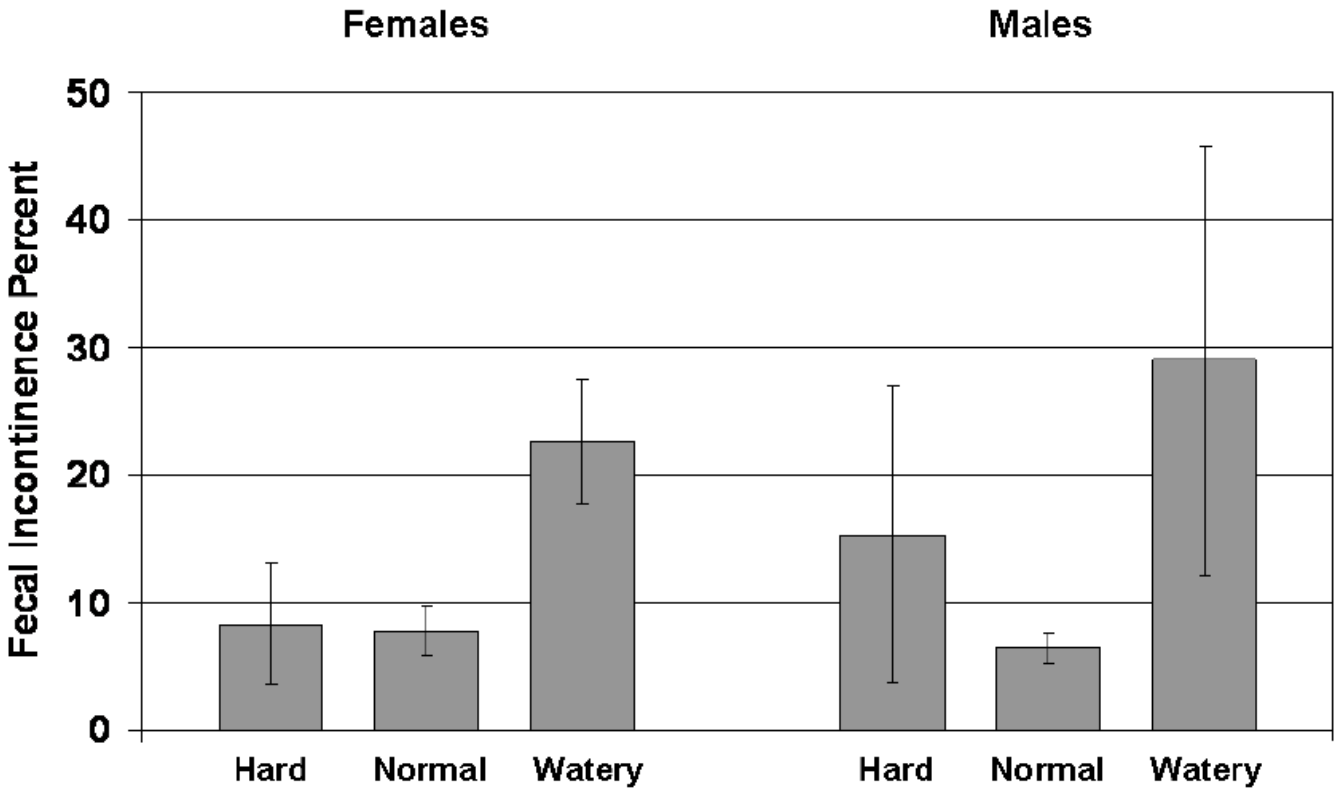

Figure 2.
Prevalence of fecal incontinence by usual stool consistency in females and males. Bars represent 95% confidence intervals. For both women and men, the odds of FI was significantly increased ($p<0.001$) for subjects whose usual stool consistency was mushy or watery compared to subjects with normal stool consistency; see Table 3.

Table 1

Characteristics of the sample[‡]

	Women	Men	Total
	n (%)		
Total sample	2229 (51.7)	2079 (48.3)	4308 (100)
Age (Years)			
20- 29	542 (24.3)	370 (17.8)	912 (21.2)
30- 39	382 (17.1)	355 (17.1)	737 (17.1)
40- 54	545 (24.5)	543 (26.1)	1088 (25.3)
55- 69	426 (19.1)	431 (20.7)	857 (19.9)
≥70	334 (15.0)	380 (18.3)	714 (16.6)
Ethnicity			
Hispanic	521 (23.4)	470 (22.6)	991 (23.0)
Non-Hispanic white	1122 (50.3)	1085 (52.2)	2207 (51.2)
Non-Hispanic black	491 (22.0)	463 (22.3)	954 (22.1)
Other	95 (4.3)	61 (2.9)	156 (3.6)
Marital Status: Married/cohabiting	1317 (59.1)	1422 (68.4)	2739 (63.6)
Education: More than high school[*]	1150 (51.6)	968 (46.6)	2118 (49.2)
Family Income: Below poverty level[*]	381 (17.9)	315 (15.8)	696 (16.9)

[‡]Data in Table 1 are unweighted.

[*]Respondents with missing data and responses of “refused” and “don’t know” were excluded from the table

Table 2

Composition and frequency of leakage: Percent of women and men with each type of fecal incontinence

	Women	Men	Total
Composition of leakage*	**% (95% Confidence Interval)**		
Liquid	6.4 (4.8-7.9)	6.0 (4.5-7.4)	6.2 (5.2-7.1)
Solid	2.0 (1.3-2.7)	1.2 (0.7-1.7)	1.6 (1.1-2.1)
Mucus	3.0 (2.4-3.5)	3.2 (2.2-4.3)	3.1 (2.6-3.6)
Frequency of leakage			
1-3/month	6.1 (4.6-7.6)	5.1 (3.8-6.4)	5.6 (4.6-6.7)
1/week	0.4 (0.1-0.7)‡	0.7 (0.2-1.2)‡	0.5 (0.3-0.8)
2-6/week	1.4 (0.7-2.1)	1.2 (0.7-1.7)	1.3 (1-1.6)
≥1/day	0.9 (0.6-1.2)	0.7 (0.3-1.0)	0.8 (0.6-1)

*Groups of subjects with different composition of leakage are not mutually exclusive. Composition and frequency of leakage was defined by subjects using the FISI(7).

‡The numbers for these cells are unreliable; relative standard error >30%.

Table 3

Odds Ratios for Variables Associated with Fecal Incontinence*

Risk factor	Women				Men			
	Bivariate Analysis		Multivariate Analysis		Bivariate Analysis		Multivariate Analysis	
	OR (CI)	P	OR (CI)	P	OR (CI)	P	OR (CI)	P
Age (10 year interval)	1.41 (1.31, 1.51)	<0.0001	1.20 (1.10, 1.31)	<0.0001	1.32 (1.22, 1.44)	<0.0001	1.24 (1.09,1.41)	0.0009
Usual stool consistency (vs. normal stools)								
Loose, watery stools	3.36 (2.21, 5.10)	<0.0001	2.82 (1.95, 4.08)	<0.0001	5.78 (2.76, 12.08)	<0.0001	4.76 (1.94, 11.69)	0.0007
Hard, lumpy stools	1.06 (0.60, 1.90)	0.84	1.00 (0.54, 1.86)	1.00	2.60 (1.10, 6.12)	0.029	1.76 (0.64, 4.82)	0.27
Usual stool frequency (vs. 3-21 BM/week)								
>21 stools per week	5.38 (2.55, 11.30)	<0.0001	2.36 (1.09, 5.12)	0.029	5.51 (2.68, 11.3)	<0.0001	2.26 (0.86, 5.9)	0.097
<3 BM/week	1.96 (0.83, 4.60)	0.12	1.62 (0.65, 4.03)	0.30	1.71 (0.87, 3.37)	0.12	1.04 (0.43, 2.54)	0.93
BMI (vs. Normal/underweight; BMI<25)								
Overweight (BMI 25-29.9)	1.24 (0.82, 1.86)	0.31	1.09 (0.65, 1.81)	0.75	0.96 (0.59, 1.56)	0.87	0.90 (0.53, 1.54)	0.70
Obese (BMI ≥ 30)	1.71 (1.15, 2.54)	0.0078	1.19 (0.76, 1.87)	0.44	1.35 (0.97, 1.89)	0.079	1.21 (0.86, 1.70)	0.28
Vigorous activity (vs. No vigorous activity)								
Does vigorous activity	0.48 (0.24, 0.97)	0.041	0.59 (0.27, 1.25)	0.17	0.64 (0.40, 1.04)	0.071	0.78 (0.43, 1.42)	0.41
Unable to do any activity	2.61 (1.36, 4.97)	0.0037	2.23 (1.09, 4.57)	0.028	1.00 (0.44, 2.26)	1.00	0.77 (0.31, 1.92)	0.57
Chronic ills (vs. no chronic ills)								
1 chronic ills	2.37 (1.55, 3.63)	<0.0001	1.96 (1.34, 2.87)	0.0006	1.25 (0.73, 2.14)	0.41	1.07 (0.65, 1.77)	0.78
≥2 chronic ills	3.12 (1.73, 5.63)	0.0002	2.20 (1.19, 4.05)	0.012	1.38 (0.77, 2.47)	0.27	1.02 (0.55, 1.90)	0.95
Poor self-rated health	1.91 (1.14, 3.21)	0.015	1.20 (0.63, 2.31)	0.58	2.20 (1.62, 2.98)	<0.0001	1.78 (1.18, 2.66)	0.0056
Urinary incontinence	2.08 (1.41, 3.07)	0.0002	1.62 (0.99, 2.66)	0.054	3.39 (2.12, 5.40)	<0.0001	2.60 (1.44, 4.67)	0.0014

*Only variables found to be significant in bivariate analyses for women or men were included in the multivariate regressions and shown in this table. All bivariate analyses except age are age-adjusted. Multivariate odds ratios are adjusted for all other risk factors in the table.