Gender and Age Differences in Constipation Characteristics, Bowel Symptoms, and Bowel and Dietary Habits in Patients Evaluated for Constipation

by

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DISSERTATION

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The manuscript “A Review of the Literature on Gender and Age Differences in the Prevalence and Characteristics of Constipation in North America”, in press in Journal of Pain and Symptom Management, is included with the permission of the publishers.

Abstract

Constipation is a common problem that affects 2% to 28% of the general population in the United States. In addition, the prevalence of constipation is higher in women and more women seek care in specialty practice than men. The prevalence of constipation increases with age, with marked increases between 65 and 75, and again after age 75. However, limited and contradictory information exist on gender and age differences in specific characteristics, symptoms, and associated bowel and dietary habits.

Purposes of this dissertation research, in a sample of patients referred for evaluation of constipation at a specialty clinic, were to: evaluate for gender and age differences in the frequency of various characteristics of constipation, as well as in the frequency of constipation specific symptoms and bowel and dietary habits, and to determine if gender or age, as well as specific clinical characteristics and the occurrence of various medical conditions, were associated with an increase in the frequency of constipation associated characteristics, symptoms, and bowel and dietary habits.

A sample of 518 patients was evaluated for constipation. Patients completed a clinical questionnaire that obtained information on demographic characteristics and previous medical history and an investigator-developed questionnaire on the characteristics of constipation, symptoms of constipation, as well as various bowel and dietary habits.

More women reported constipation and a higher frequency of constipation characteristics, associated symptoms, and bowel habits. Women were significantly more likely to report a longer duration of constipation symptoms, less frequent bowel movements, stool that was very hard or pellet like, abdominal pain, abdominal bloating, unsuccessful attempts at evacuation, and more frequent use of anal digitation.

Younger and middle aged patients had higher frequencies of occurrence of bowel movements, abdominal bloating, and use of position changes. Older patients reported more chronic diseases than the younger patients. Otherwise, they did not have a dramatically different profile than the middle aged patients. Across age groups, a high prevalence of depression was reported.

Gender and age differences were found in patients with constipation. Replication in both population- and specialty clinic-based samples, across all age groups is recommended. Mechanisms that underlie these gender and age differences and the high prevalence of depression in this sample warrant further investigation.

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Introduction

The body of this work contains five papers. The first paper, entitled "Pathophysiology of Constipation in the Older Adult," provides an overview of the definition of constipation, normal continence and defecation and a description of the pathophysiologic mechanisms of constipation. In addition, changes in the anatomy and physiology of the lower gastrointestinal tract associated with aging that may contribute to constipation are described [World Journal of Gastroenterology, (2008), *14* (17), 2631-2638].

The second paper, entitled "Review Article: Self-report Measures to Evaluate Constipation" compares and contrasts published self-report measures of constipation in terms of development, content, general characteristics, psychometric properties, and clinical utility [Alimentary, Pharmacology & Therapeutics, (2008) *27* (8), 638-648]. The third paper, entitled "A Review of the Literature on Gender and Age Differences in the Prevalence and Characteristics of Constipation in North America", summarizes the findings on the prevalence of constipation in the general population; as well as on gender and age differences in the prevalence and characteristics of constipation [In press: Journal of Pain and Symptom Management].

The fourth paper, entitled "Gender Differences in Constipation Characteristics, Symptoms, and Bowel and Dietary Habits in Patients Evaluated for Constipation", reports findings that suggest that women are at increased risk for constipation and that they experience a number of symptoms and abnormal bowel habits more frequently than men. The fifth paper, entitled "Age Differences in Characteristics of Constipation, Symptoms, and Bowel and Dietary Habits in Patients Evaluated for Constipation",

reports findings that suggest that while significant age differences were found, younger and middle aged patients reported symptoms and abnormal habits at higher frequencies than older patients. Finally, in the conclusion section of this dissertation, implications for future research are discussed.

PATHOPHYSIOLOGY OF CONSTIPATION IN THE OLDER ADULT

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Abstract

AIM: This review provides information on the definition of constipation, normal continence and defecation and a description of the pathophysiologic mechanisms of constipation. In addition, changes in the anatomy and physiology of the lower gastrointestinal tract associated with aging that may contribute to constipation are described.

METHODS: MEDLINE (1966-2007) and CINAHL (1980-2007) were searched. The following MeSH terms were used: constipation/etiology OR constipation/physiology OR constipation/physiopathology) AND (age factors OR aged OR older OR 80 and over OR middle age).

RESULTS: Constipation is not well defined in the literature. While self-reported constipation increases with age, findings from a limited number of clinical studies that utilized objective measures do not support this association. Dysmotility and pelvic floor dysfunction are important mechanisms associated with constipation. Changes in GI function associated with aging appear to be relatively subtle based on a limited amount of conflicting data.

CONCLUSIONS: Additional research is warranted on the effects of aging on GI function, as well as on the timing of these changes.

KEY WORDS: Constipation; Mechanisms; Functional constipation; Dysmotility; Older adults; Pelvic floor dysfunction; Gastrointestinal tract, Review

Introduction

Constipation is a problem that affects all ages. However, it is a common problem in older adults and is often a concern to elders and clinicians. In older people, acute bouts of constipation can occur with acute illness or dietary alterations. In contrast, chronic constipation usually has an insidious onset of many years, often dating to childhood. The symptom experience can range from a mild, acute event that is remedied with a shift in fluid and dietary intake to a chronic condition that requires daily interventions with mixed results. Elders may falsely believe that constipation is a "natural" part of aging (Chan et al., 2005; Chang et al., 2006; Laurberg & Swash, 1989; Longstreth et al., 2006).

The purposes of this review are to: define constipation; provide an overview of normal continence and defecation; and describe the pathophysiologic mechanisms of constipation. In addition, the changes in the anatomy and physiology of the lower GI tract associated with aging that may contribute to constipation are described.

Methods

To identify the relevant studies on the pathophysiology of constipation in the older adult, a number of strategies were employed. A literature search was conducted that included the following databases and time periods: MEDLINE (1966-2007) and CINAHL (1980-2007). The following MeSH terms were used: (constipation/etiology OR constipation/physiology OR constipation/physiopathology) AND (age factors OR aged OR older OR 80 and over OR middle age).

Definition of Constipation

Constipation is not a disease entity but a general term that is used to describe the difficulties that patients experience with moving their bowels. Clinical and research literature documents that patients and clinicians use different definitions of constipation. Clinicians consider the frequency of defecation episodes, stool weight, colonic transit time, and anorectal manometry as proxy measures for constipation (Ashraf, Park, Lof, & Quigley, 1996; T. Koch & Hudson, 2000). A commonly held belief amongst clinicians is that the problem of constipation is more imagined than real, as "the great majority of those complaining of constipation have a bowel motion (movement) more frequently than three times a week"(Campbell, Busby, & Horwath, 1993). The actual problem lies in the definition of constipation. The term itself holds different meanings depending on the individual. Individual perception of bowel function, whether or not the symptoms associated with constipation are endured, is quite distinct from how the medical dictionary defines the problem. Because of the subjective nature of the condition, no consensus exists on the definition of constipation.

Measurement of the frequency of stools has been used to define constipation. "Normal" frequency of stool evacuation comprises a broad or narrow range of time that has large intra- and inter-individual variability. The "usual" range is anywhere from one to three times per day to three times per week (Schaefer & Cheskin, 1998). Less than three times per week may be considered normal if this does not represent a change from the usual frequency of baseline defecation events and is not associated with discomfort (Abyad & Mourad, 1996). This self-report criterion does not describe the entire symptom experience of constipation.

Patients define constipation quite differently from clinicians. A study of 531 general practice patients found that 50% of them gave a different definition of constipation than their physicians (Herz et al., 1996). Most patients define it by one or more of the following symptoms: hard stools, infrequent stools, the need for excessive straining, a sense of incomplete evacuation, and/or an excessive amount of time spent on the toilet or in unsuccessful evacuation (Koch, Voderholzer, Klauser, & Muller-Lissner, 1997). Patients may perceive any or all of the following as constipation: straining to expel hard, dry stools; difficulty with initiating a bowel movement or an inability to defecate when desired; feelings of incomplete evacuation; and/or abdominal cramping and bloating. Subjective reports among middle aged and older individuals have identified the most common definition of constipation as being difficulty with defecation (Ross, 1993).

Most patients with a complaint of constipation have a functional disorder that affects the colon and/or anorectum. "Functional" is used to describe symptoms or problems that have no underlying anatomic abnormalities. However, the normal function of an organ has changed. Functional bowel disorders are functional gastrointestinal disorders with symptoms that arise in the middle or lower gastrointestinal tract (Longstreth et al., 2006). Functional constipation is defined as the reduced frequency of bowel movements and/or an altered act of evacuation (Drossman, 1999).

Functional bowel disorders, including functional constipation, are diagnosed primarily through patients' reports of symptoms. As a result, a symptom based classification is needed for clinical diagnosis, evidence based management, and research. Since 1989, an international panel of experts has met four times and issued

recommendations on the diagnosis and management of Irritable Bowel Syndrome (IBS), as well as diagnostic criteria for other functional bowel disorders. Known as the Rome I, Rome II, and Rome III (See Table 1) criteria, these recommendations have evolved to include functional anorectal disorders. All disorders are defined by specific symptoms. However, functional disorders of defecation include the results of diagnostic tests as part of the definition (Bharucha, Wald, Enck, & Rao, 2006).

Functional constipation is defined by Rome III as a functional bowel disorder that presents as persistently difficult, infrequent, or seemingly incomplete defecation, which does not meet IBS criteria. Patients are diagnosed with functional constipation if they are devoid of organic alterations and present with at least two or more of the symptoms listed in Table 1, fulfilled for at least three months with symptom onset at least six months prior to diagnosis, and insufficient criteria for IBS (Longstreth, et al., 2006).

Several changes occurred in the development of the diagnostic criteria between Rome I and Rome III, in particular between Rome II and III. Studies using the Rome II criteria yielded lower prevalence rates for constipation than those using Rome I criteria. A factor that contributed to this decrease was a change in the Rome II criteria that did not allow for laxative-induced loose stools (Thompson, Irvine, Pare, Ferrazzi, & Rance, 2002). Rome III includes this criterion. In addition, the frequency of occurrence of the various criteria was modified from > 25% to ≥ 25%. This approach was taken to be consistent with the criteria for other functional bowel disorders (Longstreth et al., 2006). Since Rome II, more consistent criteria for the diagnosis and management of constipation have appeared in the literature.

With this definition of constipation as background information, the next section of this paper reviews normal continence and defecation prior to a discussion of the pathophysiology of constipation and constipation in the older adult.

Normal Continence And Defecation

Normal anatomy and physiology of the gastrointestinal tract is well documented in the literature. Normal continence and defecation are complex processes that are altered in someone with constipation. Continence is the ability to retain feces until an acceptable time for defecation. Defecation is the evacuation of fecal material from the colon. Both functions involve complex physiologic processes that are not completely understood. Voluntary regulation through the central nervous system (CNS) and involuntary intrinsic reflex mechanisms are involved in both of these functions. Fecal continence is maintained by anatomic factors, anorectal sensation, and rectal compliance (Bharucha, 2006). Problems with continence and defecation can arise from an extrinsic disorder involving the central or peripheral nervous systems; from an intrinsic disorder of the colon, rectum, or anal sphincters; or from a combination of these mechanisms.

Normal stool output is about 200 gm daily. Activity in the proximal colon determines the consistency and volume of delivery of contents to the rectum. The rectum is a reservoir. As rectal filling gradually proceeds, anorectal sampling permits subconscious perception of the consistency of the content. An intact internal anal sphincter (IAS) ensures continence.

Autonomic neurons relay the anorectal sensation of the rectal contents. Activation of these afferents results in both conscious perception and activation of local reflexes, such as the rectoanal inhibitory reflex to begin the relaxation of the IAS. Reflex

voluntary contraction of the external anal sphincter (EAS) maintains continence until voluntary defecation is possible. A similar reflex contraction occurs to maintain continence when a rise in abdominal pressure occurs, such as during a cough or with positional changes. Partial external contraction is also observed during the passage of flatus, and coupled with an intact anorectal sensation this is the mechanism through which fecal continence is maintained during the passage of gas. Preservation of continence depends on the normal functioning of anorectal sensation, the appropriate perception of that sensory information, the integrity of lower and higher reflex arcs, and the action of the internal and external anal sphincters.

Defecation (Figure 1A) begins with rectal sensory awareness of a critical level of filling, which is relayed to the cerebral cortex as the perception of the need to evacuate the rectum. The actual volume that triggers the perception is dependent on the condition of the rectum (e.g., mucosal inflammation, rectal wall compliance) and the character of the contents (e.g., consistency, volume). When appropriate, the individual adopts a sitting or squatting position. This position results in a straightening of the anorectal angle that allows more effective propulsion of the rectal contents. The EAS and puborectalis muscles relax. The rectal contents provoke reflex relaxation of the IAS and the individual can then bear down. Abdominal pressure rises, abdominal wall muscles tense and relaxation of the pelvic floor allows some stool to enter the lower rectum. This movement of stool initiates a spontaneous rectosigmoid contraction, which pushes the stool through the relaxed anal canal (Bharucha, 2006).

Large propulsive contractions of the rectum occur until the rectum is empty. Sensory input from the anus maintains the propulsive activity until the rectum is fully

voided. This reflex appears to be mediated at the level of the spinal cord, as even spinally injured patients can evacuate a complete stool from the rectum, once initiated (Read, 1994). Such patients tend to use digital rectal stimulation to initiate the propulsive contractions of the recto-sigmoid colon. As stool passes through the anal canal, it stretches the EAS and creates a traction force on it. After the last bolus of stool has passed, the closing reflex of the EAS is stimulated by the release of traction. Therefore, anal continence is maintained following defecation.

Changes In The Lower Gastrointestinal Tract Associated With Aging

Age-related anatomic changes within the lower gastrointestinal tract may contribute to delayed transit time and decreased stool water content (Lynch, Anthony, Dobbs, & Frizelle, 2000). These changes can include intestinal wall atrophy, reduced blood supply, and intrinsic neuronal changes. However, no significant functional changes are readily apparent in the aging gastrointestinal tract. Secretion and absorption remain relatively constant. This constancy is thought to be due to the redundancy in each segment of the intestinal tract.

Gut transit time and colonic motility are similar in healthy older adults compared to younger participants (Hanani, Fellig, Udassin, & Freund, 2004). In contrast, elderly people with chronic illness who report constipation have a prolonged total gut transit time of 4 to 9 days (normal < 3 days), with evacuation delayed through the lowest part of the large bowel and rectum. Nursing home residents have even more prolonged transit times of up to three weeks in those least mobile which makes them highly susceptible to slow transit constipation (STC) and overflow fecal incontinence (Loening-Baucke & Anuras,

1984). Colonic function appears to be more influenced by factors associated with aging (e.g., chronic disease, immobility, and medications) than aging itself.

Age-related neurodegenerative changes in the enteric nervous system (ENS) may be key to functional changes observed with advanced age. In colons of people older than age 65, a 37% loss of enteric neurons was found when compared with younger people (Brocklehurst, Kirkland, Martin, & Ashford, 1983). The number of nerve cells present in the myenteric plexus of the human large intestine was examined using laminar preparations of the muscularis externa in two groups of participants aged 20 to 35 and over 65 years. In addition, the collagen and elastic system related fibers in the myenteric ganglia were qualitatively evaluated. The total number of neurons was decreased in older individuals. Both collagen and elastic system fibers were more numerous in the ganglia from the older participants. The authors concluded that the decrease in neuron density with age is accompanied by an apparent increase in the fibrous components of the myenteric ganglia. These findings suggest that neurodegenerative changes may contribute to the disturbed colonic motility seen in the aging population.

Older people have age-related reductions in IAS pressure and pelvic muscle strength (Gomes, de Souza, & Liberti, 1997; McHugh & Diamant, 1987a), as well as changes in rectal sensitivity (McHugh & Diamant, 1987b) and anal function. Women in particular experience a larger decrease in squeeze pressures with aging especially after menopause, and due to injuries sustained during vaginal delivery (Ryhammer, Laurberg, & Sorensen, 1997; Sultan, Kamm, & Hudson, 1994). These changes increase both the risk and the potential for constipation.

The interrelationship between aging and parity in the anorectal squeeze pressure in women is difficult to determine from currently available data. However, the authors suggested that menopausal effects may be relevant (Laurberg & Swash, 1989). These age-related changes are not in and of themselves pathologic, but may contribute to the development of constipation in the elderly.

Pathophysiologic Mechanisms Of Constipation

Two mechanisms explain the pathophysiology of constipation (Cheung & Wald, 2004; Sultan, Kamm, & Hudson, 1994). Colonic motility dysfunction, or dysmotility, is failure of coordinated motor activity to move stool through the colon. It is sometimes associated with: dietary factors, medications that can alter motility; or systemic disease (e.g. neurologic, metabolic, or endocrine disorders). Others exhibit abnormalities of the enteric nerves, such as decreased volume of interstial cells of Cajal (ICC) and other neural elements (Sagar & Pemberton, 1996). The second mechanism involves pelvic floor dysfunction, or disorders of the anorectum and pelvic floor, which result in outlet dysfunction and an inability to adequately evacuate rectal contents. Functional constipation may occur as a result of disordered movement through the sigmoid colon and/or anorectum. Both mechanisms coexist in some patients (Cheung & Wald, 2004), making it difficult to determine the exact underlying mechanisms for constipation.

Physiology of Dysmotility

Dysmotility results in colonic delay (i.e., abnormally prolonged colonic transit time). Three types of colonic delay have been identified: right colonic (colonic inertia), left colonic, and rectosigmoid. Additionally, delay can occur in patients with no colonic dysmotility (Wedel et al., 2002). Mechanisms of delay include: dysfunction of the

autonomic nervous system, disruption in the ENS (Mertz, Naliboff, & Mayer, 1999), disruptions in the neuroendocrine system (Bassotti & Villanacci, 2006; Ehrenberg & Ehnfors, 1999), and/or colonic myopathy (Knowles et al., 2001; Sjolund et al., 1997).

Impaired colonic propulsive activity may represent a major mechanism for colonic dysmotility. In patients with constipation (n=45), there were fewer mass movements segmental contractions (Knowles, Scott, & Lunniss, 2001). No differences in post awakening values were found in patients with chronic constipation which suggests that the brain-gut control of fundamental mechanisms governing colonic motility are preserved (Bassotti, Chistolini, Nzepa, & Morelli, 2003).

A disorder of the ICC may have a role in the development of diminished or absent colonic motor activity (Bassotti et al., 1998). In patients with STC, the number of ICC was significantly decreased in all layers of the colonic wall (Sagar & Pemberton, 1996), including the external muscle layer (Shafik, Shafik, El-Sibai, & Mostafa, 2003). Thus, constipation in patients with colonic inertia is attributable to weak or absent electric activity.

When compared with healthy controls, patients with STC exhibit reduced daytime colonic pressure waves and a higher frequency of periodic rectal motor activity (PRMA) that were unrelated to proximal colonic activity. Their findings suggest that excessive and uncoordinated phasic rectal activity may further impede stool transport and contribute to STC (Tong, Liu, Zhang, Zhang, & Lei, 2004).

The gastrocolic response to ingestion of a meal in individuals with constipation is characterized by a shorter contractile activity in all three colon segments and significantly fewer high amplitude propagated contractions (HAPCs) (S.S. Rao, Sadeghi, Batterson, &

Beaty, 2001). Changes in rectal wall contractility in response to feeding, as well as with the administration of a cholinergic agonist, and a smooth muscle relaxant, are decreased in constipated patients. This finding suggests an abnormality in rectal muscular wall contractility (Grotz, Pemberton, Levin, Bell, & Hanson, 1993).

The gastrocolic response after ingestion of a standardized liquid meal and the response to a local chemical stimulus were investigated in 10 healthy controls and 10 patients with STC. Increases in motility after a meal and bisacodyl were seen in healthy participants but not in patients with STC. Timing of the high amplitude propagating contractions was prolonged and decreased in number in the patients with STC. In addition, symptom reports of a cramp felt at the time of a HAPC were significantly lower than in controls ($P<0.05$) (De Schryver, Samsom, & Smout, 2003).

The nerve fibers in the colonic circular muscle may be abnormal in patients with STC. A reduction in the density of excitatory nerve fibers with tachykinin and enkephalin immunoreactivity was found in the colonic circular muscle of patients with STC, whereas innervation of all the other layers was normal (Porter, Wattchow, Hunter, & Costa, 1998). Small sensory fiber dysfunction has also been suggested in patients with STC (Knowles et al., 1999).

Abnormalities in neurotransmitters may contribute to dysmotility and the subsequent development of constipation. Changes in excitatory and inhibitory neurotransmitters have been evaluated with conflicting results. Levels of vasoactive intestinal peptide (VIP) were found to be unchanged (Tzavella et al., 1996) or increased (El-Salhy, Norrgard, & Spinnell, 1999) in patients with STC. The release of acetylcholine was found to be depressed in colonic tissue specimens from constipated

patients (Mitolo-Chieppa et al., 1998). Excessive nitric oxide was found in ICC preparations from the distal colon of patients with STC (Zhao et al., 2003). A decrease in serotonin immunoreactivity in the muscular mucosa and circular muscle was identified in patients who underwent subtotal colectomy for colonic inertia (Mollen, Hopman, Kuijpers, & Jansen, 2000). How changes in the release of various neurotransmitters contribute to the pathogenesis of STC has not been described in detail.

A number of gut hormones (i.e., cholecystokinin, peptide YY, somatostatin, enteroglucagon, pancreatic peptides) are thought to have potent effects on gastrointestinal motility. Plasma cholecystokinin and peptide YY have not been found to be altered in patients with STC (van der Sijp et al., 1998). However, specific abnormalities in circulating gut hormones have been identified in patients with STC including: higher levels of circulating somatostatin, lower levels of somatostatin integrated with an incremental meal response, and decreased levels of enteroglucagon 30 to 60 minutes after a meal (Battle, Snape, & Alair, 1980). Significantly fewer enteroglucagon and serotonin immunoreactive cells were found in patients with STC (El-Salhy, Norrgard, & Spinnell, 1999). However, how changes in these hormones contribute to the pathogenesis of STC has not been described.

Changes in Physiology Associated with Disease States

Disease states that alter slow wave patterns or spike responses will alter contraction and motility (Meunier, Rochas, & Lambert, 1979). Abnormalities in colonic motility seen in diabetic patients with constipation are due in part to altered autonomic neural control manifested as an abnormal gastrocolonic response. Slow wave patterns appear unaltered in healthy participants compared to patients with constipation and

diabetes. Minimal spike potential activity is seen in both healthy and diabetic patients during fasting. Following a meal, spike potential activity quickly increases during the first 10 minutes and is sustained for 30 minutes in healthy participants. This activity is inhibited by the pre-administration of an anticholinergic drug, which suggests that the postprandial response is mediated through the cholinergic nervous system. In diabetic patients without constipation, the response to a meal is the same as in controls. In chronic insulin dependent diabetic patients with constipation, the normal postprandial increase in spike potential is not present. The lack of spike potential leads to abnormal postprandial motor activity in the colon which results in constipation (Lembo & Camilleri, 2003; Schang & Devroede, 1983).

Pelvic Floor Dysfunction

The second major mechanism for constipation is pelvic floor dysfunction which results in disordered defecation. It is most commonly due to dysfunction of the pelvic floor muscles or anal sphincters (Thompson, Irvine, Pare, Ferrazzi, & Rance, 2002). Different terms that are used to describe these disorders include anismus, pelvic-floor dyssynergia, paradoxical pelvic floor contraction, obstructed defecation, functional rectosigmoid obstruction, and functional fecal retention in childhood (Pezim, Pemberton, Levin, Litchy, & Phillips, 1993). The pathophysiology of these disorders is not completely understood.

Physiology of Pelvic Floor Dysfunction

When constipation is accompanied by an immobile perineum, patients have impaired balloon expulsion, impaired and delayed artificial stool expulsion, decreased straightening of the anorectal angle, decreased descent of the pelvic floor with defecation,

and prolonged rectosigmoid transit times. All are thought to be signs of pelvic floor dysfunction rather than delayed transit time (Rao, Welcher, & Leistikow, 1998).

When compared to healthy controls, patients with obstructed defecation demonstrate lower intrarectal pressure and defecation indices and higher anal residual pressures on anorectal manometry recordings during straining (Figure 1B). Impaired rectal contraction, paradoxical anal contraction, or inadequate anal relaxation seen in patients with obstructed defecation suggests that rectoanal coordination is impaired (Dinning et al., 2004).

The overall frequency of propagating sequences in the colon does not differ between patients with obstructed defecation and healthy controls. In fact, patients with obstructed defecation were found to have a significant increase in the frequency of retrograde and antegrade propagating sequences ($P<0.05$) in the left colon and a significant reduction in the amplitude of propagating pressure waves throughout the entire colon ($P<0.03$). In the 15 minutes before defecation, controls showed a highly significant increase in frequency ($P=0.001$) and amplitude ($P=0.01$) of propagating sequences. In contrast, patients did not demonstrate this or the typical spatiotemporal organization of propagating sequences normally observed before expulsion of stool (Gosselink & Schouten, 2001b).

Neural Influences on Pelvic Floor Dysfunction

Parasympathetic afferent nerves are stimulated by both slow or cumulative and fast or intermittent distention of the rectum, whereas sympathetic afferent nerves are only stimulated by fast distention. In a study that examined the role of sympathetic afferent nerves in the mediation of rectal filling sensations, women with obstructed defecation

were found to have either blunted or absent rectal sensory perception (Gosselink, Hop, & Schouten, 2001). Participants experienced a nonspecific sensation in the pelvis or lower abdomen with fast distention which suggested that sympathetic efferents were deficient. In spite of this, rectal wall compliance was normal in the patients with obstructed defecation (Gosselink & Schouten, 2001a).

The gastrocolic reflex has been evaluated in patients with obstructed defecation. It was found to be absent or prolonged in patients with obstructive defecation in whom transit time is prolonged. The gastrocolic reflex was found to be intact if slow transit was absent (Liu, Zou, & Song, 2000).

Patients with STC can also have anorectal motility disturbances. The minimum relaxation volume, the rectal defecatory threshold, the rectal maximal tolerable volume, and the rectal compliance are significantly higher in patients with STC than in healthy controls ($P<0.01$ or $P<0.05$) (Shafik, Shafik, El-Sibai, & Ahmed, 2003). The anorectal reflex is active in puborectalis paradoxical syndrome, but the rectoanal reflex is not, indicating a possible myogenic defect in the puborectalis muscle (S. S. Rao, Tuteja, Vellema, Kempf, & Stessman, 2004).

How people develop defecation disorders is unclear. In two-thirds of patients, dyssynergic or obstructed defecation appears to be an acquired behavioral disorder of defecation and in the rest the process of defecation may not have been learned since childhood (De Lillo & Rose, 2000).

Pathophysiology Of Constipation In The Older Adult

Constipation is often considered a natural part of aging but it is a disorder that is not caused by aging itself. Although changes in the gastrointestinal tract associated with

aging may predispose one to develop constipation, the disorder usually has a multifactoral etiology and may be a lifetime disorder.

As shown in Table 2, numerous factors may contribute to the development of constipation (Abyad & Mourad, 1996; Campbell, Busby, & Horwath, 1993; Donald, Smith, Cruikshank, Elton, & Stoddart, 1985; Koch & Hudson, 2000; Schaefer & Cheskin, 1998; Whitehead, Drinkwater, Cheskin, Heller, & Schuster, 1989). Though bowel transit time and frequency of bowel movements do not change with aging, a number of comorbid conditions may contribute to the development of constipation (Donald, Smith, Cruikshank, Elton, & Stoddart, 1985). Some data suggest that older adults perceive constipation as straining during defecation rather than decreased bowel frequency (Harari, Gurwitz, Avorn, Bohn, & Minaker, 1997; Talley, O'Keefe, Zinsmeister, & Melton, 1992). Another study of elderly individuals who reported constipation demonstrated that straining and hard bowel movements were the most frequent complaints [69]. A determination of the most likely etiology for constipation requires identification of the primary complaint (Donald, Smith, Cruikshank, Elton, & Stoddart, 1985).

Aging is associated with changes in the structure and function of the colon and defecatory mechanisms. Regional differences in colonic properties and in neurotransmitter functions have implications for normal function and dysfunction (Camilleri, Lee, Viramontes, Bharucha, & Tangalos, 2000).

Rectal sensation plays a critical role in normal defecation and may change with aging. In one study elderly patients with constipation and a history of fecal impaction had impaired rectal and perineal sensation and required significantly larger volumes of rectal distention to stimulate the normal urge to defecate (McHugh & Diamant, 1987b).

A second report described impaired rectal perception of stool in elderly patients with constipation (Bannister, Abouzekry, & Read, 1987), while sensation appeared to remain intact in those patients without constipation.

Disordered defecation can occur as a result of injury to the pudendal nerve. The incidence of increased pudendal nerve terminal motor latency, an indicator of pudendal nerve dysfunction, is increased in elderly females (Laurberg & Swash, 1989). Injury to the pudendal nerves can lead to abnormal perineal descent, which can impact rectal emptying by causing partial prolapse of the anal canal by the anterior rectal mucosa (Engel & Kamm, 1994).

Several types of anorectal abnormalities occur in older people with constipation including dyschezia and pelvic dyssynergia. Dyschezia is characterized by reduced tone, increased compliance, and impaired sensation such that a greater degree of rectal distention is required to induce the defecatory mechanism (McHugh & Diamant, 1987b). Seen most commonly in frail elders, these individuals have recurrent rectal impactions, a frequent consequence of which is fecal soiling. Fecal soiling affects 28% of older people. However, it is a problem that is not assessed by doctors or nurses (O'Keefe, Talley, Zinsmeister, & Jacobsen, 1995). Pelvic dyssynergia, also termed anismus, involves a failure to relax the pelvic floor and external anal sphincter muscles during defecation.

Implications For Further Research

Constipation is not a straightforward problem. However, recent research on the mechanisms and affects of constipation on the elderly is extremely sparse. Until the mechanisms of constipation are completely understood, it is likely that treatment will be at best, minimally successful. Dysmotility and pelvic floor dysfunction are clearly

important mechanisms associated with constipation, but further work is needed to understand the anatomic, physiologic, and lifestyle factors that affect these mechanisms. In addition, longitudinal data on gastrointestinal motility are needed to determine the effects of aging on normal lower GI and pelvic floor anatomy and function. Studies are needed that evaluate for changes in the physiology of the pelvic floor in women over the menopause transition and whether these changes contribute to functional outcomes seen at that time and on into old age.

Changes in GI function associated with aging appear to be relatively subtle based on a limited amount of conflicting data. Additional research is warranted on the effects of aging on GI function, as well as on the timing of these changes. A deeper understanding of the basic mechanisms of dysfunction, changes in the colonic wall, and pelvic floor dysfunction in the older adult could provide new directions for the assessment and management of constipation in this vulnerable group.

While significant progress has occurred in the development of consensus criteria for the assessment of constipation the definition is not standardized. The Rome criteria constitute a self-reported, complaint-based diagnostic system with a significant overlap between the criteria for dysmotility and pelvic dysfunction disorders. Studies are needed to clarify the discrete differences between colonic motor dysfunction and functional defecation disorders.

References

Abyad, A., & Mourad, F. (1996). Constipation: Common-sense care of the older patient. *Geriatrics, 51*, 28-34, 36.

Ashraf, W., Park, F., Lof, J., & Quigley, E. M. (1996). An examination of the reliability of reported stool frequency in the diagnosis of idiopathic constipation. *American Journal of Gastroenterology, 91*, 26-32.

Bannister, J. J., Abouzekry, L., & Read, N. W. (1987). Effect of aging on anorectal function. *Gut, 28*, 353-357.

Bassotti, G., Chistolini, F., Nzepa, F. S., & Morelli, A. (2003). Colonic propulsive impairment in intractable slow-transit constipation. *Archives of Surgery, 138*, 1302-1304.

Bassotti, G., Germani, U., Fiorella, S., Roselli, P., Brunori, P., & Whitehead, W. E. (1998). Intact colonic motor response to sudden awakening from sleep in patients with chronic idiopathic (slow-transit) constipation. *Diseases of the Colon and Rectum, 41*, 1550-1555; discussion 1555-1556.

Bassotti, G., & Villanacci, V. (2006). Slow transit constipation: A functional disorder becomes an enteric neuropathy. *World Journal of Gastroenterology, 12*, 4609-4613.

Battle, W. M., Snape, W. J., & Alair, A. (1980). Colonic dysfunction in diabetes mellitus. *Gastroenterology, 79*, 1217-1221.

Bharucha, A. E. (2006). Pelvic floor: Anatomy and function. *Neurogastroenterology and Motility, 18*, 507-519.

Bharucha, A. E., Wald, A., Enck, P., & Rao, S. (2006). Functional anorectal disorders. *Gastroenterology, 130*, 1510-1518.

Brocklehurst, J.C., Kirkland, J.L., Martin, J., & Ashford, J. (1983). Constipation in long-stay elderly patients: its treatment and prevention by lactulose, poloxalkol-dihydroxyanthroquinolone and phosphate enemas. *Gerontology, 29*, 181-184.

Camilleri, M., Lee, J.S., Viramontes, B., Bharucha, A.E., & Tangalos, E.G. (2000). Insights into the pathophysiology and mechanisms of constipation, irritable bowel syndrome, and diverticulosis in older people. *Journal of the American Geriatrics Society, 48*, 1142-1150.

Campbell, A.J., Busby, W.J., & Horwath, C. C. (1993). Factors associated with constipation in a community based sample of people aged 70 years and over. *Journal of Epidemiology and Community Health, 47*, 23-26.

Chan, A. O., Cheng, C., Hui, W. M., Hu, W. H., Wong, N. Y., Lam, K. F., et al. (2005). Differing coping mechanisms, stress level and anorectal physiology in patients with functional constipation. *World Journal of Gastroenterology, 11*, 5362-5366.

Chang, L., Toner, B. B., Fukudo, S., Guthrie, E., Locke, G. R., Norton, N. J., et al. (2006). Gender, age, society, culture, and the patient's perspective in the functional gastrointestinal disorders. *Gastroenterology, 130*, 1435-1446.

Cheung, O., & Wald, A. (2004). Review article: The management of pelvic floor disorders. *Alimentary Pharmacology and Therapeutics, 19*, 481-495.

De Lillo, A. R., & Rose, S. (2000). Functional bowel disorders in the geriatric patient: Constipation, fecal impaction, and fecal incontinence. *American Journal of Gastroenterology, 95*, 901-905.

De Schryver, A. M., Samsom, M., & Smout, A. I. (2003). Effects of a meal and bisacodyl on colonic motility in healthy volunteers and patients with slow-transit constipation. *Digestive Diseases and Sciences, 48*, 1206-1212.

Dinning, P. G., Bampton, P. A., Andre, J., Kennedy, M. L., Lubowski, D. Z., King, D. W., et al. (2004). Abnormal predefecatory colonic motor patterns define constipation in obstructed defecation. *Gastroenterology, 127*, 49-56.

Donald, I. P., Smith, R. G., Cruikshank, J. G., Elton, R. A., & Stoddart, M. E. (1985). A study of constipation in the elderly living at home. *Gerontology, 31*(2), 112-118.

Drossman, D. A. (1999). The functional gastrointestinal disorders and the Rome II process. *Gut, 45 Suppl 2*, II1-5.

Ehrenberg, A., & Ehnfors, M. (1999). Patient problems, needs, and nursing diagnoses in Swedish nursing home records. *Nursing Diagnosis, 10*, 65-76.

El-Salhy, M., Norrgard, O., & Spinnell, S. (1999). Abnormal colonic endocrine cells in patients with chronic idiopathic slow-transit constipation. *Scandinavian Journal of Gastroenterology, 34*, 1007-1011.

Engel, A. F., & Kamm, M. A. (1994). The acute effect of straining on pelvic floor neurological function. *International Journal of Colorectal Disease, 9*, 8-12.

Gomes, O. A., de Souza, R. R., & Liberti, E. A. (1997). A preliminary investigation of the effects of aging on the nerve cell number in the myenteric ganglia of the human colon. *Gerontology, 43*, 210-217.

Gosselink, M. J., Hop, W. C., & Schouten, W. R. (2001). Rectal compliance in females with obstructed defecation. *Diseases of the Colon and Rectum, 44*, 971-977.

Gosselink, M. J., & Schouten, W. R. (2001a). The gastrorectal reflex in women with obstructed defecation. *International Journal of Colorectal Disease, 16*, 112-118.

Gosselink, M. J., & Schouten, W. R. (2001b). Rectal sensory perception in females with obstructed defecation. *Diseases of the Colon and Rectum, 44*, 1337-1344.

Grotz, R. L., Pemberton, J. H., Levin, K. E., Bell, A. M., & Hanson, R. B. (1993). Rectal wall contractility in healthy subjects and in patients with chronic severe constipation. *Annals of Surgery, 218*, 761-768.

Hanani, M., Fellig, Y., Udassin, R., & Freund, H. R. (2004). Age-related changes in the morphology of the myenteric plexus of the human colon. *Autonomic neuroscience : Basic & clinical, 113*, 71-78.

Harari, D., Gurwitz, J. H., Avorn, J., Bohn, R., & Minaker, K. L. (1997). How do older persons define constipation? Implications for therapeutic management. *Journal of General Internal Medicine, 12*, 63-66.

Herz, M. J., Kahan, E., Zalevski, S., Aframian, R., Kuznitz, D., & Reichman, S. (1996). Constipation: A different entity for patients and doctors. *Family Practice, 13*, 156-159.

Knowles, C. H., Nickols, C. D., Scott, S. M., Bennett, N. I., de Oliveira, R. B., Chimelli, L., et al. (2001). Smooth muscle inclusion bodies in slow transit constipation. *Journal of Pathology and Bacteriology, 193*, 390-397.

Knowles, C. H., Scott, S. M., & Lunniss, P. J. (2001). Slow transit constipation: A disorder of pelvic autonomic nerves? *Digestive Diseases and Sciences, 46*, 389-401.

Knowles, C. H., Scott, S. M., Wellmer, A., Misra, V. P., Pilot, M. A., Williams, N. S., et al. (1999). Sensory and autonomic neuropathy in patients with idiopathic slow-transit constipation. *British Journal of Surgery, 86*, 54-60.

Koch, T., & Hudson, S. (2000). Older people and laxative use: Literature review and pilot study report. *Journal of Clinical Nursing, 9*, 516-525.

Koch, T. R., Voderholzer, W. A., Klauser, A. G., & Muller-Lissner, S. (1997). Symptoms in chronic constipation. *Diseases of the Colon and Rectum, 40*, 902-906.

Laurberg, S., & Swash, M. (1989). Effects of aging on the anorectal sphincters and their innervation. *Diseases of the Colon and Rectum, 32*(9), 737-742.

Lembo, A., & Camilleri, M. (2003). Chronic constipation. *New England Journal of Medicine, 349*, 1360-1368.

Liu, S., Zou, K., & Song, J. (2000). A study of anorectal manometry in patients with chronic idiopathic constipation. *Journal of Tongji Medical University, 20*(4), 351-352.

Loening-Baucke, V., & Anuras, S. (1984). Sigmoidal and rectal motility in healthy elderly. *Journal of the American Geriatrics Society, 32*, 887-891.

Longstreth, G. F., Thompson, W. G., Chey, W. D., Houghton, L. A., Mearin, F., & Spiller, R. C. (2006). Functional bowel disorders. *Gastroenterology, 130*, 1480-1491.

Lynch, A. C., Anthony, A., Dobbs, B. R., & Frizelle, F. A. (2000). Anorectal physiology following spinal cord injury. *Spinal Cord, 38*(10), 573-580.

McHugh, S. M., & Diamant, N. E. (1987a). Anal canal pressure profile: A reappraisal as determined by rapid pullthrough technique. *Gut, 28*, 1234-1241.

McHugh, S. M., & Diamant, N. E. (1987b). Effect of age, gender, and parity on anal canal pressures. Contribution of impaired anal sphincter function to fecal incontinence. *Digestive Diseases and Sciences, 32*, 726-736.

Mertz, H., Naliboff, B., & Mayer, E. A. (1999). Symptoms and physiology in severe chronic constipation. *American Journal of Gastroenterology, 94*, 131-138.

Meunier, P., Rochas, A., & Lambert, R. (1979). Motor activity of the sigmoid colon in chronic constipation: Comparative study with normal subjects. *Gut, 20*, 1095-1101.

Mitolo-Chieppa, D., Mansi, G., Rinaldi, R., Montagnani, M., Potenza, M. A., Genualdo, M., et al. (1998). Cholinergic stimulation and nonadrenergic, noncholinergic relaxation of human colonic circular muscle in idiopathic chronic constipation. *Digestive Diseases and Sciences, 43*, 2719-2726.

Mollen, R. M., Hopman, W. P., Kuijpers, H. H., & Jansen, J. B. (2000). Plasma cholecystokinin, plasma peptide YY and gallbladder motility in patients with slow transit constipation: effect of intestinal stimulation. *Digestion, 62*, 185-193.

O'Keefe, E. A., Talley, N. J., Zinsmeister, A. R., & Jacobsen, S. J. (1995). Bowel disorders impair functional status and quality of life in the elderly: A population-based study. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences 50*, M184-189.

Pezim, M. E., Pemberton, J. H., Levin, K. E., Litchy, W. J., & Phillips, S. F. (1993). Parameters of anorectal and colonic motility in health and in severe constipation. *Diseases of the Colon and Rectum, 36*, 484-491.

Porter, A. J., Wattchow, D. A., Hunter, A., & Costa, M. (1998). Abnormalities of nerve fibers in the circular muscle of patients with slow transit constipation. *International Journal of Colorectal Disease, 13*, 208-216.

Rao, S. S., Sadeghi, P., Batterson, K., & Beaty, J. (2001). Altered periodic rectal motor activity: A mechanism for slow transit constipation. *Neurogastroenterology and Motility, 13*, 591-598.

Rao, S. S., Tuteja, A. K., Vellema, T., Kempf, J., & Stessman, M. (2004). Dyssynergic defecation: Demographics, symptoms, stool patterns, and quality of life. *Journal of Clinical Gastroenterology, 38*, 680-685.

Rao, S. S., Welcher, K. D., & Leistikow, J. S. (1998). Obstructive defecation: A failure of rectoanal coordination. *American Journal of Gastroenterology, 93*(7), 1042-1050.

Read, N. W. (1994). Feedback regulation and sensation. *Digestive Diseases and Sciences, 39*, 37S-40S.

Ross, D. G. (1993). Subjective data related to altered bowel elimination patterns among hospitalized elder and middle-aged persons. *Orthopaedic Nursing, 12*, 25-32.

Ryhammer, A. M., Laurberg, S., & Sorensen, F. H. (1997). Effects of age on anal function in normal women. *International Journal of Colorectal Disease, 12*, 225-229.

Sagar, P. M., & Pemberton, J. H. (1996). Anorectal and pelvic floor function. Relevance of continence, incontinence, and constipation. *Gastroenterology Clinics of North America, 25*, 163-182.

Schaefer, D. C., & Cheskin, L. J. (1998). Constipation in the elderly. *American Family Physician, 58*, 907-914.

Schang, J. C., & Devroede, G. (1983). Fasting and postprandial myoelectric spiking activity in the human sigmoid colon. *Gastroenterology, 85*, 1048-1053.

Shafik, A., Shafik, A. A., El-Sibai, O., & Ahmed, I. (2003). Study of the role of the second defecation reflex: Anorectal excitatory reflex in the pathogenesis of constipation. *Journal of the American College of Surgeons, 196*, 729-734.

Shafik, A., Shafik, A. A., El-Sibai, O., & Mostafa, R. M. (2003). Electric activity of the colon in subjects with constipation due to total colonic inertia: An electrophysiologic study. *Archives of Surgery, 138*, 1007-1011; discussion 1011.

Sjolund, K., Fasth, S., Ekman, R., Hulten, L., Jiborn, H., Nordgren, S., et al. (1997). Neuropeptides in idiopathic chronic constipation (slow transit constipation). *Neurogastroenterology and Motility, 9*, 143-150.

Sultan, A. H., Kamm, M. A., & Hudson, C. N. (1994). Pudendal nerve damage during labour: prospective study before and after childbirth. *British Journal of Obstetrics and Gynaecology, 101*, 22-28.

Talley, N. J., O'Keefe, E. A., Zinsmeister, A. R., & Melton, L. J., 3rd. (1992). Prevalence of gastrointestinal symptoms in the elderly: A population-based study. *Gastroenterology, 102*, 895-901.

Thompson, W. G., Irvine, E. J., Pare, P., Ferrazzi, S., & Rance, L. (2002). Functional gastrointestinal disorders in Canada: First population-based survey using Rome II criteria with suggestions for improving the questionnaire. *Digestive Diseases and Sciences, 47*, 225-235.

Tong, W. D., Liu, B. H., Zhang, L. Y., Zhang, S. B., & Lei, Y. (2004). Decreased interstitial cells of Cajal in the sigmoid colon of patients with slow transit constipation. *International Journal of Colorectal Disease, 19*, 467-473.

Tzavella, K., Riepl, R. L., Klauser, A. G., Voderholzer, W. A., Schindlbeck, N. E., & Muller-Lissner, S. A. (1996). Decreased substance P levels in rectal biopsies from patients with slow transit constipation. *European Journal of Gastroenterology and Hepatology, 8*, 1207-1211.

van der Sijp, J. R., Kamm, M. A., Nightingale, J. M., Akkermans, L. M., Ghatei, M. A., Bloom, S. R., et al. (1998). Circulating gastrointestinal hormone abnormalities in patients with severe idiopathic constipation. *American Journal of Gastroenterology, 9*, 1351-1356.

Wedel, T., Spiegler, J., Soellner, S., Roblick, U. J., Schiedeck, T. H., Bruch, H. P., et al. (2002). Enteric nerves and interstitial cells of Cajal are altered in patients with slow-transit constipation and megacolon. *Gastroenterology, 123*, 1459-1467.

Whitehead, W. E., Drinkwater, D., Cheskin, L. J., Heller, B. R., & Schuster, M. M. (1989). Constipation in the elderly living at home. Definition, prevalence, and relationship to lifestyle and health status. *Journal of the American Geriatrics Society, 37*, 423-429.

Zhao, R. H., Baig, M. K., Thaler, K. J., Mack, J., Abramson, S., Woodhouse, S., et al. (2003). Reduced expression of serotonin receptors in the left colon of patients with colonic inertia. *Diseases of the Colon and Rectum, 46*, 81-86.

Table 1 Rome III Criteria for Defining Functional Constipation

Loose stools rarely present with laxative use and insufficient criteria for IBS **AND**
Two or more of the following (fulfilled for the last 3 months with symptom onset at least six months prior to diagnosis):

Fewer than three bowel movements per week

Straining *

Lumpy or hard stools *

Sensation of incomplete evacuation *

Sensation of anorectal obstruction or blockade *

Manual maneuvers (e.g., digital evacuation, support of the pelvic floor) to facilitate a bowel movement *

* = ≥ 25 % of defecations

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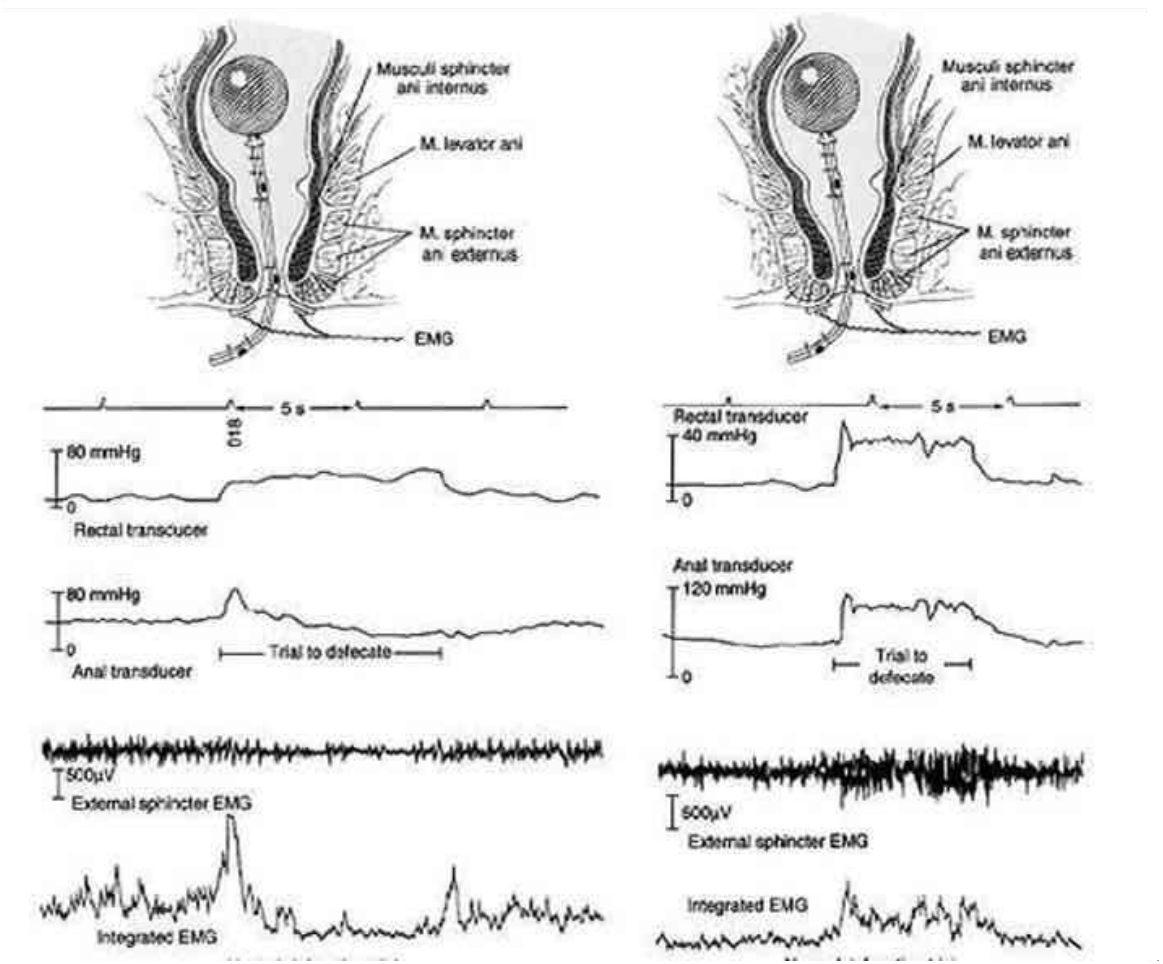
Table 2 Etiology of Constipation in the Older Adult

- Endocrine and Metabolic Disease
  - Diabetes Mellitus
  - Hypothyroidism
- Neurologic Disease
  - Autonomic neuropathy
  - Cerebrovascular disease
  - Multiple Sclerosis
  - Parkinson's Disease
  - Spinal cord injury
- Psychological conditions
  - Anxiety
  - Depression
- Structural abnormalities
  - Anorectal conditions: fissures, hemorrhoids, rectal prolapse or rectocele
  - Obstructive colonic lesions
- Lifestyle
  - Dehydration
  - Low calorie diet
  - Low fiber diet
  - Immobility
- Iatrogenic
  - Medications

Figure Legend

Figure 1. Manometric and electromyographic recordings seen with normal (A) and abnormal (B) defecation. EMG: Electromyography; Footnote: Wald A. Manometry. In: Schuster MM, Crowell, MD, Koch, KL, eds. *Atlas of Gastrointestinal Motility in Health and Disease 2nd Edition,* Hamilton, Ontario: BC Decker; 2002: 289-303.


Musculi sphincter ani internus
M. levator ani
M. sphincter ani externus
EMG
5 s
018
80 mmHg
0
Rectal transducer
80 mmHg
0
Anal transducer
Trial to defecate
500μV
External sphincter EMG
Integrated EMG
Musculi sphincter ani internus
M. levator ani
M. sphincter ani externus
EMG
5 s
Rectal transducer
40 mmHg
0
Anal transducer
120 mmHg
0
Trial to defecate
500μV
External sphincter EMG
Integrated EMG

REVIEW: SELF-REPORT MEASURES TO EVALUATE CONSTIPATION

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Abstract

BACKGROUND: Constipation is a subjective phenomenon, and as such must be evaluated using patient self-report. Valid and reliable measures of constipation are essential to standardize the diagnosis, assess the severity, and evaluate the effectiveness of treatments.

AIM: This review compares and contrasts published self-report measures of constipation in terms of development, content, general characteristics, psychometric properties, and clinical utility.

METHODS: MEDLINE (1966-2007), CINAHL (1980-2007), Cochrane (1993-2007), and Web of Science (1995-2007) were searched to identify self-report measures of constipation. Measures of constipation were selected if they: 1) were self-report measures that measured only constipation; 2) had undergone psychometric testing; 3) were used in adults; and 4) were written in English.

RESULTS: Seven self-report measures of constipation were identified. The content areas evaluated by these measures varied. Only two measures had adequate validity and reliability, sensitivity to change, or were tested in more than one sample.

CONCLUSIONS: Findings from this review suggest that the Chinese constipation Questionnaire and the Patient Assessment of Constipation-Symptom Questionnaire demonstrate adequate psychometric properties for a constipation measure. Additional research is warranted to refine or develop a more comprehensive self-report measure to evaluate constipation in adults.

Introduction

Constipation, a common problem that involves a constellation of symptoms, affects between 2% to 27% of the general population (Corazziari, 2004; Harris, 2005; Higgins & Johanson, 2004; Sonnenberg & Koch, 1989; Stewart et al., 1999). The severity of constipation can range from a mild acute event to a chronic condition. Often it requires frequent interventions that may produce mixed or even unsatisfactory results.

A key issue for clinical practice and research is the assessment and measurement of constipation. Because it is a subjective phenomenon, constipation must be evaluated using patient self-report. Valid and reliable measures of constipation are essential to standardize the diagnosis, assess severity, and evaluate the effectiveness of treatments. Such measures have only recently been developed.

To date, no systematic evaluation has been done of the published measures of constipation. Therefore, the purpose of this review is to compare and contrast these measures of constipation in terms of their development, content, general characteristics, psychometric properties, and clinical utility. Understanding the strengths and limitations of existing measures of constipation makes it possible to adapt existing tools or develop new measures that can be used in clinical practice and research.

Methods

Selection of the Constipation Measures

To identify the relevant measures of constipation, a number of strategies were employed. A literature search was conducted using the following databases and time periods: MEDLINE (1966-2007), CINAHL (1980-2007), Cochrane (1993-2007), and Web of Science (1995-2007). The following exploded MeSH terms were used:

(constipation OR functional constipation) AND (instrument OR questionnaire OR inventory OR scale OR assessment).

Criteria for inclusion of a measure were: 1) self-report measures that measured only constipation; 2) had undergone psychometric testing; 3) were used in adults; and 4) were written in English. Measures were excluded if they evaluated constipation in children and/or measured other symptoms in addition to constipation.

The abstracts of 900 citations were reviewed to determine if the paper described the development and testing of a self-report measure for constipation. Based on this initial screening and a review of the reference lists, ten papers were reviewed and seven met the criteria for inclusion in this review. The seven studies (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996; Chan et al., 2005; Frank, Kleinman, Farup, Taylor, & Miner, 1999; Garrigues et al., 2004; Knowles et al., 2000; McMillan & Williams, 1989; Pamuk, Pamuk, & Celik, 2003) described the development and testing of seven different self-report measures of constipation. Table 1 provides a synthesis of the content of the seven self-report measures selected for this review. Table 2 summarizes their psychometric properties and Table 3 summarizes their characteristics and clinical utility.

Results

Description of Measures and Reports of Psychometric Testing

Each measure, described below in chronologic order of development, is summarized in terms of its characteristics, scoring procedure, and psychometric properties. The criteria used to evaluate the measures consisted of established validity and reliability, ability to identify constipation, and sensitivity to change over time.

The Constipation Assessment Scale (CAS)

The CAS (McMillan & Williams, 1989) is an 8-item self-report measure designed to assess the presence and severity of constipation in cancer patients taking opioids or vinca alkaloids. The CAS was subsequently modified and validated for use with women during pregnancy (Broussard, 1998).

Constipation was defined qualitatively as defecation less than normal, amount of stool less than normal, and bowel movements that were painful or difficult. The CAS was developed from a list of 22 defining characteristics for constipation proposed by McShane and McLane (McShane & McLane, 1985). Characteristics that appeared to be peripheral to constipation (such as headache) were removed. Eight characteristics were included in the initial evaluation of the CAS: abdominal distention or bloating, change in the amount of gas passed rectally, less frequent bowel movements, oozing liquid stool, rectal fullness or pressure, rectal pain with bowel movements, small volume of stool, and inability to pass stool.

A three point summated rating scale was constructed (0 = "no problem", 1 = "some problem", 2 = "severe problem"). A total score is calculated that can range from 0 (no constipation) to 16 (severe constipation). Each item is rated based on the patients' experience with each characteristic in the previous week. A score of ≥ 1 indicates constipation. No cutoff score was provided.

Content validity was established through a review of the literature. Construct validity was evaluated by comparing 32 patients (69% female; mean age=53.9 years) who were at risk for developing constipation from cancer treatments to 32 healthy adults (94% female; mean age=37.9). Significantly higher constipation scores were reported by the cancer

patients than by the control group (t=6.32, p<0.0001). In addition, symptom severity was evaluated in two subgroups of the 32 cancer patients. Significantly higher CAS scores were reported by patients who received morphine than those who received vinca alkaloids (t=2.54, p<0.01) (McMillan & Williams, 1989).

Test-retest reliability of the CAS with one-hour delay was high in a sample of 32 healthy controls (r=0.98, p=0.000) (McMillan & Williams, 1989). The internal consistency of the CAS was found to be acceptable (α = 0.70 and 0.78) in a single study. The findings from this single, small study, led the authors to conclude that the CAS had acceptable psychometric properties to measure the severity of constipation.

The CAS was modified and validated to assess constipation in pregnant women (Broussard, 1998). The original 8-item measure was revised from a 3-point to a 5-point summated rating scale. A total score can range from 0 to 32, with 0 to 8 indicating no to minimal problems with constipation during pregnancy; 9 to 16, indicating some problems; 17 to 24, indicating some to moderately severe problems; and 25 to 32, indicating moderately severe to severe problems. The revised scale was tested in a sample of 30 pregnant women (15 who had low-risk pregnancies and 15 who had high-risk pregnancies) and 16 non-pregnant women of childbearing age. The revised measure was found by an expert panel to have a high calculated percentage of agreement of 0.75 and a Cohen's kappa of 0.71. Test-retest and internal consistency estimates for the revised measure were also high (r = 0.84, α = 0.82, respectively).

Constipation Scoring System (CSS)

The CSS (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996) is an 8-item self report measure designed to assess the prevalence and severity of constipation. The

authors used a pathophysiologic definition of constipation. The scoring system is based on eight variables (frequency of bowel movements; difficult or painful evacuation; completeness of evacuation; abdominal pain; time per attempt; type of assistance including laxatives; digitations or enemas; number of unsuccessful attempts at evacuation in a 24 hour period; duration of constipation). The CSS consists of 7 items that are scored using 5-point Likert scales that range from 0 (none of the time) to 4 (all of the time) and one item that is rated on a 0 to 2 scale. A total score can range from 0 (normal) to 30 (severe constipation). A cutoff score of 15 suggests constipation.

The measure was tested in a sample of 232 patients with constipation referred for an anorectal physiology evaluation (79.4% female; mean age=64.9). Significant correlations, between CSS scores and objective findings from anorectal physiology tests, provide evidence of criterion validity (r not reported, $p<0.05$). In addition, CSS scores differentiated between patients who were constipated and those who were not; both groups were confirmed by physiologic testing, with 96% accuracy. Additional evidence to support the discriminant validity of the CSS comes from its ability to distinguish between subgroups of constipated and not constipated patients whose condition was confirmed by physiologic tests. Physiologic tests in this validation study were used to establish convergent validity. However, no data were reported on the reliability of the CSS, its responsiveness, or its sensitivity to change.

Patient Assessment of Constipation – Symptom (PAC-SYM)

The PAC-SYM (Frank, Kleinman, Farup, Taylor, & Miner, 1999) was developed as a brief, easily administered tool to assess symptom frequency and severity of chronic constipation. The authors used a definition for constipation based on the Rome II criteria

(Thompson et al., 1999). This 12-item self-report measure is divided into three symptom subscales (i.e., abdominal, rectal, stool). Items are scored on a 4-point Likert scale, with 4 indicating the worst symptom severity. A total score for the PAC-SYM can range from 0 to 48. No cutoff score was reported.

The initial psychometric evaluation of the PAC-SYM involved patients (n=216; 93.5% female; mean age=42.22) from nine sites (Frank, Kleinman, Farup, Taylor, & Miner, 1999). Subsequently, the validity of the PAC-SYM was evaluated for use in older adults in long-term care facilities (Frank, Flynn, & Rothman, 2001) and in patients with low back pain and opioid-induced constipation (Slappendel, Simpson, Dubois, & Keininger, 2006).

Criterion or concurrent validity was established based on the high correlations between patient and investigator global severity ratings. Construct validity of the PAC-SYM was established using exploratory factor and multi-trait analyses. Six factors were retained based on Eigen values of >1 and factor loadings of > 0.3 on at least 4 items. The factor matrices were used to identify a 5-factor solution or 5 subscales: stool symptoms, rectal symptoms, abdominal symptoms, systemic symptoms, urgency symptoms. Systemic symptoms and urgency symptoms were found to be separate from the constipation symptom domain and were deleted. The final 12 items were assigned to three subscales: stool, rectal, abdominal symptoms (Frank, Kleinman, Farup, Taylor, & Miner, 1999).

Positive correlations between three items recorded in a bowel diary (straining, incomplete evacuation, stool consistency) and corresponding symptoms on the PAC-SYM provide evidence of convergent validity. Additional evidence of the PAC-SYM's

validity comes from moderate positive correlations between items on the Medical Outcomes Study-Short Form 36 (SF-36) scale (Ware, Snow, Kosinski, & Gandek, 1993) and the Patient Global Well Being (PGWB) scale (Dupuy, 1984). Participants who received interventions for constipation were assessed at three different times using the PAC-SYM, in order to assess for both sensitivity to change and discriminant validity. The PAC-SYM distinguished between responders (those who reported improvement in symptoms) and non-responders (those who reported no change or worse symptoms) (t=6.12, p< 0.001) (Frank, Kleinman, Farup, Taylor, & Miner, 1999).

Estimates of test-retest reliability of the initial measure were high (r=0.74, intraclass correlation coefficient (ICC) = 0.72, p<0.01). The Cronbach's alpha for the total PAC-SYM score was 0.98. Test-retest and internal consistency estimates for the final measure were high (α = 0.89, ICC 0.75). Subscale Cronbach's alphas were 0.80 for stool symptoms, 0.84 for abdominal symptoms, and 0.87 for rectal symptoms (Frank, Kleinman, Farup, Taylor, & Miner, 1999).

Knowles Eccersley Scott Symptom Score (KESS)

The KESS (Knowles et al., 2000) is an 11-item measure that was developed to help diagnose constipation and to discriminate among pathophysiologic subgroups. The authors acknowledged that constipation is a poorly defined clinical symptom, but did not provide a definition of constipation. This omission makes evaluation of content validity nearly impossible. Items on the KESS are based on a review of the literature, items from the CSS questionnaire (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996), as well as the Rome II criteria (Thompson et al., 1999). The KESS uses 4 to 5 point Likert scales

that are scored on an unweighted linear integer scale. Total scores can range from 0 (no symptoms) to 39 (high symptom severity). A cutoff score of ≥ 11 indicates constipation.

The KESS was tested in a sample of patients with chronic constipation (n=71; 93% female) and healthy controls (n=20; 90% female) with a similar, unspecified age distribution in each group (Knowles et al., 2000). Content validity was established through a review of the literature and incorporation of elements from the Rome II criteria and the CSS into the KESS. In a sample of patients with constipation, convergent validity was established based on significant correlations between KESS and CSS scores (r=0.90). In addition, the KESS was able to discriminate between constipated patients, whose diagnosis was confirmed with physiologic tests, and healthy controls. KESS scores predicted which patients had pure slow-transit constipation or rectal evacuatory disorder better than patients with a mixed etiology (ROC 55%, CI 43-67%). However, no significant differences were found in median total KESS scores by subgroup (p= 0.13). No data are available on the reliability of the KESS or on its responsiveness or sensitivity to change.

Visual Scale Analog Questionnaire (VSAQ)

The VSAQ (Pamuk, Pamuk, & Celik, 2003) is a five-item tool designed to assess the frequency and severity of constipation symptoms in healthy individuals. The Rome II definition of constipation was used to create the items. Two of the 5 VSAQ items, stool consistency and straining, are rated on a Likert scale that ranges from 1 to 5. Three items, presence of constipation, duration of constipation, incomplete evacuation, are rated on a 0 to 10 scale. Methods for scoring the VSAQ are not reported, although a score of ≥ 3 on the 0 to 10 scale is the cutoff score for constipation.

The VSAQ was tested in a sample of healthy hospital employees (n = 369; 53.6% female; mean age=31.6). Participants were asked to rate each bowel movement for seven days. Significant correlations were found between items on the VSAQ and bowel diaries (i.e., straining, incomplete evacuation). The VSAQ was found to be discriminative only for those participants without constipation, not for those with constipation. Estimates of test-retest reliability were high in healthy participants (kappa= 0.97). However, no data were reported on criterion validity, internal consistency, or sensitivity to change.

Garrigues Questionnaire (GQ)

The GQ (Garrigues et al., 2004) is a 21-item self-report measure that was developed to define the presence of chronic constipation. Only 13 of the 21 items are related to bowel habits. The Rome I (Drossman, 1989) and Rome II (Thompson et al., 1999) criteria were used to define constipation. A pilot study of 10 people determined that the GQ was easy to understand and to complete. The items are scored using two different 4-point Likert scales. The first consisted of "never", "sometimes" (<25% of the time), "often" (≥ 25 % of the time) and "always". The second consisted of "never", "fewer than once a week", "one or more times a week", and "every day". Total and cut off scores were not reported.

The measure was tested in a sample of 349 participants (52.1% female; age range 18 to 65 years). Content validity was established through having included the Rome criteria in the development of the measure. Convergent validity was reported through partial testing of the Rome I and II criteria. The GQ was able to discriminate between participants with constipation and those without it. However, the low, positive likelihood

ratios limit the clinical usefulness of the GQ to identify individuals with constipation. No data were reported on the reliability of the GQ or on its sensitivity to change.

Chinese Constipation Questionnaire (CCQ)

The CCQ (Chan et al., 2005) is a six-item self-report measure designed to diagnose functional constipation in Chinese participants. The Rome II criteria (Thompson et al., 1999) were used as the definition of constipation.

A sample of 111 patients (95% female; mean age=38.5) with constipation and 110 healthy controls (64% female; mean age=34.2) participated in a 4-week psychometric evaluation of the CCQ. The initial version of the CCQ consisted of 24 items that were scored using a 5-point Likert scale. Principal components analysis was used to create the final version of the CCQ that consisted of six items with 4 subscales: bowel function, stool and rectal symptoms, laxative use, abdominal symptoms. A composite score was generated by principal components analysis with a cut-off score of ≥ 5 being able to discriminate between controls and constipated patients with both a sensitivity and specificity of 91%.

Content validity of the CCQ was established through interviews with patients and a review of the literature. Evidence of construct validity was provided by negative correlations between CCQ scores and seven domains on the SF-36 scale (Ware, Snow, Kosinski, & Gandek, 1993) (physical functioning, role physical, bodily pain, general health, social functioning, role emotional, mental health), but not vitality. In addition, the CCQ was able to discriminate between constipated patients and healthy controls.

Estimates of test-retest reliability were high (ICC = 0.70, $p<0.01$), with patients rating themselves unchanged from baseline and at a second retesting 10 to 14 days later. Cronbach's alpha for the total CCQ score was 0.79.

Critique of the Seven Constipation Measures

Definition of Constipation

Defining a construct is an important first step in the development of a measure. Historically, measurement of stool frequency was used to define constipation. "Normal" frequency of stool evacuation comprises a narrow to a broad range of time that has large intra- and inter-individual variability. This self-report criterion does not describe the entire symptom experience of constipation. The definition of constipation has evolved to now include abdominal and rectal symptoms.

Wide variations exist in the definition of constipation used in the development of measures included in this review. The CSS and KESS utilized a purely pathophysiologic definition based on the underlying etiology of constipation (e.g., slow transit, pelvic outlet obstruction). Interestingly, developers of the CSS and KESS attempted to identify the subtypes of constipation more from a clinical than a mechanistic perspective. In contrast, the developers of the CAS provided a clear definition of constipation and used it to develop the instrument. The CCQ, PAC-SYM, and VSAQ were developed using the Rome II criteria (Thompson et al., 1999), whereas the developers of the GQ used both the Rome I (Drossman, 1989) and Rome II (Thompson et al., 1999) criteria.

Content of the Measures

How a construct is operationalized is represented by the content included in the measure. Table 1 provides a synthesis of the content evaluated by each measure. We compared each measure to the others in terms of its specific content. We also compared the content of each measure to the symptoms of functional constipation found in the most recent version of the Rome criteria (Longstreth et al., 2006) (i.e., at least two or more of the following symptoms at least 25% of the time: straining, lumpy or hard stools, sensation of incomplete evacuation, sensation of anorectal obstruction, manual maneuvers to facilitate evacuation, fewer than 3 defecations per week). Since no gold standard exists for the evaluation of the symptoms of constipation, we compared the content of these measures to the Rome III criteria because these criteria are a diagnostic standard (Johanson & Kralstein, 2007).

All but one (Frank, Kleinman, Farup, Taylor, & Miner, 1999) of the seven measures evaluates some aspect of stool frequency. However, only the CCQ and VSAQ assess frequency of bowel movements using the Rome III format of <3 bowel movements per week. The remaining measures assess stool frequency in a variety of ways and three measures (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996; Garrigues et al., 2004; Knowles et al., 2000) include an evaluation of the length of time per attempt.

Stool consistency is evaluated in all but one (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996) of the measures. In five of the measures (Chan et al., 2005; Frank, Kleinman, Farup, Taylor, & Miner, 1999; Garrigues et al., 2004; Knowles et al., 2000; Pamuk, Pamuk, & Celik, 2003), hard stool is one of the descriptors and is consistent with

the Rome III criteria. At the other end of the continuum, the descriptors of stool consistency are not consistent (e.g., oozing, watery).

In terms of rectal symptoms, all seven measures include a rating of incomplete evacuation, which is one of the Rome III criteria. Five measures (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996; Chan et al., 2005; Frank, Kleinman, Farup, Taylor, & Miner, 1999; Garrigues et al., 2004; Knowles et al., 2000; McMillan & Williams, 1989) have "urge to defecate present, unable to defecate" as one of the items in this content area. Three measures (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996; Frank, Kleinman, Farup, Taylor, & Miner, 1999; McMillan & Williams, 1989) include a rating of "pain with defecation". Only three measures (Frank, Kleinman, Farup, Taylor, & Miner, 1999; Garrigues et al., 2004; Pamuk, Pamuk, & Celik, 2003) contain the other Rome criterion, namely straining.

Six of the seven measures include abdominal symptoms. The two most common symptoms assessed are bloating and abdominal pain. These symptoms do not appear in the Rome III criteria for functional constipation, but are descriptors for Irritable Bowel Syndrome.

Only three (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996; Garrigues et al., 2004; Knowles et al., 2000) of the seven measures assess for the use of assistive measures, which is part of the Rome III criteria. Only three of the measures (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996; Knowles et al., 2000; Pamuk, Pamuk, & Celik, 2003) evaluate the duration of constipation.

None of the seven measures includes all of the Rome III criteria for functional constipation. The total number of items matching the Rome III criteria ranges from only

one (McMillan & Williams, 1989) to five (Garrigues et al., 2004) of the six, in addition to a range of other symptoms described above and in Table 1. Our review of the content in all of the measures suggests that the assessment of constipation using self-report measures is complex.

Psychometric Properties: Validity

The psychometric properties of the seven measures are summarized in Table 2. All of the measures provide some evidence of content validity. Most of the measures were developed based on a review of the literature, but the CCQ and the PAC-SYM were based on patient interviews and clinical opinions. Four measures provided evidence of good to moderate criterion validity by demonstrating significant correlations between the measure's scores and Rome I and II criteria (Garrigues et al., 2004), anorectal physiologic tests (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996; Chan et al., 2005; Frank, Kleinman, Farup, Taylor, & Miner, 1999; Garrigues et al., 2004; Knowles et al., 2000), or patient and investigator global severity ratings (Frank, Kleinman, Farup, Taylor, & Miner, 1999).

Evidence of convergent validity was established in five measures (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996; Frank, Kleinman, Farup, Taylor, & Miner, 1999; Garrigues et al., 2004; Knowles et al., 2000; Pamuk, Pamuk, & Celik, 2003) through significant correlations between constipation symptoms and a variety of constipation measures such as bowel diaries, Rome criteria, and self-report measures. However, the authors of the CSS did not identify the measures used to support their assertion of convergent validity.

Only the CCQ and the PAC-SYM provided evidence of divergent validity. Both of these measures were associated with changes in QOL. Patients with higher constipation scores on the CCQ reported lower scores on seven domains of the SF-36 (Ware, Snow, Kosinski, & Gandek, 1993). The PAC-SYM had moderate positive correlations with items on both the SF-36 and PGWB (Dupuy, 1984), showing a relationship between symptoms and QOL. The authors of the PAC-SYM concluded that their tool measured a construct distinct from QOL.

Though discriminant validity was tested in all seven of the measures, only four of them (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996; Chan et al., 2005; Knowles et al., 2000; McMillan & Williams, 1989) provided evidence to support their measure's ability to discriminate between patients with and without constipation, and only one of them[8] provided evidence to support their measure's ability to discriminate between responders and non responders. The two other measures (Garrigues et al., 2004; Pamuk, Pamuk, & Celik, 2003) were only able to identify patients who did not have constipation which limits the utility of these measures.

A validity test essential for measures with evaluative purpose is sensitivity to change. This test, frequently mistaken for test-retest, analyzes the sensitivity of the tool to measure changes in a symptom over time. Only the PAC-SYM and the CCQ provided evidence of the measure's ability to detect changes in constipation over time.

Psychometric Properties: Reliability

Reliability estimates were reported for only four (Chan et al., 2005; Frank, Kleinman, Farup, Taylor, & Miner, 1999; McMillan & Williams, 1989; Pamuk, Pamuk, & Celik, 2003) of the seven scales. All four have Cronbach's alphas in the acceptable

range of ≥ 0.70. In addition, adequate estimates of test-retest reliability were reported for the same four measures (Chan et al., 2005; Frank, Kleinman, Farup, Taylor, & Miner, 1999; McMillan & Williams, 1989; Pamuk, Pamuk, & Celik, 2003).

Our analysis of their psychometric properties found that only the CCQ and the PAC-SYM provide robust evidence of validity and reliability. Both measures also provide evidence of their sensitivity to detect change over time. Of these two measures, only the PAC-SYM has undergone psychometric evaluation in more than one patient sample (Frank, Flynn, & Rothman, 2001; Slappendel, Simpson, Dubois, & Keininger, 2006).

General Characteristics of the Seven Constipation Measures

Table 3 summarizes the general characteristics and clinical utility of the seven measures. Three measures (42.8%) were developed in the United States (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996; Frank, Kleinman, Farup, Taylor, & Miner, 1999; McMillan & Williams, 1989), one in Hong Kong (Chan et al., 2005), one in Spain (Garrigues et al., 2004), one in Turkey (Pamuk, Pamuk, & Celik, 2003), and one in the United Kingdom (Knowles et al., 2000). Only the PAC-SYM has been translated into several languages, though validation studies of the translations have not been published.

The target population was identified in all seven of the measures. For two of the measures (Garrigues et al., 2004; Knowles et al., 2000; McMillan & Williams, 1989; Pamuk, Pamuk, & Celik, 2003), the target population was the general population, which consisted of healthy individuals. Four measures (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996; Chan et al., 2005; Frank, Kleinman, Farup, Taylor, & Miner, 1999; Knowles et al., 2000) identified patients with constipation as the target population. Only

one measure (McMillan & Williams, 1989) was constructed as a risk assessment measure for patients undergoing cancer treatment.

Participant and administrator burden are minimal for all seven of the measures. Time to completion ranges from 5 to 15 minutes because the number of items ranges from 5 to 21. Six measures have less than 12 items. While short measures are clinically useful, they may lack sensitivity and specificity.

All of the measures used some form of a Likert scale, with 3 to 5 points to rate items. While the Likert scale is a widely used scaling technique, the requirements for a "good" scale include a minimum number of items (usually > 10 items) and an adequate number of response alternatives (usually ≥ five points) to ensure the scale's reliability (Nunnally & Bernstein, 1994). Only the PAC-SYM meets both of these criteria.

A cutoff score is an important aspect of the clinical utility of a measure. Without a cutoff score, it is difficult to use a measure for treatment decisions and outcome evaluation. Five of the measures (Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996; Chan et al., 2005; Knowles et al., 2000; McMillan & Williams, 1989; Pamuk, Pamuk, & Celik, 2003) reported a cutoff score for the presence of constipation. The scoring system for the KESS is rather complicated, which may limit its clinical utility.

Conclusions

Only the CCQ (Chan et al., 2005) meets all of our pre-specified criteria for a constipation self-report measure. It underwent rigorous development and testing; provided robust estimates of validity and reliability; described a cutoff score that discriminated for constipation; and provided evidence of the measure's sensitivity to detect change over time. The major limitation of the CCQ is that it was designed for a

Chinese speaking population and no published reports in English speaking populations were identified, which suggests that it is not widely used. The PAC-SYM (Frank, Kleinman, Farup, Taylor, & Miner, 1999) is an acceptable alternative. Though a cutoff score and its ability to discriminate between healthy and symptomatic patients have not been determined, other positive aspects of this measure include the degree of rigor used in its development, robust validity and reliability estimates, its sensitivity to detect change, and use in English speaking populations.

The results of this summary and critique suggest that additional research is warranted to refine or develop a more comprehensive self-report measure to evaluate constipation in adults. As this review highlights, no one perfect measure is currently available. A measure is needed that evaluates the complex constellation of symptoms that constipation encompasses. Using the findings from this review, more comprehensive measures can be developed and tested in a variety of clinical populations, as well as in the general population. The development of more valid, reliable, and comprehensive self-report measures of constipation will facilitate research on its epidemiology and management.

References

Agachan, F., Chen, T., Pfeifer, J., Reissman, P., & Wexner, S. D. (1996). A constipation scoring system to simplify evaluation and management of constipated patients. *Diseases of the Colon and Rectum, 39*, 681-685.

Broussard, B. S. (1998). The constipation assessment scale for pregnancy. *Journal of Obstetric, Gynecologic, and Neonatal Nursing, 27*, 297-301.

Chan, A. O., Lam, K. F., Hui, W. M., Hu, W. H., Li, J., Lai, K. C., et al. (2005). Validated questionnaire on diagnosis and symptom severity for functional constipation in the Chinese population. *Alimentary Pharmacology and Therapeutics, 22*, 483-488.

Corazziari, E. (2004). Definition and epidemiology of functional gastrointestinal disorders. *Best Practices Research Clinical Gastroenterology, 18*, 613-631.

Drossman, D. A. (1989). A questionnaire for functional bowel disorders. *Annals of Internal Medicine, 111*, 627-629.

Dupuy, H. (1984). The Psychological Well-Being (PGWB) Index. In N. K. Wenger, M. E. Mattson, C. D. Furberg, & J. Elinson (Ed.), *Assessment of quality of life in clinical trials of cardiovascular therapies* (pp. 170-183, 353-176). Greenwich: Le Jacq Publications.

Frank, L., Flynn, J., & Rothman, M. (2001). Use of a self-report constipation questionnaire with older adults in long-term care. *Gerontologist, 41*, 778-786.

Frank, L., Kleinman, L., Farup, C. E., Taylor, L., & Miner, P., Jr. (1999). Psychometric validation of a constipation symptom assessment questionnaire. *Scandinavian Journal of Gastroenterology, 34*, 870-877.

Garrigues, V., Galvez, C., Ortiz, V., Ponce, M., Nos, P., & Ponce, J. (2004). Prevalence of constipation: Agreement among several criteria and evaluation of the diagnostic accuracy of qualifying symptoms and self-reported definition in a population-based survey in Spain. *American Journal of Epidemiology, 159*, 520-526.

Harris, L. A. (2005). Prevalence and ramifications of chronic constipation. *Managing Care Interface, 18*, 23-30.

Higgins, P. D., & Johanson, J. F. (2004). Epidemiology of constipation in North America: A systematic review. *American Journal of Gastroenterology, 99*, 750-759.

Johanson, J. F., & Kralstein, J. (2007). Chronic constipation: A survey of the patient perspective. *Alimentary Pharmacology and Therapeutics, 25*, 599-608.

Knowles, C. H., Eccersley, A. J., Scott, S. M., Walker, S. M., Reeves, B., & Lunniss, P. J. (2000). Linear discriminant analysis of symptoms in patients with chronic constipation: Validation of a new scoring system (KESS). *Diseases of the Colon and Rectum, 43*, 1419-1426.

Longstreth, G. F., Thompson, W. G., Chey, W. D., Houghton, L. A., Mearin, F., & Spiller, R. C. (2006). Functional bowel disorders. *Gastroenterology, 130*, 1480-1491.

McMillan, S. C., & Williams, F. A. (1989). Validity and reliability of the Constipation Assessment Scale. *Cancer Nursing, 12*, 183-188.

McShane, R. E., & McLane, A. M. (1985). Constipation: Consensual and empirical validation. *Nursing Clinics of North America, 20*(801-808).

Nunnally, J. C., & Bernstein, I. R. (1994). *Psychometric theory* (3rd ed.). New York: McGraw-Hill.

Pamuk, O. N., Pamuk, G. E., & Celik, A. F. (2003). Revalidation of description of constipation in terms of recall bias and visual scale analog questionnaire. *Journal of Gastroenterology and Hepatology, 18*, 1417-1422.

Slappendel, R., Simpson, K., Dubois, D., & Keininger, D. L. (2006). Validation of the PAC-SYM questionnaire for opioid-induced constipation in patients with chronic low back pain. *European Journal of Pain, 10*, 209-217.

Sonnenberg, A., & Koch, T. R. (1989). Epidemiology of constipation in the United States. *Diseases of the Colon and Rectum, 32*, 1-8.

Stewart, W. F., Liberman, J. N., Sandler, R. S., Woods, M. S., Stemhagen, A., Chee, E., et al. (1999). Epidemiology of constipation (EPOC) study in the United States: Relation of clinical subtypes to sociodemographic features. *American Journal of Gastroenterology, 94*, 3530-3540.

Thompson, W. G., Longstreth, G. F., Drossman, D. A., Heaton, K. W., Irvine, E. J., & Muller-Lissner, S. A. (1999). Functional bowel disorders and functional abdominal pain. *Gut, 45 Suppl 2*, II43-47.

Ware, J. E., Snow, K. K., Kosinski, M., & Gandek, B. (1993). *SF-36 Health Survey. Manual and interpretation guide*. Boston: Health Institute

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Table 1. Summary of the Content Areas Evaluated in Seven Self-Report Measures of Constipation

Content Areas	Constipation Measures						
	Chinese Constipation Questionnaire (CCQ)(Chan et al., 2005)	**Constipation Assessment Scale (CAS)(McMillan & Williams, 1989)**	**Constipation Scoring System (CSS)(Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996)**	**Garrigues Questionnaire (GQ)(Garrigues et al., 2004)**	**Knowles, Eccersley, Scott Symptom Score (KESS)(Knowles et al., 2000)**	**Patient Assessment of Constipation-Symptom Questionnaire (PAC-SYM)(Frank, Kleinman, Farup, Taylor, & Miner, 1999)**	**Visual Scale Analog Questionnaire (VSAQ)(Pamuk, Pamuk, & Celik, 2003)**
Stool Frequency	< 3 per week *	Less frequent than normal	1-2 times per 1-2 days to < 1 per month Length of time per attempt	# per week Length of time per attempt	1-2 times per 1-2 days to <1 per 2 weeks Length of time per attempt		< 3 per week*
Stool Consistency	Hard/lumpy *	Small/oozing		Hard * or small Loose or watery	Hard * to pellet like Soft/loose/ Normal	Hard * Small	Hard * or pellety Watery
Rectal Symptoms	Incomplete evacuation *	Incomplete evacuation *	Incomplete evacuation *	Incomplete evacuation *	Incomplete evacuation *	Incomplete evacuation *	Incomplete evacuation *
Abdominal Symptoms	+Urge to defecate Bloating	+Urge to defecate Difficult to pass stools Pain with BM Rectal fullness or pressure Distention/ bloating	+Urge to defecate Pain with BM Abdominal pain	Sensation of anorectal blockage/ obstruction * Strain * Pain, visits to provider > 6X last year	+Urge to defecate Bloating Abdominal pain	+Urge to defecate Strain * Pain with BM Rectal bleeding Bloating Abdominal pain Discomfort in abdomen stomach cramps	Strain *
Assistive Measures			Digital evacuation of stool *	Digital evacuation of stool *	Digital evacuation of stool *		

Content Areas	Constipation Measures						
	Chinese Constipation Questionnaire (CCQ)(Chan et al., 2005)	**Constipation Assessment Scale (CAS)(McMillan & Williams, 1989)**	**Constipation Scoring System (CSS)(Agachan, Chen, Pfeifer, Reissman, & Wexner, 1996)**	**Garrigues Questionnaire (GQ)(Garrigues et al., 2004)**	**Knowles, Eccersley, Scott Symptom Score (KESS)(Knowles et al., 2000)**	**Patient Assessment of Constipation-Symptom Questionnaire (PAC-SYM)(Frank, Kleinman, Farup, Taylor, & Miner, 1999)**	**Visual Scale Analog Questionnaire (VSAQ)(Pamuk, Pamuk, & Celik, 2003)**
Medications	# of Laxatives		Laxatives/ Enemas	Support vagina or perineum * Laxatives/ Enemas/ Suppositories	Laxatives/ Enemas		
Number of items (*) congruent with Rome III (X items of 6)	4 items	1 item	2 items	5 items	3 items	3 items	4 items

Table 2. Summary of Psychometric Properties of the Self-Report Measures for Constipation Assessment

Measure	Participants	Number of items/ Dimensions	Validity						Reliability	
			Content	Criterion	Sensitivity to change	Construct			Internal Consistency	Test-Retest
						Divergent/ Convergent	Factor Analysis	Discriminant		
CCQ	N=221; 111 constipated patients; 110 healthy controls	6 items, Unidimensional, Derived from 30 items	Literature review, patient interview	NR	Kendalls tau = 0.69, $p = 0.001$	DV: Reported; CV: NR	Completed	Present, Sensitivity and Specificity = 91%	Cronbach's alpha = 0.79	ICC = 0.70 10-14 days
CAS	N=64, 32 at-risk patients being treated for cancer; 32 controls healthy adults; 16 healthy adults in the reliability arm	9 items, Unidimensional	Literature review	NR	NR	NR	NR	Present between patients at risk and healthy controls (t=6.32, $p < 0.0001$) Present, Differentiates between moderate and severe intensity (t =2.54, $p < 0.01$)	Cronbach's alpha = 0.70	$r = 0.98$ 1 hour delay
CSS	N=232 consecutive patients with constipation	8 items, Unidimensional, Derived from 100 items with 12 dimensions	Literature review	CSS scores correlate with findings of physiology tests, PPV 96% ($p < 0.05$)	NR	DV: NR; CV: Not performed	NR	Present	NR	NR
GQ	N=349 community dwelling adults; systematic population based	21 items of which 13 are related to bowel habits, Unidimensional	Rome I & II	SR & Rome 1 good (kappa: 0.68, CI: 0.59,0.77) Rome I & Rome II gold standard good (kappa: 0.71, CI: 0.61, 0.81), SR & Rome II moderate (kappa: 0.55, CI: 0.44, 0.65)	NR	DV: NR; CV: Partial test Rome I and II	NR	Present	NR	NR
KESS	N=91 71 chronically constipated patients; 20 asymptomatic	11 items, Unidimensional	Literature review, Rome II and CSS questionnaire	Discriminated between three pathophysiologic subgroups (ROC 55%, CI 43-67%), median total KESS	NR	DV: NR; CV: Correlation with CSS tool (Pearson r = 0.90)	NR	Present, Mann-Whitney U $p < 0.0001$ Sensitivity CI 95-100% and Specificity CI 63-100%	NR	NR

Measure	Participants	Number of items/ Dimensions	Validity						Reliability	
			Content	Criterion	Sensitivity to change	Construct			Internal Consistency	Test-Retest
						Divergent/ Convergent	Factor Analysis	Discriminant		
	controls			scores by subgroup *NS* ($p = 0.13$)						
PAC-SYM	N=216 chronically constipated patients	12 items, Unidimensional 3 subscales: Stool symptoms (a), Rectal symptoms (b), Abdominal symptoms (c), Derived from 44 items	Literature review and 5 focus groups of constipated patients	Correlation of subjects and investigator global severity ratings ($r = 0.72$ & 0.68, $p < 0.001$)	Change from visit 1 to visit 3 noted	DV: Correlation with SF-36 (physical and mental component summary scores) and PGWB ($r = 0.36$, 0.49, 0.54 $p < 0.0001$); CV: Correlation indicated between items and bowel diaries, though no *r*	Completed	Present, $t = -6.12$, $p < 0.001$	Cronbach's alpha = 0.89 0.80 (a) 0.84 (b) 0.87 (c)	ICC = 0.75
VSAQ	N=369 healthy hospital employees, prospective study	5 items, Unidimensional	Literature review, Rome I & II and SR	NR	NR	DV: NR; CV: Correlated with items on daily bowel diaries $r = -0.68$ stool consistency, $r = 0.52$ straining, $r = 0.56$ incomplete evacuation $p < 0.001$	NR	Discriminates only subjects without constipation	NR	Kendall's Tau = 0.47-0.97, 7 day delay

Abbreviations: NR= Not reported; DV: Divergent Validity; CV=Convergent Validity; SR=Self-Report; PPV=Positive Predictive Validity; NS=non significant; ICC=Intra Class Coefficient; PGWB= Patient Global Well Being; SF-36=Medical Outcomes Study-Short Form 36

Table 3. Summary of Constipation Measures: Characteristics and Clinical Utility

Measure	# of items	Response format	Scoring	Time frame	Time to administer. Ease of use, Mode of Administration	Country of Origin Populations in which the instrument has been used	How often cited
CCQ	6	0 to 4 Likert scale, 0= asymptomatic 4= very severe symptoms	Total score 0 to 24; Cutoff score ≥ 5	Preceding 2 weeks & preceding 3 months	Not reported Patient sample reported easy to understand Questionnaire	Hong Kong	0
CAS	8	0 to 2 Likert scale, 0= no problem 2=severe problem	Total score 0 to 16; > 0 = problem with constipation	Preceding week	~2 minutes Readability of the instrument 6th grade level Questionnaire	USA Pregnancy, Opioid constipation in patients with cancer	8
CSS	8	0 to 4 Likert scale for 7 items; 0 to 2 Likert scale for 1 item	Total score 0 to 30; Cutoff for constipation > 15	Not reported	Not reported Not reported Interview format	USA Constipated patients	57 (5 times by the authors)
GQ	21 (13 related to bowel habits)	Never, sometimes, often, always; never, < 1 per week, ≥1 per week, every day	Not reported	Preceding 12 months	Not reported Pilot study concluded easy to understand and to complete Mailed questionnaire	Spain	7
KESS	11	0 to 4 Likert scale for 6 items; 0 to 3 Likert scale for 5 items; Lower scores= symptom free, Increased scores=increased symptom severity	Total score 0 to 39; Cutoff score ≥ 11	Not reported	< 5 minutes Not reported Questionnaire	UK	11
PAC-SYM	12	0 to 4 Likert scale, Frequency: 0= none of the time, 4= all of the time; Severity: 0=absent 4=very severe	Total score 0 to 48; Cutoff score not reported	Preceding 2 weeks	Not reported Pilot study concluded comprehensive and understandable Questionnaire	US (42 translations; not all have been validated) Opioid Constipation, Constipation in Older Adults in Long Term Care	9
VSAQ	5	0 to 10 Likert for 3 items; 1 to 5 Likert scale for 2 items	Total score not reported; Cut off scores > 3	Preceding 12 months	Not reported Not reported Questionnaire	Turkey	2

A REVIEW OF THE LITERATURE ON GENDER AND AGE DIFFERENCES IN THE PREVALENCE AND CHARACTERISTICS OF CONSTIPATION IN NORTH AMERICA

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Abstract

Constipation is a common problem that affects between 2% to 28% of the general population and is thought to affect more women than men. The severity of constipation is variable and it can be an acute or chronic condition. Often it requires frequent interventions that may produce mixed or even unsatisfactory results. Knowledge of potentially gender- and age-related differences in constipation would be useful to clinicians to help them identify high risk patients. In addition, researchers might use this information to design both descriptive and intervention studies. This article reviews the evidence from the studies on gender and age differences in prevalence of constipation, gender differences in the prevalence and characteristics of constipation, and age differences in the prevalence and characteristics of constipation. Prevalence of constipation is consistently higher in women than in men. However, evidence of gender differences in characteristics of constipation is inconsistent. Prevalence rates appear to increase gradually after the age of 50, with the largest increase after age 70. The literature is both sparse and inconsistent in its reports of age differences in the characteristics of constipation. This lack of research is a significant issue given the magnitude of this problem in the older adult population. Research is needed on gender and age differences in the symptoms of constipation as well as how covariates impact the prevalence and severity of constipation in the elderly.

KEY WORDS: constipation, symptoms, gender, age, review

Introduction

Constipation is a common problem that affects between 2% to 28% of the general population (Corazziari, 2004; Harris, 2005; Higgins & Johanson, 2004; Sonnenberg & Koch, 1989; Stewart, Lieberman, Sandler, et al., 1999) and is thought to affect more women than men (Higgins & Johanson, 2004). It leads to an estimated 2.5 million physician visits annually in the United States (Sonnenberg & Koch, 1989) with a reported expenditure of $7,522 per patient (Nyrop, Palsson, Levy, et al., 2007). The severity of constipation is variable and it can be an acute or chronic condition. Often it requires frequent interventions that may produce mixed or even unsatisfactory results.

In addition, constipation is expensive to treat, especially in the elderly. In the United States (US), the estimated annual cost of treatment is $1 billion which includes an annual laxative expenditure of several hundred million dollars (Lembo & Camilleri, 2003). Complications, though not life-threatening, place the elderly at increased risk for hospitalizations and long term placement in an institution (Harari, Gurwitz, Avorn, Choodnovskiy, & Minaker, 1994). These constipation-associated complications include: anorectal problems (e.g., fissures, hemorrhoids, sigmoid volvulus, rectal prolapse), fecal impaction (Creason & Sparks, 2000; Read, Celik, & Katsinelos, 1995), fecal incontinence (Chassagne, Jego, Gloc, et al., 2000; Read & Abouzerky, 1986), and urinary dysfunction (Chiarelli, Brown, & McElduff, 1999; Kinnunen, 1991).

According to the Administration on Aging (2004), the older population in the US will grow to more than twice its current number, reaching 71.5 million by 2030 when the last of the baby boom generation reaches age 65. Recent projections suggest the majority of the elderly will be female, non-institutionalized, and living alone.

Most patients with a complaint of constipation have a functional disorder that affects the colon or rectum. The most common method used to classify constipation is the Rome III criteria (Drossman, 2006). This symptom based criteria were developed by an international panel of experts to aid in the diagnosis and management of a number of functional gastrointestinal disorders (i.e., constipation-predominant Irritable Bowel Syndrome (IBS), functional constipation, and pelvic floor dyssynergia also referred to as outlet delay, dyschezia, or obstructed defecation). Functional constipation, one of the most common types of constipation, is defined by the Rome III criteria as a functional bowel disorder that presents as persistently difficult, infrequent, or seemingly incomplete evacuation that does not meet IBS criteria (Drossman, 2006). However, the differential diagnosis of constipation is difficult because the same symptoms occur across the various types.

While several large epidemiologic studies have noted that constipation is a significant problem (Stewart et al., 1999; Everhart, Go, Hohannes, Fitzsimmons, et al., 1989; Pare, Ferrazzi, Thompson, Irvine, & Rance, 2001), no systematic evaluation of the magnitude of the problem in terms of gender and age exists in the literature. Knowledge of potentially gender- and age-related differences in constipation would be useful to clinicians to help them identify high risk patients. In addition, researchers might use this information to design both descriptive and intervention studies. Therefore, the purposes of this review are to summarize the findings in: the prevalence of constipation in the general population; gender differences in the prevalence and characteristics (i.e., specific symptoms, diagnostic subgroups) of constipation; and age differences in the prevalence

and characteristics of constipation. The paper concludes with a discussion of gaps in the current literature and recommendations for future research.

Methods

To identify the relevant epidemiologic studies on constipation, a number of strategies were employed. A literature search was conducted that included the following databases and time periods: MEDLINE (1966-2007), CINAHL (1980-2007), and Cochrane (1993-2007). The following exploded MeSH terms were used: (constipation OR functional constipation) AND (incidence OR prevalence OR natural history OR epidemiology) AND (gender identity OR sex factors OR male OR female OR man OR men OR woman OR women) AND (age factors OR aged OR older OR 80 and over OR middle age). Only epidemiologic studies from North American populations were evaluated in this review.

The criteria for study inclusion were: (1) studies of population-based samples of adults with constipation; (2) results reported on prevalence, natural history, gender, or age; (3) results published in full manuscript form; and (4) papers published in English. Data on study methodology and results were abstracted. In addition, data abstraction involved the following information: (1) what symptom-based definition of constipation was used (e.g., patient self-report, Rome Criteria); (2) sample size; (3) sampling strategy used to identify participants with constipation; and (4) overall prevalence of constipation, as well as prevalence by diagnostic subgroups or symptoms, gender distribution, and age distribution.

The abstracts of all of the citations identified through this literature search were reviewed. Potentially relevant studies were retrieved and the selection criteria were

applied. Manual searches of reference lists from potentially relevant articles were performed to identify any additional studies that were missed during the computer-assisted search. Over 250 articles were identified using the above criteria and 16 met the pre-specified inclusion criteria. Ten studies evaluated the overall prevalence of constipation; 11 evaluated for gender differences; and 11 evaluated for age differences. Some studies addressed more than one topic.

Results

Overall Prevalence of Constipation in North America

Data from the ten studies on the prevalence of constipation are summarized in Table 1. Nine of these studies were conducted in the United States and one was done in Canada. Sample sizes ranged from 690 to 890,394. Eight of these studies reported data from national surveys (i.e., American Cancer Society (ACS), National Health Interview Survey (NHIS), National Health and Nutrition Evaluation Survey (NHANES), US Householder Survey, the US Epidemiology of Constipation (EPOC), Canada EPOC and two studies were population-based surveys of residents of Olmsted County, Minnesota. Four studies used face-to-face interviews (Everhart, et al., 1989; Johanson, SOnnenberg, & Koch, 1989; Sandler, Jordan, & Shelton, 1990; Harari, Gurwitz, Avorn, Bohn, & Minaker, 1996), five used mail surveys (Pare, et al., 2001; Hammond, 1964; Talley, Zinzmeister, Van Dyke, & Melton, 1991; Talley, Weaver, Zinsmeister, & Melton, 1993; Drossman, Li, Andruzzi, et al., 1993), and one used a phone survey (Stewart, et al., 1999) to collect data.

The overall prevalence of constipation ranged from 1.9 to 27.2 per 100 participants. The variations in prevalence estimates may be related to the different

definitions of constipation used across studies, as well as the methods of data collection. For example, in the studies that defined constipation based on participants' self-reports (Everhart, et al., 1989; Pare, et al., 2001; Johanson, Sonnenberg, & Koch, 1989; Sandler, Jordan, & Shelton, 1990; Harari, et al., 1996; Hammond, 1964; Talley, et al., 1992), the prevalence rates ranged from 1.9 to 27.2. In contrast, in those studies that defined constipation using either the Rome I (Pare, et al., 2001; Talley, et al., 1993; Drossman, et al., 1993) or Rome II (Stewart, et al., 1999; Pare, et al., 2001) criteria, the prevalence rates were generally lower (i.e., 3.6 to 16.7).

In terms of methods of data collection, the prevalence rate based on one phone survey was 14.7. This rate is closer to the high end of those obtained through face-to-face interviews (i.e., 1.9 to 15.8) and mid-range in terms of those obtained through mail surveys (i.e., 3.6 to 27.2). Because of the differences in the definitions of constipation and the cross-sectional nature of these studies, it is difficult to obtain an accurate estimate of the prevalence of constipation in adult populations.

To date, few studies have evaluated changes in the prevalence of constipation over time. While two studies evaluated the onset rates of constipation since a prior survey (Everhart, et al., 1989; Talley, et al., 1993), no data were provided on the participants' previous history of constipation.

Gender Differences in the Overall Prevalence of Constipation

As shown in Table 2, eleven studies reported on gender differences in the prevalence of constipation. Data came from national (Stewart, et al., 1999, Everhart, et al., 1989, Pare, et al., 2001, Johanson, et al., 1989, Sandler, et.al., 1990, Harari, et al., 1996, Hammond, 1964, Drossman, et al., 1993) or population based (Talley, et al., 1991,

Talley, et al., 1993, Talley, et al., 1996) surveys. Seven studies defined constipation based on participants' self-reports (Everhart, et al., 1989, Pare, et al., 2001, Sandler, et.al., 1990, Harari, et al., 1996, Hammond, 1964, Talley, et al., 1991, Drossman, et al., 1993); four studies used the Rome I criteria (Pare, et al., 2001, Talley, 1993, Drossman, et al., 1993, Talley, et al., 1996); and two studies used the Rome II criteria (Stewart, et al., 1999, Pare, et al., 2001).

As shown in Table 3, gender differences in prevalence rates varied based on the definitions of constipation. Across all of the studies, constipation rates were higher in women with female/male ratios that ranged from 1.01 to 3.77 (median of 2.0). Of note, higher ratios were observed in studies that used self-reported rates of constipation (average=2.65), compared to either of the Rome criteria (average=1.75).

Gender Differences in the Characteristics of Constipation

As shown in Table 4, gender differences in the characteristics of constipation were evaluated in 10 studies. Six studies were of the general population (Stewart, et al., 1999, Everhart, et al., 1989, Pare, et al., 2001, Harari, et al., 1996, Talley, et al., 1991, Drossman, et al., 1993) and four reported on gender differences in population specific samples (Talley, et al., 1996, Johanson, et al., 2007, Rao, et al., 2004, Talley, et al., 1992).

Seven studies evaluated for gender differences in the prevalence of the diagnostic subtypes of constipation. Functional constipation (FC) was found to be more common in women (Pare, et al., 2001, Harari, et al., 1996, Talley, et al., 1991, Drossman, et al., 1993, Talley, et al., 1992), more common in men (Stewart, et al., 1999), and to occur with the same frequency in both genders (Talley, et al., 1996). Outlet delay (OD) was found to be

more common in women (Stewart, et al., 1999, Drossman, et al., 1993, Talley, et al., 1996, Talley, et al., 1992).

Gender differences in bowel movement frequency were reported in five studies. Infrequent bowel movements were found to be more common in women in four studies (Everhart, et al., 1989, Harari, et al., 1996, Talley, et al., 1991, Rao, et al., 2004), while no gender difference in frequency was found in one study (Talley, et al., 1996).

Gender differences in specific symptoms of constipation were described in only four studies. Straining (Talley, et al., 1991, Rao, et al., 2004); incomplete evacuation (Talley, et al., 1996, Talley, et al., 1992); anal blockage, self digitation, and painful evacuation (Talley, et al., 1996) were found to be significantly more common in women. In a sample of patients with dyssynergic defecation (Rao, et al., 2004), while more women than men reported incomplete evacuation and digital maneuvers to evacuate, this difference was not significant.

Gender differences in frequency, duration, and severity of symptoms were evaluated in four studies. No gender differences were found in: symptom duration, frequency, or severity in patients who reported pain and discomfort (Stewart, et al., 1999); ranking of most bothersome symptoms (Pare, et al., 2001); duration of constipation symptoms in patients with dyssynergic defecation (Talley, et al., 1996); or duration or frequency of symptoms (Johanson, et al., 2007).

Age Differences in the Prevalence of Constipation

As summarized in Table 5, eleven studies reported on the relationship between age and constipation prevalence. A wide variation existed across these studies in how age groups were subdivided and categorized. Based on the data from the large,

population-based surveys (Johanson, et al., 1989, Sandler, et al., 1990, Harari, et al., 1996, Hammond, et al., 1964), constipation rates appear to increase gradually after age 50, with the largest increase after age 70. For example, prior to age 50, prevalence rates for constipation ranged from 2.6% to 28.4% . After age 70 the rates ranged from 7.7% to 42.8%.

In population-based studies of the elderly (Talley, et al., 1996, Talley, et al., 1992), age was a significant predictor of constipation. For example, in a survey of 328 elderly Olmsted county residents (Talley, et al., 1992), 23% self-reported constipation. In a subsequent survey of 1,375 elderly persons (Talley, et al., 1996), the self-reported prevalence rate for constipation was 20.7%. Rates were variable when specific criteria were used (i.e., 12.7% based on Rome I FC criteria, 6.8% based on Rome OD criteria, 12.4% for both FC and OD). All of these rates were significantly higher than values obtained from a younger population in the same county (Talley, et al., 1993). In addition, functional constipation and laxative use increased with age.

In a study of the incidence of constipation among nursing home residents (Robson, et al., 2000), 7% were constipated within the first three months of admission. This finding translates to an incidence rate of 280/1000 person years, which is sevenfold higher than seen in ambulatory Olmstead county residents. Although this sample was biased towards a high-risk population (i.e., elderly, immobile, disabled), data were captured on 21,012 Medicare and Medicaid beneficiaries to obtain estimates of incidence. While findings from this study do not provide detailed information on the incidence of constipation in the elderly in the general population, it does suggest that nursing home residents are at higher risk than the general population.

Age Differences in the Characteristics of Constipation

As shown in Table 6, age differences in the characteristics of constipation were reported in ten studies. Only three studies specifically evaluated the elderly (Talley, et al., 1996, Talley, et al., 1992, Whitehead, et al., 1989), and one evaluated middle aged residents of Olmsted County, Minnesota (Talley, et al., 1996). The remaining six studies (Stewart, et al., 1999, Everhart, et al., 1989, Pare, et al., 2001, Sandler, et al., 1990, Harari, et al., 1996, Drossman, et al., 1993) examined age differences within the general population.

In studies of age differences in the prevalence of FC, findings were highly variable with two studies suggesting an increased prevalence in the elderly (Talley, et al., 1996, Talley, et al., 1992), three suggesting a decreased prevalence (Stewart, et al., 1999, Talley, et al., 1993, Drossman, et al., 1993), and two suggesting no age differences (Pare, et al., 2001, Whitehead, et al., 1989). OD was found to be more common in younger age groups in one study (Drossman, et al., 1993), while in two studies no differences were found (Stewart, et al., 1999, Talley, et al., 1996).

In terms of age differences in bowel movement frequency, the results are also inconclusive. Three studies found no age differences (Everhart, et al., 1989, Sandler, et al., 1990, Talley, et al., 1996) while in one study, similar frequencies of reports of ≤ 2 BMs per week were found in those < age 40 and ≥ 70 (Harari, et al., 1996). However, those aged 60 to 69 were least likely to report infrequent stools (Harari, et al., 1996).

Age differences in specific symptoms of constipation were described in only two studies (Stewart, et al., 1999, Talley, et al., 1996). When elders were compared with

middle aged participants, they reported more frequent straining, anal blockage, and self digitation (Talley, et al., 1996).

Discussion

Findings from this review suggest that the prevalence of constipation is consistently higher in women than in men. Women are more likely to report constipation and pelvic floor dysfunction. However, evidence of gender differences in the characteristics of constipation is inconsistent. Lack of consensus about the definition and measurement of constipation may explain these inconsistent findings. Additional factors that may contribute to higher constipation rates in females include the fact that women are more likely to report symptoms and they are more likely to respond to surveys (van Wijk, et al., 1997). In addition, women are at higher risk for injury to the pelvic floor muscles and nerves that are required for defecation (O'Brien, et al., 1996, Scott, et al., 2001, Sloots, et al., 2003). Finally, because women are more likely to participate in research studies than men, the smaller number of male participants makes it difficult to adequately assess for gender differences (Chang, et al., 2006).

The literature is both sparse and inconsistent in its reports of age differences in the characteristics of constipation. This lack of research is a significant issue given the magnitude of this problem in the older adult. While self-report as well as Rome I and Rome II definitions of constipation were used, how these definitions were applied as inclusion criteria is not specified in most of the studies. In addition, the symptoms of FC and OD were not differentiated. Finally, the prevalence rates for associated anatomic abnormalities such as rectocele, rectal intussuception or prolapse, or pelvic floor

dyssynergia, all of which can contribute to constipation symptoms, in the older adult population are unknown.

Findings on gender and age differences in the characteristics of constipation (i.e., diagnostic subtypes, symptoms) are inconsistent, primarily because of the paucity of research, lack of clarity in the definition of constipation, and reliance on primarily population-based surveys. Clinicians need to understand that the characteristics and symptoms associated with constipation are highly variable. Because constipation is a highly prevalent symptom, particularly in women and the elderly, clinicians need to assess for this symptom particularly in patients who are taking potentially constipating medications (e.g., opioid analgesics, antidepressants). Future research needs to determine whether clinically meaningful differences exist in the prevalence and severity of constipation symptoms by gender and age. While some data suggest that the prevalence of constipation is higher in women, most studies have recruited larger samples of women and not controlled for this imbalance in their analyses. Finally research is needed on gender differences in the symptoms of constipation as well as on differences in the physiologic mechanisms that underlie various types of constipation.

Virtually no data are available on the incidence and natural history of constipation, particularly as people age. Therefore, well designed, population-based longitudinal studies are needed that explore the natural history of constipation as well as changes in the symptoms of constipation. In addition, information on how significant covariates (e.g., comorbid conditions, functional status) impact the prevalence and severity of constipation in the elderly is needed.

References

Administration on Aging, U.S. Department on Aging. *A profile of older Americans*. 2004.

Chang, L., Toner, B. B., Fukudo, S., et al. (2006). Gender, age, society, culture, and the patient's perspective in the functional gastrointestinal disorders. *Gastroenterology, 130,* 1435-1446.

Chassagne, P., Jego, A., Gloc, P., et al. (2000). Does treatment of constipation improve faecal incontinence in institutionalized elderly patients? *Age and Ageing, 29*, 159-164.

Chiarelli, P., Brown, W., McElduff, P. (1999). Leaking urine: Prevalence and associated factors in Australian women. *Neurourology & Urodynnamics, 18,* 567-577.

Corazziari, E. (2004) Definition and epidemiology of functional gastrointestinal disorders. *Best Practices Research in Clinical Gastroenterology,18*, 613-631.

Creason., N., & Sparks, D. (2000). Fecal impaction: A review. *Nursing Diagnosis,11,* 11:15-23.

Drossman D A. The functional gastrointestinal disorders and the Rome III process. Gastroenterology 2006;130:1377-1390.

Drossman, D. A., Li, Z., Andruzzi, E., et al. (1993). U.S. householder survey of functional gastrointestinal disorders. Prevalence, sociodemography, and health impact. *Digestive Diseases & Sciences, 38,* 1569-1580.

Everhart, J. E., Go, V. L. W., Hohannes, R. S., Fitzsimmons, S. C., Roth, H. P., & White, L.R. (1989). A longitudinal study of self-reported bowel habits in the United States. *Digestive Diseases & Sciences, 34,* 1153-1162.

Hammond, E. (1964). Some preliminary findings on physical complaints from a prospective study of 1,064,004 men and women. *American Journal of Public Health, 54,* 11-23.

Harari, D., Gurwitz, J. H., Avorn, J., Bohn, R., & Minaker, K. L. (1996). Bowel habit in relation to age and gender. Findings from the National Health Interview Survey and clinical implications. *Archives of Internal Medicine, 156,* 315-320.

Harari, D., Gurwitz, J. H., Avorn, J., Choodnovskiy, I., & Minaker, K. L. (1994). Constipation: Assessment and management in an institutionalized elderly population. *Journal of the American Geriatrics Society, 42,* 947-952.

Harris, L. A. (2005). Prevalence and ramifications of chronic constipation. *Managed Care Interface,18*, 23-30.

Higgins, P.D., & Johanson, J. F. (2004). Epidemiology of constipation in North America: A systematic review. *American Journal of Gastroenterology, 99*, 750-759.

Johanson, J. F., & Kralstein, J. (2007). Chronic constipation: A survey of the patient perspective. *Alimentary, Pharmacology, & Therapeutics, 25,* 99-608.

Johanson, J. F., Sonnenberg, A., & Koch, T.R. (1989). Clinical epidemiology of chronic constipation. *Journal of Clinical Gastroenterology, 11,* 525-536.

Kinnunen, O. (1991). Study of constipation in a geriatric hospital, day hospital, old people's home and at home. *Aging, 3,* 161-170.

Lembo, A., & Camilleri, M. (2003). Chronic constipation. *New England Journal of Medicine, 349,* 1360-1368.

Nyrop KA, Palsson OS, Levy RL, et al. (2007). Costs of health care for irritable bowel syndrome, chronic constipation, functional diarrhoea and functional abdominal pain. *Alimentary Pharmacolology & Therapeutics, 26*, 237-248.

O'Brien, M. D., Camilleri, M., von der Ohe, M. R., et al. (1996). Motility and tone of the left colon in constipation: A role in clinical practice? *American Journal of Gastroenterology, 91,* 2532-2538.

Pare, P., Ferrazzi, S., Thompson, W. G., Irvine, E. J., & Rance, L. (2001). An epidemiological survey of constipation in Canada: Definitions, rates, demographics, and predictors of health care seeking. *American Journal of Gastroenterology, 96,* 3130-3137.

Rao, S. S., Tuteja, A. K., Vellema, T., Kempf, J., & Stessman, M. (2004). Dyssynergic defecation: Demographics, symptoms, stool patterns, and quality of life. *Journal of Clinical Gastroenterology, 38,* 680-685.

Read, N. W., & Abouzerky, L. (1986). Why do patients with faecal impaction have faecal incontinence? *Gut, 27,* 283-287.

Read, N. W., Celik, A. F., & Katsinelos, P. (1995). Constipation and incontinence in the elderly. *Journal of Clinical Gastroenterology, 20,* 61-70.

Robson, K. M., Kiely, D. K., & Lembo, T. (2000). Development of constipation in nursing home residents. *Diseases of the Colon & Rectum, 43,* 940-943.

Sandler, R. S., Jordan, M. C., & Shelton, B. J. (1990). Demographic and dietary determinants of constipation in the US population. *American Journal of Public Health, 80,* 185-189.

Scott, S. M., Knowles, C. H., Newell, M., Garvie, N., Williams, N. S., & Lunniss, P. J. (2001). Scintigraphic assessment of colonic transit in women with slow-transit constipation arising de novo and following pelvic surgery or childbirth. *British Journal of Surgery, 88,* 405-411.

Sloots, C. E., Felt-Bersma, R. J., Meuwissen, S. G., & Kuipers, E.J. (2003). Influence of gender, parity, and caloric load on gastrorectal response in healthy subjects: A barostat study. *Digestive Diseases & Sciences, 48,* 516-521.

Sonnenberg, A., & Koch, T. R. (1989). Epidemiology of constipation in the United States. *Diseases of the Colon & Rectum, 32,* 1-8.

Sonnenberg, A., & Koch, T.R. (1989). Physician office visits in the United States for constipation. *Digestive Diseases & Sciences, 34,* 606-611.

Stewart, W. F., Liberman, J. N., Sandler, R. S., et al. (1999). Epidemiology of constipation (EPOC) study in the United States: Relation of clinical subtypes to sociodemographic features. *American Journal of Gastroenterology, 94,* 3530-3540.

Talley, N. J., Fleming, K. C., Evans, J. M., et al. (1996). Constipation in an elderly community: A study of prevalence and potential risk factors. *American Journal of Gastroenterology, 91,* 19-25.

Talley, N. J., O'Keefe, E. A., Zinsmeister, A. R., & Melton, LJ, 3rd. (1992). Prevalence of gastrointestinal symptoms in the elderly: A population-based study. *Gastroenterology,* 102, 895-901.

Talley, N. J., Weaver, A. L., Zinsmeister, A. R., & Melton, L. J., 3rd. (1993). Functional constipation and outlet delay: A population-based study. *Gastroenterology, 105,* 781-790.

Talley, N. J., Zinsmeister, A. R., Van Dyke, C., & Melton, L. J., 3rd. (1991). Epidemiology of colonic symptoms and the irritable bowel syndrome. *Gastroenterology, 101,* 927-934.

van Wijk, C. M., & Kolk, A. M. (1997). Sex differences in physical symptoms: The contribution of symptom perception theory. *Social Sciences Medicine, 45,* 231-246.

Whitehead, W. E., Drinkwater, D., Cheskin, L. J., Heller, B. R., & Schuster, M. M.. (1989). Constipation in the elderly living at home. Definition, prevalence, and relationship to lifestyle and health status. *Journal of the American Geriatrics, 42,* 947-952

Table 1. Prevalence of Constipation in Representative Population Samples in North America

Reference	*Population*	*Method*	*N*	*Case Criteria*	*Prevalence per 100*
Hammond, 1964	ACS	Mail survey	890,394	Self-Report	27.1
Everhart et al., 1989	NHANES I	Face to face	11,024	Self-Report	15.8
Johanson et al., 1989	NHIS	Face to face	NR	Self-report	1.9
Sandler et al., 1990	NHANES I	Face to face	15,014	Self-Report	12.8
Talley et al., 1991	Olmsted County	Mail survey	835	(Strain & Hard) or < 3 BMs/week	17.4
Talley et al., 1993	Olmsted County	Mail survey	690	Self-Report	13.0
				Rome I-FC	19.2
				Rome I-OD	11.0
Drossman et al., 1993	US Householder	Mail survey	5,435	Rome I-FC	3.6
				Rome I-Dyschezia	13.8
Harari et al., 1996	NHIS	Face to face	42,375	Self-Report	3.4
Stewart et al., 1999	US EPOC	Phone survey	10,018	Rome II-FC, OD, or IBS-C	14.7
Pare et al., 2001	Canada EPOC	Mail survey	1,149	Self-Report	27.2
				Rome I	16.7
				Rome II	14.9

Abbreviations: ACS=American Cancer Society; NHANES= National Health and Nutrition Examination Survey; NHIS= National Health Interview Survey; US EPOC= United States Epidemiology of Constipation; FC=Functional Constipation; OD=Outlet Delay; IBS-C=Irritable Bowel Syndrome-Constipation.

Table 2. Gender Differences in Prevalence of Constipation

Reference	*Population*	*Definition*	*Male %*	*Female %*	*Ratio F/M*
Hammond, 1964	ACS	Self-Report	18.5	33.7	1.82
Everhart et al., 1989	NHANES I	Self-Report	8.0	20.8	2.60
Johanson et al., 1989	NHIS	Self-Report	0.9	2.8	3.11
Sandler et al., 1990	NHANES I	Self-Report	7.0	18.2	2.60
Talley et al., 1991	Olmsted County	(Strain & Hard) or < 3 BMs/week	13.9	20.8	1.50
Talley et al., 1993	Olmsted County,	Self-Report	2.7	7.3	2.70
	Middle age	Rome I-FC	18.3	20.1	1.01
		Rome I-OD	5.2	16.5	3.17
Drossman et al., 1993	US Householder	Rome I-FC	2.4	4.8	2.00
		Rome I-Dyschezia (OD)	11.5	16.0	1.39
Talley et al., 1996	Olmsted County	Self-Report	12.2	21.3	NR
	Elderly	Rome I-FC	22.1	26.1	NR
		Rome I-OD	10.9	27.1	NR
Harari et al., 1996	NHIS	Self-Report	1.3	4.9	3.77
Stewart et al., 1999	US EPOC	Rome II-FC, OD, or IBS-C	12.0	16.0	1.33
Pare et al., 2001	Canada EPOC	Self-Report	18.4	35.4	1.92
		Rome I	12.0	21.0	1.75
		Rome II	8.3	21.1	2.54

Abbreviations: ACS= American Cancer Society; NHANES= National Health and Nutrition Examination Survey; NHIS= National Health Interview Survey; US EPOC= United States Epidemiology of Constipation; FC=Functional Constipation; OD=Outlet Delay; IBS-C=Irritable Bowel Syndrome-Constipation.

Table 3. Gender Differences in Prevalence by Definition of Constipation

Definition	***Males***	***Females***
Self-report	0.9 % - 18.5 %	2.8 % - 35.4 %
Rome I – Functional Constipation	2.4 % - 22.1 %	4.8 % - 26.1 %
Rome I – Outlet Delay	5.2 % - 11.5 %	16.0 % - 27.5 %
Rome II – Functional Constipation	8.3 %	21.1 %
Rome II – Outlet Delay	10.9 %	27.1 %

Table 4. Gender Differences in Subtypes and Characteristics of Constipation

Reference	***Population, Sample size***	***Diagnostic Subtypes or Characteristic***	***Findings***
Everhart et al., 1989	National survey, N=11,024	BM Frequency	Men higher daily BM frequency than women (≥ 2/day); women higher infrequent BM than men (≤ 3/week)
Talley et al., 1991	Olmsted County, N=835	Subtypes	Chronic Constipation more common in women (OR 1.6, 95% 1.1-2.3)
		BM Frequency	Infrequent defecation (≤ 3 BMs/week) more common in women.
		Symptoms	Prevalence of "disturbed defecation" similar in men and women; Straining more common in women.
Talley et al., 1992	Olmsted County, N=328 Elderly	Subtypes	Chronic Constipation significantly more common in Elderly women ($p<0.02$); Outlet Delay: Significantly more common in women ($p<0.05$).
		Symptoms	Women report painful defecation, incomplete evacuation, feeling of anal blockage, and digital disimpaction significantly more often than men ($p<0.05$).
Drossman et al., 1993	National survey, N=5,435	Subtypes	Women more likely to report functional constipation (OR 1.99, 95% CI 1.5-.7) and dyschezia than men (OR 1.44, 95% CI 1.2-1.7).
Talley et al., 1996	Olmsted County, N=1,375	Subtypes	No significant gender differences in overall prevalence of FC. OD

Reference	*Population, Sample size*	*Diagnostic Subtypes or Characteristic*	*Findings*
	Elderly		significantly more common in women.
		BM Frequency	No gender differences in BM frequency.
Harari et al., 1996	National survey, N=42,375	Subtypes	Proportion of females reporting exceeded the proportion of males.
		BM Frequency	Women had fewer BMs than men
Stewart et al., 1999	National survey, N=10,018	Subtypes	Gender ratios by subtypes varied with elevated ratios for OD F/M 1.65. FC most common subtype in men.
		Frequency and Severity	Men and women who reported pain and discomfort had similar average of duration, frequency, and severity of episodes.
Pare et al. 2001	National survey, N=1,149	Subtypes	FC significantly more common in women.
		Most Bothersome symptom	No gender differences when ranking most bothersome symptoms. #1 Straining, #2 hard or lumpy stools
Rao et al., 2004	Clinic population Dyssynergic Defecation patients, N=118	BM Frequency	Significantly more women than men reported infrequent BM
		Duration of symptoms	No gender differences in duration of constipation

Reference	*Population, Sample size*	*Diagnostic Subtypes or Characteristic*	*Findings*
		Symptoms	Significantly more women than men reported need to strain excessively ($p<0.04$) More women than men reported incomplete evacuation, abdominal fullness, digital maneuvers to evacuate, though difference was not significant
Johanson et al., 2007	National survey, N=557	Frequency and Duration of Symptoms Symptom	No gender differences as to duration or frequency of symptoms Women were more likely to report bloating than men.

Abbreviations: CC=Chronic Constipation; FC=Functional Constipation; OD=Outlet Delay.

Table 5. Age Differences in Prevalence of Constipation

Reference	*Population*	*Criteria*	*Age*	*Percentage*	*OR*
Hammond, 1964	ACS	Self-Report	40-44	21.6	1.02
			45-49	23.4	1.10
			50-54	26.2	1.24
			55-59	27.7	1.31
			60-64	29.7	1.40
			65-69	32.8	1.55
			70-74	37.3	1.76
			75-79	42.6	2.01
			80-84	48.6	2.29
			≥ 85	54.6	2.56
Whitehead et al., 1989	Baltimore Survey	Self-report	≥ 65	30.0	NR
Everhart et al., 1989	NHANES I	Self-Report	45-64	2.11	3.35
			65-74	4.71	7.48
			≥ 75	9.83	15.60
Johanson et al., 1989	NHIS	Self-Report	45-64	2.11	3.35
			65-74	4.71	7.48
			≥ 75	9.83	15.60
Sandler et al., 1990	NHANES I	Self-Report	30-59	13.9	1.72
			60-75	23.3	2..88
Talley et al., 1992	Olmsted County Elderly	Straining, Hard Stools < 3 BMs/week	≥ 65	23.0	NR
		Rome I-OD	≥ 65	13.0	NR
Drossman et al., 1993	US Householder	Rome I-FC	>45	3.5	.95
		Rome I-Dyschezia (OD)	>45	13.0	.85
Harari et al., 1996	NHIS	Self-Report	40-49	2.6	1.00
			50-59	2.9	1.12
			60-69	4.1	1.58
			70-79	5.5	2.12
			≥ 80	10.0	3.85

Reference	*Population*	*Criteria*	*Age*	*Percentage*	*OR*
Talley et al., 1996	Olmsted County, Elderly	Self-Report	≥ 65	20.7	NR
		Rome I-FC	≥ 65	12.7	NR
		Rome I-OD	≥ 65	6.8	NR
		Both FC & OD	≥ 65	12.4	NR
Stewart et al., 1999	US EPOC	Rome II-FC, OD, or IBS-C	40-49	20.0	NR
			50-59	15.0	NR
			60-69	12.0	NR
			70+	14.0	NR
Pare et al., 2001	Canada EPOC	Self-Report	35-49	28.4	1.08
			50-64	26.3	1.00
			≥ 65	27.4	1.04
		Rome I	35-49	14.5	.71
			50-64	15.1	.74
			≥ 65	15.4	.76
		Rome II	35-49	12.9	.80
			50-64	14.8	.92
			≥ 65	16.7	1.04

Abbreviations: ACS= American Cancer Society; NHANES= National Health and Nutrition Examination Survey; NHIS= National Health Interview Survey; US EPOC= United States Epidemiology of Constipation; FC=Functional Constipation; OD=Outlet Delay; IBS-C=Irritable Bowel Syndrome-Constipation.

Table 6. Age Differences in Characteristics of Constipation

Reference	***Population, Sample size***	***Diagnostic Subtypes or Characteristic***	***Findings***
Whitehead et al., 1989	Baltimore survey Elderly, N=209	Subtypes	Age differences not statistically significant, though SRC increase with advancing age. Straining and > 3 days without a stool significantly associated with laxative use.
Everhart et al., 1989	National survey, N=11,024	BM Frequency	No relationship between age and defecation frequency, though infrequent defecation decreased with age.
Sandler et al., 1990	National survey, N=15,014	BM Frequency	Elderly did not report consistently fewer stools than young, though reports of constipation increased.
Talley et al., 1992	Olmsted County Elderly, N=328,	Subtypes	Age effect with increase in symptoms of CC increasing with age; but after accounting for laxative use and incomplete evacuation, age effect not seen.
Talley et al., 1993	Olmsted County Middle-aged, N=690	Subtypes	Inverse age association with FC, younger > older. SRC and OD not significantly associated with advancing age
Drossman et al., 1993	National survey, N=5,435	Subtypes	Younger age groups (< 45 years) more likely than older age groups to report symptoms consistent with FC or Dyschezia.
Harari et al., 1996	National survey, N=42,375	Subtypes	SRC increased substantially with advancing age.
		BM Frequency	U shape relationship between advancing age and stool frequency.

Reference	*Population, Sample size*	*Diagnostic Subtypes or Characteristic*	*Findings*
Talley et al., 1996	Olmsted County Elderly, N=1,375	Subtypes	FC and SRC increases with advancing age; no significant age effect with OD. FC associated with painful defecation, anal blockage, prolonged defecation, self-digitation; OD associated with frequent abdominal pain, painful defecation, straining, hard stools, and incomplete evacuation.
		BM Frequency	No statistically significant difference in frequency with advancing age.
		Symptoms	Age effect when compared with middle-aged subjects: more frequent straining, self-digitation, anal blockage than middle aged subjects.
Stewart et al., 1999	National survey, N=10,018	Subtypes	FC and OD highest prevalence in young subjects, FC decreases with age; OD did not vary by age.
		Symptoms	Manual support of the rectum or vagina to facilitate BM more common in women ≥ 60.
Pare et al., 2001	National survey, N=1,149	Subtypes	FC affects young and elderly with similar frequency.

Abbreviations: SRC=Self-Report Constipation; CC=Chronic Constipation; FC=Functional Constipation; OD=Outlet Delay.

GENDER DIFFERENCES IN CONSTIPATION CHARACTERISTICS, SYMPTOMS, AND BOWEL AND DIETARY HABITS IN PATIENTS EVALUATED FOR CONSTIPATION

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Abstract

PURPOSE: The purposes of this study were: to evaluate the role of gender differences in the frequency of various characteristics of constipation, as well as in the frequency of constipation specific symptoms and bowel and dietary habits, and to assess the effects of independent but associated risk factors.

METHODS: A clinical database of 518 patients who were evaluated for constipation was used to answer the study aims. Patients completed self-report questionnaires that assessed demographics, medical history, characteristics of constipation, symptoms, and bowel and dietary habits. Univariate and multivariate analyses were used to evaluate for gender differences in these variables. A number of medical conditions that were known to differ by gender as well as influence constipation were controlled for in the multivariate analyses.

RESULTS: The majority of the patients were female (78.9%), white (76.3%), employed (58.9%), with a mean age of 52.4 years. After controlling for medical conditions that were found more frequently in women and that might be associated with constipation, women were still more likely than men to have infrequent bowel movements (OR 2.97, 95% CI 1.67, 5.28), hard or pellet-like stools (OR 3.08, 95% CI 1.80, 5.28), and a longer duration of constipation symptoms (OR 2.00, 95% CI 1.05, 3.82). In addition, women were more likely to report an increased frequency of occurrence of abdominal pain (OR 2.22, 95% CI 1.22, 4.05), bloating (OR 2.65, 95% CI 1.49, 4.70), unsuccessful attempts at evacuation (OR 1.74, 95% CI 1.01, 3.00), and the use of anal digitations to evacuate stool (OR 3.37, 95%CI 1.15, 9.90).

CONCLUSIONS: Findings from this study suggest that women are at increased risk for constipation. In addition, women experience a number of symptoms and abnormal bowel habits more frequently than men. Of note, even after controlling for a number of medical conditions that occurred more frequently in women, these gender differences persisted. These findings warrant replication in both population- and specialty clinic-based samples. In addition, the mechanisms that underlie these gender differences warrant investigation.

KEY WORDS: constipation, gender, symptoms, characteristics, comorbid conditions, bowel habits, dietary habits, sex differences

Introduction

Constipation is a common problem that affects between 2% to 28% of the general population (Corazziari, 2004; Higgins & Johanson, 2004). Constipation is a disorder that is characterized by a constellation of symptoms including infrequent stools, difficult stool passage, or both (American College of Gastroenterology Chronic Constipation Task Force, 2005). Difficult stool passage includes straining, a sense of difficulty passing stool, incomplete evacuation, hard to pass stools, prolonged time to stool, or need for manual maneuvers to pass stool. Data from national (Drossman et al., 1993; Everhart et al., 1989; Harari, Gurvitz, Avorn, Bohn, & Minaker, 1996; Johanson, Sonnenberg, & Koch, 1989; Pare et al., 2001; Sandler, Jordan, & Shelton, 1990; Stewart et al., 1999) and population-based (Talley, Zinsmeister, Van Syke, & Melton, 1991; Talley, Weaver, Zinsmeister, & Melton, 1993; Talley et al., 1996) surveys suggest that the prevalence of constipation is two to three times higher in women than in men. In addition, more women than men seek care for constipation in specialty practice (Pare et al., 2001).

While gender differences in the prevalence of constipation are documented, only limited and contradictory information is available on gender differences in the specific characteristics of constipation, its symptoms, and associated bowel habits. For example, while one study found no gender differences in stool frequency (Talley et al., 1996), three studies found that women reported less frequent stools than men (Everhart et al., 1989; Talley et al., 1991; Harari et al., 1996). Differences across these studies may be partially explained by different definitions for infrequent stools, as well as the populations surveyed.

In terms of gender differences in the specific symptoms of constipation, findings from five population-based studies (Stewart et al., 1999; Talley et al., 1991; Talley 1992; Talley et al.,1993; Talley et al., 1996) suggest that women experience higher rates of abdominal bloating, unsuccessful attempts at evacuation, incomplete evacuation, painful defecation, and straining. However, with the exception of abdominal bloating and painful defecation, two population-based studies (Pare et al., 2001; Talley et al., 1993) reported a higher frequency of occurrence of those symptoms in men. Finally, in terms of bowel habits, the findings from four population-based studies (Pare et al., 2001; Talley et al., 1992; Talley et al., 1993; Talley et al., 1996) suggest that women use more anal digitations, laxatives, and enemas than men. Again, these inconsistent findings may be explained by differences in the methods of data collection, the specific questions used, and the populations surveyed. Even in descriptive studies of constipation symptoms, characteristics, and bowel habits in patients who sought evaluation in a specialty clinic (Koch, Voderholzer, Klauser, & Muller-Lissner, 1997; Mertz, Nabiloff, & Mayer, 1999), no reports on gender differences in the characteristics or symptoms of constipation were found.

Any evaluation of gender differences in the prevalence or characteristics of constipation needs to consider that the presence of a number of chronic conditions (e.g., arthritis, irritable bowel syndrome (IBS), depression) may influence the patients' reports of constipation. In addition, many of these chronic conditions are known to occur more frequently in women than in men (Pleis & Lethbridge, 2006). However, only one study was found that noted that women with constipation compared to men reported a higher number of chronic conditions (Whitehead, Drinkwater, Cheskin, Heller, & Schuster,

1989). Therefore, any study designed to evaluate for gender differences in the characteristics, symptoms, and bowel and dietary habits associated with constipation needs to evaluate for gender differences in the occurrence of chronic conditions that may effect constipation and account for these differences in the statistical analyses.

Given the paucity of research as well as the inconsistent findings on gender differences in the specific characteristics of constipation, the purposes of this study were: to evaluate for gender differences in the frequency of various characteristics of constipation, as well as in the frequency of constipation specific symptoms and bowel and dietary habits, and to determine if gender, the occurrence of various chronic medical conditions, and a history of sexual assault, were associated with an increase in the frequency of constipation associated characteristics, symptoms, and bowel and dietary habits.

Methods

Participants

A search of the clinical database of all patients (n=1228) evaluated at the University of California, San Francisco (UCSF) Center for Pelvic Physiology between March 2003 and October 2007 yielded 518 patients with a primary diagnosis of constipation who were ≥ 18 years of age. Patients were excluded if they had a primary diagnosis of fecal incontinence. The Committee on Human Research at UCSF approved the clinical database, as well as the use of the database for this study.

Questionnaires

As part of patients' routine assessment, they completed a clinical questionnaire that obtained information on demographic characteristics (i.e., gender, age, ethnicity,

employment status) and previous medical history (i.e., medical conditions, previous surgeries, sexual assault history, medications). In addition, patients completed an investigator-developed questionnaire on the characteristics of constipation, symptoms of constipation, as well as various bowel and dietary habits.

Four characteristics of constipation were evaluated: frequency of constipation, duration of constipation symptoms at least once per month, stool frequency, and stool consistency. Patients were asked to rate the frequency of constipation on a 4-point Likert scale; the duration of symptoms and stool frequency on 5-point Likert scales; and stool consistency on a 6-point Likert scale.

A 5-point Likert scale was used to evaluate the frequency of occurrence of six constipation symptoms (i.e., abdominal pain, abdominal bloating, incomplete evacuation, unsuccessful attempts at evacuation, pain with evacuation, straining with evacuation). The bowel habits that were evaluated included: time spent at each evacuation; frequency of needing to change position to evacuate; use of anal digitations to evacuate; and the use of laxatives, enemas, stool softeners, foods, or other aids. Patients were asked to rate time spent at each evacuation using a 4-point Likert scale and the frequency of the other bowel habits using a 5-point Likert scale.

The dietary habits that were evaluated included: use of dietary fiber, use of fiber supplements, and water intake. Patients were asked if they ingested dietary fiber; took a fiber supplement daily; and drank ≥ 6 glasses of water per day.

Statistical analysis

Data were analyzed using SPSS Version 14.0. Descriptive statistics, means and standard deviations for quantitative variables, and frequencies and percents for

categorical variables, were used to describe the demographic and clinical characteristics of the patients. Appropriate statistical tests (i.e., independent sample t-tests, Chi square tests, or Mann Whitney U tests) were used to evaluate for gender differences in demographic and clinical characteristics, as well as in constipation characteristics, symptoms, and bowel and dietary habits. Variables that were significantly different between the genders in these univariate analyses were included as covariates in the subsequent multivariate analyses to asses the independent association of gender and the constipation outcome of interest.

The main study outcomes of constipation characteristics, symptoms, and bowel and dietary habits were dichotomized into low and high frequencies of occurrence for use in multiple logistic regression analyses. In order to determine if gender and the occurrence of various comorbid conditions were associated with an increase in the frequency of constipation associated characteristics, symptoms, and bowel and dietary habits, separate multiple logistic regression models were developed for each outcome. In each multiple logistic regression analysis, gender was entered as an independent variable along with the variables that were previously determined in the univariate analyses to be significantly different between the genders. Differences were considered to be statistically significant at the $p<0.05$ level. The significance of the adjusted odds ratio (OR) for gender and its 95% confidence intervals (CI) were used to evaluate the magnitude of the gender differences in the main study outcomes.

Results

Characteristics of the sample

The majority of the patients was female (78.9%), white (76.3%), employed (58.9%), with a mean age of 52.4 years (SD=16.5, range 18.6 to 91.5). As shown in Table 1, no gender differences were found in age, number of medications, ethnicity, and employment status. However, women reported a significantly higher total number of comorbid conditions than men (mean, 3.9 versus 2.9, respectively, $p<.0001$). In addition, significantly more women than men reported arthritis, chronic back pain, depression, hemorrhoids, IBS, and a history of sexual assault (all, $p \leq .01$).

Gender differences in characteristics of constipation

As shown in Table 2, no gender differences were found in the frequency of the complaint of constipation. However, women were more likely to have constipation for a longer duration ($p<.0001$), with over 42% of women reporting a symptom duration of ≥ ten years. In addition, a higher percentage of women reported infrequent bowel movements ($p<.0001$), as well as abnormal stool consistency (i.e., hard or pellet like stools) ($p=.002$).

Gender differences in bowel symptoms

As shown in Figure 1, men and women had the same frequency of pain with evacuation or straining with evacuation. A significantly higher percentage of women compared to men reported a higher frequency of occurrence of abdominal pain, bloating, incomplete evacuation, and unsuccessful attempts at evacuation (all, $p \leq .01$).

Gender differences in bowel and dietary habits

As shown in Table 3, no gender differences were found in the amount of time spent per bowel movement, or in the frequency of the use of laxatives, stool softeners, enemas, or foods, drinks, or other aids to facilitate bowel evacuations. A higher percentage of women compared to men reported more frequent use of anal digitations ($p< .0001$), as well as the use of position changes to evacuate ($p=.018$).

As shown in Table 4, the majority of patients (84.6%) reported ingesting dietary fiber. Only 40.3% reported the use of a daily fiber supplement. Approximately 50% of patients reported drinking ≥ 6 glasses of water on a daily basis. Of note, no gender differences were found in any of these dietary habits.

Multivariate findings on gender differences

Significant gender differences were found in nine of 13 characteristics of constipation (i.e., duration of symptoms, bowel movement, stool consistency), bowel symptoms (i.e., abdominal pain, abdominal bloating, incomplete evacuation, unsuccessful attempts at evacuation), and bowel habits (i.e., anal digitations, position changes to evacuate). Multiple logistic regression analyses were done to determine if the gender differences in these outcomes remained significant, after controlling for the six medical conditions (i.e., arthritis, depression, chronic back pain, hemorrhoids, IBS, history of sexual assault) that were significantly different between the genders. As shown in Table 5, gender differences found in the univariate analyses remained significant in the multivariate analyses for seven of the nine outcomes. Women were two times more likely than men to report a longer duration of constipation symptoms. In addition,

patients with IBS were nearly two times more likely (OR=1.98) to report a longer duration of symptoms than those without IBS.

Women were nearly three times more likely than men to report a decreased frequency of stool, as well as three times more likely to report an abnormal stool consistency. Women were over two times more likely (OR=2.22) than men to report a higher frequency of occurrence of abdominal pain. In addition, patients with chronic back pain (OR=1.77) and IBS (OR=2.46) were more likely to report the more frequent occurrence of abdominal pain. However, patients with arthritis were less likely to report frequent occurrences of abdominal pain (OR=0.48).

Women were over two times more likely (OR=2.65) than men to report more frequent occurrences of abdominal bloating. Patients with depression (OR= 1.88) and IBS (OR=1.79) were also more likely to report a higher frequency of occurrence of abdominal bloating. Again, patients with arthritis were less likely to report frequent occurrences of abdominal bloating (OR=0.49).

Women were nearly two times more likely (OR=1.74) than men to report more frequent occurrences of unsuccessful attempts at evacuation. Women were over three times more likely (OR=3.37) than men to report more frequent use of anal digitations to facilitate stool evacuation. Patients with depression (OR = 2.49) were more likely to report more frequent use of anal digitations.

No gender differences remained in the frequency of incomplete evacuation and the need to change position to evacuate, after controlling for the six potential confounding variables. No significant interactions were found between gender and the significant comorbid conditions and any of the main study outcomes.

Discussion

To our knowledge, this study is the first to perform a detailed evaluation of gender differences in constipation characteristics, symptoms, and bowel and dietary habits in a large sample of patients who were evaluated in a pelvic physiology center. Consistent with previous national (Stewart et al., 1999; Harari et al., 1994; Everhart et al., 1989; Pare et al., 2001; Harari et al., 1996; Drossman et al., 1993) and population-based (Talley et al., 1991; Talley et al., 1993; Johanson et al., 2007) studies, a significantly higher percentage of women (78.9%) than men (21.1%) were evaluated for constipation. This gender distribution is also consistent with reports from other specialty centers that evaluate constipation (Koch,Voderholzer, Klauser,& Muller-Lissner, 1997; Mertz, Naliboff, & Mayer, 1999; Rao et al., 2004; Surrenti, Rath, Pemberton, & Camilleri, 1995).

Not only did more women report constipation, they reported a higher frequency of constipation characteristics, associated symptoms, and bowel habits. A unique aspect of this study is that a number of factors that could have confounded the potential gender effect were accounted for in the analyses. In fact, after controlling for a number of chronic medical conditions, women were significantly more likely to report a longer duration of constipation symptoms, less frequent bowel movements, stool that was very hard or pellet like, abdominal pain, abdominal bloating, unsuccessful attempts at evacuation, and more frequent use of anal digitations. These findings are consistent with studies of community-based samples that show that women seek health care more frequently than men and report more symptoms than men (van Wijk, & Kolk, 1997; Verbrugge, 1985).

All three of the characteristics of constipation that were found to occur more frequently in women in the univariate analyses, remained significant in the multivariate analyses. Of note, with the exception of duration of symptoms of constipation and its association with IBS, none of the other chronic conditions influenced any of the characteristics of constipation. Findings from this study suggest that women may seek an evaluation in a specialty clinic when constipation symptoms are more frequent and of longer duration. However, this hypothesis requires verification in future studies because the data were not available in the database about whether patients had been seen in a specialty clinic prior to this visit.

Consistent with other reports (Stewart et al., 1999; Talley et al., 1991; Talley 1992; Talley et al.,1993; Talley et al., 1996), in our sample women were twice as likely to report symptoms of constipation (i.e., abdominal pain, abdominal bloating, unsuccessful attempts at evacuation) than men. Though differences were found in the association between a number of chronic conditions and specific bowel symptoms, we found no gender by chronic condition interaction. For example, though patients with IBS were almost two times more likely to report an increased frequency of occurrence of abdominal pain and abdominal bloating, we found no gender by IBS interaction. The gender difference persisted, regardless of reported IBS.

The independent associations between chronic back pain and depression and an increased frequency of occurrence of abdominal pain and bloating are consistent with clinical experience. For example, patients with these two medical conditions may be taking medications (e.g., opioid analgesics, antidepressants) that have constipation as one of their side effects. In fact, 50% of the patients in this study who reported depression

were taking antidepressants and 31% of the patients who reported chronic back pain were taking analgesics.

Arthritis was found to have a negative association with increased frequency of abdominal pain and abdominal bloating. Though the medications used to treat arthritis and its associated symptoms were not evaluated, medicines commonly used include non steroidal anti-inflammatory drugs (NSAIDS). The association between NSAIDS and constipation in the community has been documented (Talley, Weaver 1993; Talley, Fleming 1996; Chang 2007). Chang (2007) also reported an association between acetaminophen and abdominal pain. The reason for the association we found is not readily apparent and warrants investigation in future studies.

Of the bowel habits surveyed, with the exception of anal digitations and its association with depression, none of the other medical conditions influenced any of the other bowel habits. While fewer patients reported the use of anal digitations compared to other bowel habits, this habit remained significant in the multivariate analysis with women being over three times more likely than men to report an increased frequency of use. This finding is consistent with previous reports (Pare et al., 2001; Talley et al., 1993; Talley et al., 1996). One potential explanation for this difference is that women are more familiar with touching their perineum as part of the management of menstruation. Of note, though not significant by gender, bowel habits that were reported as being never or infrequently used by a relatively high percentage of patients in this study included: laxatives (49%), stool softeners (58%), enemas (74%), and other foods, drinks, or aids to facilitate bowel evacuation (48%).

While an association between constipation and history of sexual assault was reported in one study (Leroi et al., 1995), a more recent report did not substantiate this finding (Hobbis et al., 2002). In this sample, while women were more likely to report a history of sexual assault than men, no associations were found between any of the characteristics of constipation, symptoms, and bowel and dietary habits and a history of sexual assault.

Several limitations of this study need to be acknowledged. The cross-sectional nature of the study allowed us to assess only associations not causality. While self-report data were available from a large cohort of patients, the analyses were limited to the variables contained in the database. For example, the dates of onset of symptoms as well as data on chronic cardiovascular and neurologic diseases were not available. In addition, detailed information on medications was not included in the database. In addition, these self-report data were subject to recall bias.

Despite these limitations, the findings from this study suggest that gender difference exist in seven characteristics, symptoms, and bowel habits in patients with constipation. These findings warrant replication in both population- and specialty clinic-based studies. These types of studies may lead to a better understanding of this common problem as well as to more effective and individualized gender based interventions.

References

American College of Gastroenterology Chronic Constipation Task Force. (2005). An evidence-based approach to the management of chronic constipation in North America. *American Journal of Gastroenterology, 100 Suppl 1*, S1-4.

Chang, J. Y., Locke, G. R., Schleck, C. D., Zinsmeister, A. R., & Talley, N. J. (2007). Risk factors for chronic constipation and a possible role of analgesics. *Neurogastroenterology and Motility, 19*, 905-911.

Corazziari, E. (2004). Definition and epidemiology of functional gastrointestinal disorders. *Best Practices Research Clinical Gastroenterology, 18*, 613-631.

Drossman, D. A., Li, Z., Andruzzi, E., Temple, R. D., Talley, N. J., Thompson, W. G., et al. (1993). U.S. householder survey of functional gastrointestinal disorders. Prevalence, sociodemography, and health impact. *Digestive Diseases Science, 38*, 1569-1580.

Everhart, J. E., Go, V. L. W., Hohannes, R. S., Fitzsimmons, S. C., Roth, H. P., & White, L. R. (1989). A longitudinal study of self-reported bowel habits in the United States. *Digestive Diseases and Sciences, 34*, 1153-1162.

Harari, D., Gurwitz, J. H., Avorn, J., Bohn, R., & Minaker, K. L. (1996). Bowel habit in relation to age and gender. Findings from the National Health Interview Survey and clinical implications. *Archives of Internal Medicine, 156*, 315-320.

Higgins, P. D., & Johanson, J. F. (2004). Epidemiology of constipation in North America: A systematic review. *American Journal of Gastroenterology, 99*, 750-759.

Hobbis, I. C., Turpin, G., & Read, N. W. (2002). A re-examination of the relationship between abuse experience and functional bowel disorders. *Scandinavian Journal of Gastroenterology, 37*, 423-430.

Koch, T. R., Voderholzer, W. A., Klauser, A. G., & Muller-Lissner, S. (1997). Symptoms in chronic constipation. *Diseases of the Colon and Rectum, 40*, 902-906.

Johanson, J. F., & Kralstein, J. (2007). Chronic constipation: A survey of the patient perspective. *Alimentary Pharmacology and Therapeutics, 25*, 599-608.

Johanson, J. F., Sonnenberg, A., & Koch, T. R. (1989). Clinical epidemiology of chronic constipation. *Journal of Clinical Gastroenterology, 11*, 525-536.

Leroi, A. M., Bernier, C., Watier, A., Hemond, M., Goupil, G., Black, R., et al. (1995). Prevalence of sexual abuse among patients with functional disorders of the lower gastrointestinal tract. *International Journal of Colorectal Disease, 10*, 200-206.

Mertz, H., Naliboff, B., & Mayer, E. A. (1999). Symptoms and physiology in severe chronic constipation. *American Journal of Gastroenterology, 94*, 131-138.

Pare, P., Ferrazzi, S., Thompson, W. G., Irvine, E. J., & Rance, L. (2001). An epidemiological survey of constipation in canada: definitions, rates, demographics, and predictors of health care seeking. *American Journal of Gastroenterology, 96*, 3130-3137.

Pleis, J. R., & Lethbridge-Cejku, M. (2006). Summary health statistics for U.S. adults: National Health Interview Survey, 2005. *Vital and Health Statistics. Series 10: Data from the National Health Survey,* 232, 1-153.

Rao, S. S., Tuteja, A. K., Vellema, T., Kempf, J., & Stessman, M. (2004). Dyssynergic defecation: Demographics, symptoms, stool patterns, and quality of life. *Journal of Clinical Gastroenterology, 3*, 680-685.

Sandler, R. S., Jordan, M. C., & Shelton, B. J. (1990). Demographic and dietary determinants of constipation in the US population. *American Journal of Public Health, 80*, 185-189.

Stewart, W. F., Liberman, J. N., Sandler, R. S., Woods, M. S., Stemhagen, A., Chee, E., et al. (1999). Epidemiology of constipation (EPOC) study in the United States: Relation of clinical subtypes to sociodemographic features. *American Journal of Gastroenterology, 94*, 3530-3540.

Surrenti, E., Rath, D. M., Pemberton, J. H., & Camilleri, M. (1995). Audit of constipation in a tertiary referral gastroenterology practice. *American Journal of Gastroenterology, 90*, 1471-1475.

Talley, N. J., Boyce, P., & Jones, M. (1998). Identification of distinct upper and lower gastrointestinal symptom groupings in an urban population. *Gut, 42*, 690-695.

Talley, N. J., Fleming, K. C., Evans, J. M., O'Keefe, E. A., Weaver, A. L., Zinsmeister, A. R., et al. (1996). Constipation in an elderly community: A study of prevalence and potential risk factors. *American Journal of Gastroenterology, 91*, 19-25.

Talley, N. J., Weaver, A. L., Zinsmeister, A. R., & Melton, L. J., 3rd. (1992). Onset and disappearance of gastrointestinal symptoms and functional gastrointestinal disorders. *American Journal of Epidemiology, 136*, 165-177.

Talley, N. J., Weaver, A. L., Zinsmeister, A. R., & Melton, L. J., 3rd. (1993). Functional constipation and outlet delay: A population-based study. *Gastroenterology, 105*, 781-790.

Talley, N. J., Zinsmeister, A. R., Van Dyke, C., & Melton, L. J., 3rd. (1991). Epidemiology of colonic symptoms and the irritable bowel syndrome. *Gastroenterology, 101*, 927-934.

van Wijk, C. M., & Kolk, A. M. (1997). Sex differences in physical symptoms: The contribution of symptom perception theory. *Social Science and Medicine, 45*, 231-246.

Verbrugge, L. M. (1985). Gender and health: An update on hypotheses and evidence. *Journal of Health and Social Behavior, 26*, 156-182.

Whitehead, W. E., Drinkwater, D., Cheskin, L. J., Heller, B. R., & Schuster, M. M. (1989). Constipation in the elderly living at home. Definition, prevalence, and relationship to lifestyle and health status. *Journal of the American Geriatrics Society, 37*, 423-429.

Table 1. Gender differences in demographic and clinical characteristics

Characteristic	Men n=109 Mean (SD)	Women n=409 Mean (SD)	Statistics
Age (years)	53.6 (19.2)	52.1 (15.7)	t=-0.74, p=0.460
Number of comorbid conditions	2.85 (1.90)	3.87 (2.20)	t=4.79, p<0.0001
Number of medications	5.57 (4.88)	5.58(4.62)	t=0.26, p=0.979
	n (%)	**n (%)**	
White	67 (73.6)	264 (77.0)	χ^2=1.47, p=0.689
Employed	59 (54.1)	246 (60.1)	χ^2=1.29, p=0.257
Comorbid conditions[†]			
Arthritis	19 (17.8)	124 (30.6)	χ^2=6.95, p=0.008
Chronic back pain	23 (21.3)	145 (35.7)	χ^2=8.06, p=0.005
Depression	29 (26.9)	163 (40.0)	χ^2=6.27, p=0.012
Hemorrhoids	42 (38.9)	217 (53.8)	χ^2=7.62, p=0.006
Irritable Bowel Syndrome	25 (23.4)	175 (44.3)	χ^2=15.40, p <.0001
History of sexual assault	3 (3.5)	56 (15.2)	χ^2=8.33, p=0.004

SD=Standard deviation

[†]No gender differences were found in the following conditions: ulcerative colitis, Crohn's disease, anal fissures, anal fistulas, spinal injury, multiple sclerosis, thyroid disease, diabetes mellitus, pelvic fracture, cancer of the anorectum, urinary incontinence, radiation therapy of the pelvis, surgery for hemorrhoids, surgery on the anorectum.

Table 2. Gender differences in characteristics of constipation

Characteristic	Men n (%)	Women n (%)	Statistics
Frequency of complaint of constipation			Z=-1.27 p=0.205
Never	12 (12.4)	14 (3.6)	
<Monthly	7 (7.2)	24 (6.2)	
≥ 1 time per month	22 (22.7)	113 (29.2)	
≥ 1 time per week	56 (57.7)	236 (61.0)	
Duration of symptoms at least once per month			Z=-4.865 p<0.0001
< 1 year	26 (27.4)	48 (12.8)	
1 to < 5 years	37 (38.9)	108 (28.6)	
5 to < 10 years	10 (10.5)	62 (16.4)	
10 to < 20 years	14 (14.7)	54 (14.3)	
≥ 20 years	8 (8.5)	105 (27.9)	
Bowel movement (BM) frequency			Z=-3.93 p<0.0001
≥ 1 BM per day	79 (73.8)	212 (52.7)	
≤ 2 BMs per week	20 (18.7)	121 (30.1)	
< 1 BM per week	4 (3.7)	32 (8.0)	
< 2 BMs per 2 weeks	2 (1.9)	35 (8.7)	
Varies	2 (1.9)	2 (0.5)	
Stool consistency without laxatives			Z=-3.17 p=0.002
Liquid/Loose	9 (8.6)	12 (3.0)	
Formed Soft	47 (44.8)	95 (23.7)	
Formed Hard	10 (9.5)	57 (14.2)	
Very hard or pellet like	7 (6.7)	124 (30.9)	
Varies	15 (14.3)	60 (15.0)	
Don’t know always use laxatives	17 (16.1)	53 (13.2)	

Table 3. Gender differences in frequency of bowel habits

Bowel Habit	**Men n (%)**	**Women n (%)**	**Statistics**
Time spent per bowel movement			Z= -0.837 *p*=0.403
< 5 minutes	23 (21.8)	96 (24.4)	
5 to < 10 minutes	31 (29.2)	119 (30.2)	
10 to < 30 minutes	31 (29.2)	114 (28.9)	
≥ 30 minutes	21 (19.8)	65 (16.5)	
Anal digitation			Z=-3.35 *p*<0.001
Never	75 (83.3)	234(65.0)	
< Monthly	3 (3.3)	25 (6.9)	
Monthly (1-3 times per month)	5 (5.6)	26 (7.2)	
Weekly (1-6 times per week)	2 (2.2)	30 (8.4)	
Daily	5 (5.6)	45 (12.5)	
Change position to evacuate			Z=-2.375 p=0.018
Never	27 (28.4)	81 (21.8)	
Rarely	10 (10.5)	39 (10.5)	
Occasionally	25 (26.3)	58 (15.6)	
Usually	17 (17.9)	101 (27.3)	
Always	16 (16.9)	92 (24.8)	

Other habits surveyed and were found not to be statistically significant by gender: frequency of use of laxatives, stool softeners, enemas, other foods, drinks or aids to facilitate bowel evacuations

Table 4. Gender differences in dietary habits

Dietary Habits	**Men n (%)**	**Women n (%)**	**Statistics**
Daily dietary fiber	89 (81.7)	349 (85.3)	χ^2=0.89, p=0.345
Daily fiber supplement	47 (44.8)	152 (39.2)	χ^2=1.07, p=0.301
Daily water intake (≥ 6 glasses per day)	50 (46.3)	207 (51.4)	χ^2=0.88, p=0.350

Table 5. Results of multiple logistic regression analyses for dichotomized characteristics, symptoms, and bowel habits

	Duration of symptoms ≥ 1 year[†]	Stool frequency[††]	Stool consistency[†††]	Frequency of abdominal pain[±]	Frequency of abdominal bloating[±]	Frequency of unsuccessful attempts[±]	Frequency of anal digitations
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
FEMALE	2.00* (1.05, 3.82)	2.97* (1.67, 5.28)	3.08* (1.80, 5.28)	2.22* (1.22, 4.05)	2.65* (1.50, 4.70)	1.74* (1.01, 3.00)	3.37* (1.15, 9.90)
Arthritis	0.84 (0.41, 1.74)	0.62 (.38, 1.02)	0.86 (0.51, 1.47)	0.48* (0.28, .82)	0.49* (.29, .83)	0.86 (0.52, 1.44)	1.15 (0.61, 2.19)
Chronic back pain	1.29 (0.63, 2.62)	1.57 (0.98, 2.51)	1.32 (0.78, 2.21)	1.77* (1.07, 2.93)	1.52 (0.92, 2.53)	1.36 (0.83, 2.22)	1.42 (0.77, 2.61)
Depression	1.42 (0.73, 2.76)	1.39 (0.90, 2.16)	1.24 (0.77, 2.02)	1.13 (0.71, 1.80)	1.88* (1.17, 3.03)	1.03 (0.65, 1.63)	2.49* (1.37, 4.51)
Hemorrhoids	1.53 (0.84, 2.78)	0.78 (0.52, 1.19)	0.87 (.55, 1.37)	0.67 (0.43, 1.04)	0.71 (0.45, 1.12)	0.68 (0.44, 1.04)	0.98 (0.55, 1.74)
IBS	1.98* (1.02, 3.85)	.83 (0.54, 1.26)	1.03 (0.65, 1.63)	2.46* (1.59, 3.82)	1.79* (1.14, 2.80)	0.85 (0.55, 1.32)	0.83 (0.46, 1.49)
Sexual Assault	6.26 (0.66, 59.08)	1.38 (0.63, 3.02)	1.81 (0.68, 4.83)	1.22 (0.54, 2.72)	1.59 (0.63, 4.00)	1.82 (0.77, 4.31)	1.31 (0.53, 3.24)

$=p<.05$

Abbreviation: OR=Odds ratio; CI= Confidence interval; IBS=Irritable Bowel Syndrome

[†]Duration of symptoms less than one year was coded 0; duration of symptoms ≥ one year was coded 1.

[††]Stool frequencies identified as one or more times per day were coded as 0; frequencies of ≤ two times per week, < one time per week, <one time per two weeks, < one time per two weeks, and varies were coded as 1.

[†††] Stool consistencies identified as liquid/loose and forms soft were coded 0; consistencies identified as formed hard, very hard or pellet like, varies, and "don't know I always use laxatives" were coded 1.

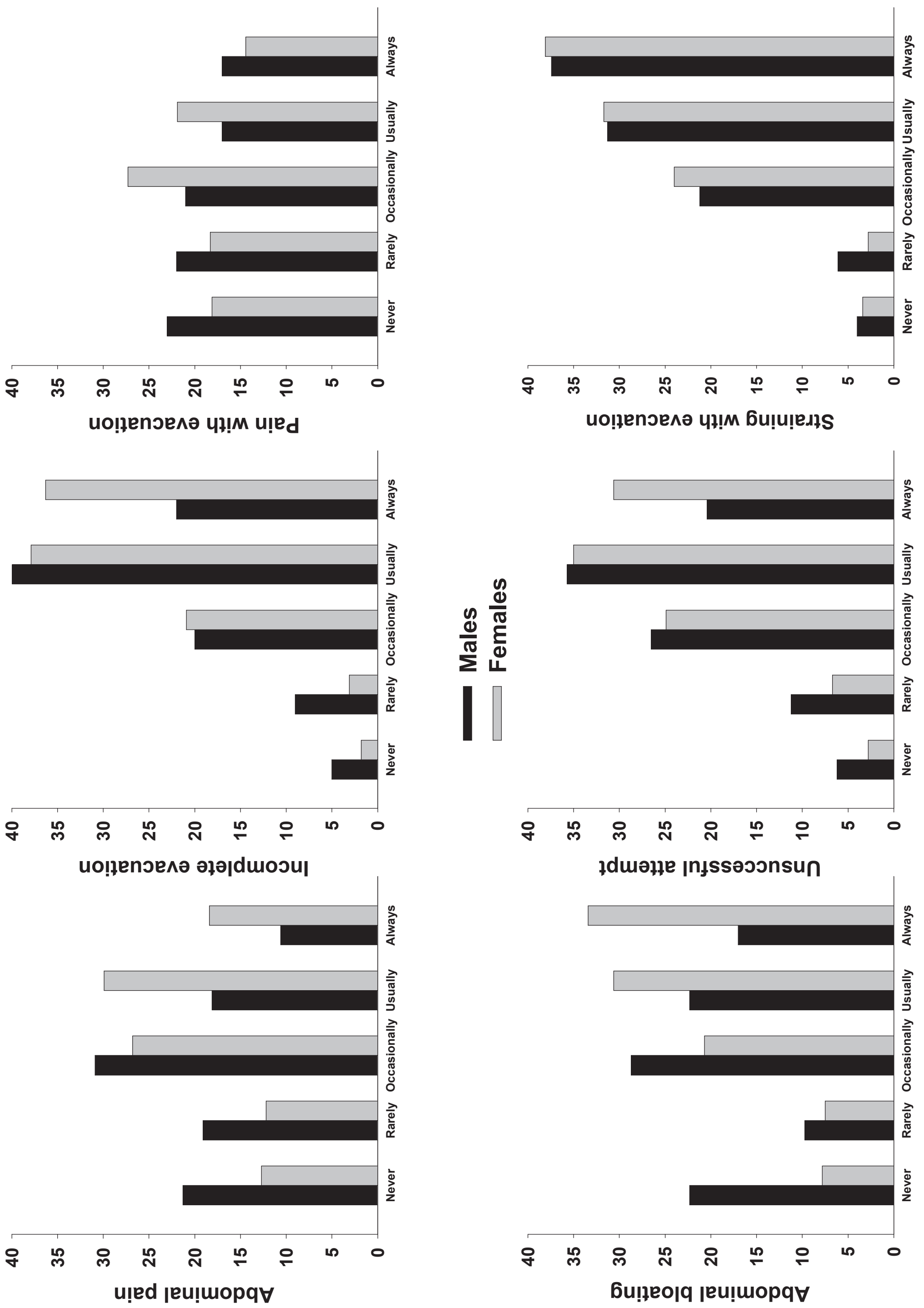
[±]Symptom frequencies identified as never, rarely, and occasionally were coded as 0; symptoms identified as usually and always were coded as 1.

[††††] Habit frequencies identified as never, less than monthly, and monthly were coded 0; frequencies identified

as weekly and daily were coded 1.

Figure Legend

Figure 1. Gender differences in frequencies of abdominal pain ($p<.0001$); abdominal bloating ($p<.0001$); incomplete evacuation ($p=.004$); unsuccessful attempts ($p=.016$); pain with evacuation ($p=.348$); and straining with evacuation ($p=.715$).


Abdominal pain
Incomplete evacuation
Pain with evacuation
Abdominal bloating
Unsuccessful attempt
Straining with evacuation
Never
Rarely
Occasionally
Usually
Always
0
5
10
15
20
25
30
35
40
Males
Females

AGE DIFFERENCES IN CONSTIPATION CHARACTERISTICS, SYMPTOMS, AND BOWEL AND DIETARY HABITS IN PATIENTS EVALUATED FOR CONSTIPATION

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Abstract

PURPOSE: The purposes of this study were: to evaluate the role of age differences in the frequency of various characteristics of constipation, as well as in the frequency of constipation specific symptoms and bowel and dietary habits, and to assess the effects of independent but associated risk factors.

METHODS: Data from a clinical database of 518 patients who were evaluated for constipation at a specialty center was used to answer the study aims. To assess whether age-related differences existed, three age groups were created: 1) patients < 40 years of age (younger), 2) patients 40 to <65 (middle aged), and 3) patients ≥65 years of age (older). Patients completed self-report questionnaires that assessed demographics, medical history, characteristics of constipation, bowel symptoms, as well as bowel and dietary habits. The main study outcomes of constipation characteristics, symptoms, and bowel and dietary habits were dichotomized into low and high frequencies of occurrence for use in multiple logistic regression analyses. In order to determine if age and the occurrence of various medical conditions and clinical characteristics were associated with an increase in the frequency of constipation associated characteristics, symptoms, and bowel and dietary habits, separate multiple logistic regression models were developed for each outcome.

RESULTS: The majority of the patients were female (78.9%), white (76.3%), employed (58.9%), with a mean age of 52.4 (SD=16.5, range 18.6 to 91.5); 23.7% were younger (< 40 years of age), 53.7% were middle age, and 22.8% were older (≥ 65 years of age). After controlling for variables found to vary significantly by age and that might be associated with constipation, younger and middle aged patients were more likely than

older patients to have infrequent bowel movements (younger > older, OR 2.67 [1.35, 5.29]; middle aged > older, OR 2.12 [1.21,3.69]), increased frequency of occurrence of abdominal pain (younger > older, OR 2.89 [1.44,5.80], abdominal bloating (younger > older, OR 5.26 [2.53,10.94], younger > middle aged, OR 2.15 [1.17, 3.95], middle aged > older, OR 2.45 [1.41,4.25]), and use position changes to facilitate bowel evacuations (younger > older, OR 2.92 [1.47,5.82]; middle aged > older OR 2.02 [1.17,3.51]).

CONCLUSIONS: Findings from this study suggest age differences in the characteristics of constipation occur. Surprisingly, younger patients experienced some symptoms and abnormal bowel habits more frequently than middle aged or older patients. Of note, even after controlling for a number of factors that varied significantly by age, these age differences persisted. These findings warrant replication in both population- and specialty clinic-based samples. In addition, the mechanisms that underlie these age differences warrant investigation.

KEY WORDS: Constipation, age factors, adult, middle age, aged, symptoms, habits, characteristics

Introduction

Constipation, characterized as difficult or infrequently passed stools, is a problem that occurs across the lifespan. An examination of age differences in the prevalence and characteristics of this condition may help to identify patterns of occurrence and guide the development of age appropriate interventions. Data from large, population-based surveys (Hammond, 1964; Harari, Gurwitz, Avorn, Bohn, & Minaker, 1996; Johanson, Sonneberg, Koch, 1989; Sandler, Jordan, Shelton, 1990) suggest that constipation rates increase gradually after age 65, with the largest increase after age 75. For example, prior to age 65, prevalence rates for constipation ranged from 2.1% to 25.7%. Between the ages of 65 and 75, the prevalence rates were in the range of 4.7% to 35.1%, while after age 75 they ranged from 9.8% to 48.6%.

The literature is both sparse and inconsistent in its reports of age differences in the symptoms of and factors associated with constipation. For example, findings from two studies suggested an increased frequency in the symptoms of constipation in the elderly (Talley, Weaver, Zinsmeister, & Melton, 1992; Talley et al., 1996), three suggested a decreased frequency (Drossman et al., 1993; Stewart et al., 1999; Talley, Weaver, Zinsmeister, & Melton, 1993); and two suggested no age differences (Pare, Ferrazzi, Thompson, Irvine, & Rance, 2001; Whitehead, Drinkwater, Cheskin, Heller, & Schuster, 1989). Given the magnitude of the problem of constipation in the older adult, more detailed information is needed on age differences in the frequency and severity of symptoms of, and lifestyle factors associated with constipation.

Of note, only two studies evaluated the prevalence of symptom characteristics of constipation in young adults. Though the range and mean age of the sample were not

reported, in one study of young adults (Sandler & Drossman, 1987), 52% defined constipation as straining, 44% as hard stools, and 32% as infrequent stools. In another study of 500 deployed servicemen (Sweeney, Krafte-Jacobs, Britton, & Hansen, 1993), the prevalence of constipation, defined as the presence of specific anorectal complaints (i.e., hard stools, straining, painful defecation, bleeding with defecation), was 7.2% when at home as compared to 10.4% aboard ship and 34.1% in the field. In addition, 77% of the servicemen reported going at least two days between bowel movements. Clearly, more information on the prevalence and characteristics of constipation in younger individuals would be useful.

In addition to age, a number of chronic conditions may influence the prevalence and severity of constipation. One study of community based elders with constipation found that the number of chronic diseases ranged from 2.5 to 3.9 (Whitehead et al., 1989). Endocrine diseases (e.g., diabetes, hypothyroidism), neurologic diseases, depression, urinary incontinence, and the use of a variety of medications are associated with constipation (Chang, Locke, Schleck, Zinsmeister, & Talley, 2007; Johanson, Sonnenberg, Koch, & McCarty, 1992; Locke, Pemberton, & Phillips, 2000; Talley, Jones, Nuyts, & Dubois, 2003). For example, depression is often associated with severe constipation (Mason, Serranos-Ikkos, & Kamm, 2000). However, no studies were found that evaluated for age differences in the co-occurrence of constipation and depression. Any evaluation of age differences in the characteristics, symptoms, and bowel and dietary habits associated with constipation needs to evaluate for age differences in the occurrence of chronic conditions that may effect constipation and account for these differences in the statistical analyses.

Research studies on age differences in the characteristics of constipation are minimal in number, are restricted primarily to prevalence rates and have produced inconsistent findings. Given the paucity of research on age differences in the specific characteristics of constipation, as well as the inconsistent findings across these studies, the purposes of this study, in a sample of patients referred for an evaluation of constipation, were to evaluate for age differences in the frequency of various characteristics of constipation, as well as in the frequency of constipation specific symptoms and bowel and dietary habits, and to determine if age, as well as specific clinical characteristics and the occurrence of various medical conditions, were associated with an increase in the frequency of constipation associated characteristics, symptoms, and bowel and dietary habits.

Methods

Participants

A search of the clinical database of all patients (n=1228) evaluated at the University of California, San Francisco (UCSF) Center for Pelvic Physiology between March 2003 and October 2007 yielded 518 patients with a primary diagnosis of constipation who were ≥ 18 years of age. Patients were excluded if they had a primary diagnosis of fecal incontinence. The Committee on Human Research at UCSF approved the clinical database, as well as the use of the database for this study.

Questionnaires

As part of patients' routine assessment, they completed a clinical questionnaire that obtained information on demographic characteristics (i.e., gender, age, ethnicity, employment status) and previous medical history (i.e., medical conditions, previous

surgeries, medications). In addition, patients completed an investigator-developed questionnaire on the characteristics of constipation, symptoms of constipation, as well as various bowel and dietary habits.

The characteristics of constipation that were evaluated included: frequency of the complaint of constipation, duration of constipation symptoms at least once per month, stool frequency, and stool consistency. Patients were asked to rate the frequency of the complaint of constipation on a 4-point Likert scale; the duration of symptoms and stool frequency on 5-point Likert scales; and stool consistency on a 6-point Likert scale.

The six constipation symptoms that were evaluated were: abdominal pain, abdominal bloating, incomplete evacuation, unsuccessful attempts at evacuation, pain with evacuation, and straining with evacuation. The frequency of occurrence of each symptom was evaluated using a 5-point Likert scale. The bowel habits that were evaluated included: time spent at each evacuation, frequency of needing to change position to evacuate, use of anal digitations to evacuate, and the use of laxatives, enemas, stool softeners, foods, or other aids. Patients were asked to rate time spent at each evacuation using a 4-point Likert scale and the frequency of the other bowel habits using a 5-point Likert scale. The dietary habits that were evaluated included: use of dietary fiber, use of fiber supplements, and water intake. Patients were asked if they ingested dietary fiber; took a fiber supplement daily; and drank $\geq$ 6 glasses of water per day.

Statistical analysis

Data were analyzed using SPSS Version 15.0. Descriptive statistics, means and standard deviations for quantitative variables and frequencies and percents for categorical variables, were used to describe the demographic and clinical characteristics of the

patients. To assess whether age-related differences existed, patients were grouped into three age groups: 1) patients < 40 years of age (younger), 2) patients 40 to < 65 years of age (middle aged), and 3) patients ≥ 65 years of age (older). The demarcation for the younger (Harari et al., 1996; Talley et al., 1993) and the older (Everhart et al., 1989; Pare et al., 2001; Talley et al., 1992; Whitehead et al., 1989) age groups were used in previous studies of age differences in constipation.

Appropriate statistical tests (i.e., ANOVA, Chi square tests, Fischer's Exact tests, Mann Whitney U tests, or Kruskal Wallis tests) were used to examine for age differences in demographic and clinical characteristics, as well as in constipation characteristics, symptoms, and bowel and dietary habits. Demographic and clinical variables that were significantly different among the age groups in the univariate analyses were included as covariates in the subsequent multivariate analyses.

The main study outcomes of constipation characteristics, symptoms, and bowel and dietary habits were dichotomized into low and high frequencies of occurrence for use in multiple logistic regression analyses. In order to determine if age and the occurrence of various medical conditions and clinical characteristics were associated with an increase in the frequency of constipation associated characteristics, symptoms, and bowel and dietary habits, separate multiple logistic regression models were developed for each outcome. In order to enter the three level categorical variable of age into the multiple logistic regression analyses, it was dummy coded. It took two dummy coded variables to represent the three level age variable. The older group was chosen as the reference group, so that the first dummy coded variable represents younger versus older and the second dummy coded variable represents middle age versus older. In order to obtain the third

pairwise contrast of interest (younger versus middle age), the dummy coding strategy was changed so that the first group was the reference group and each of the multiple logistic regression analyses were rerun.

In each multiple logistic regression analysis, the dummy coded age variable that represented categorical age was entered along with the variables that were previously determined in the univariate analyses to be significantly different among the age groups. Overall, categorical age and the other potential confounding variables were considered to be statistically significant at the $p<0.05$ level. When evaluating the three pairwise contrasts for age group, the overall alpha level of .05 was divided by three so that the criterion for significance for any one contrast was .0167. The significance of the adjusted odds ratios (OR) for the pairwise age contrasts and their 95% confidence intervals (CI) were used to evaluate the magnitude of the age differences in the main study outcomes.

Results

Characteristics of the sample

Differences in demographic and clinical characteristics among the three age groups are presented in Table 1. Regardless of age, the majority of the patients were female (78.9%), white (76.3%), and employed (58.9%). While the mean age of the sample was 52.4 (SD=16.5) years; 23.7% were in the younger age group, 53.5% were middle-aged, and 22.8% were older. No differences in ethnicity were found among the age groups.

Regardless of age group, a significantly higher percentage of patients were female. Older patients reported a significantly higher number of comorbid conditions than

middle-aged patients whose number of comorbid conditions was higher than younger patients. In addition, older patients reported significantly more arthritis and surgery for hemorrhoids than middle-aged patients whose rates for these conditions were higher than younger patients. Older and middle-aged patients reported significantly more hemorrhoids, thyroid disease, and urinary incontinence than younger patients. Older patients also reported a significantly higher number of medications, other medical conditions, and anorectal surgeries than younger and middle-aged patients. In addition, older patients reported significantly more diabetes mellitus than younger patients. Middle-aged patients reported significantly more chronic back pain than younger patients. Middle-aged patients used significantly more antidepressants than older patients.

Age differences in characteristics of constipation

As shown in Table 2, no age differences were found in the frequency of the complaint of constipation or in stool consistency without the use of laxatives. Regardless of age, approximately 60% of the patients reported that the symptoms of constipation occurred ≥ one time per week in the last 12 months. However, middle aged patients were significantly more likely than younger patients to have constipation for a longer duration, with over 43% of the middle aged patients reporting symptom duration of ≥ ten years. In addition, younger and middle aged patients reported a significantly lower frequency of bowel movements than older patients.

Age differences in bowel symptoms

As shown in Table 3, no age differences were found in the frequency of unsuccessful attempts at evacuation or straining with evacuation. Compared with middle aged or older patients, younger patients were significantly more likely to report a higher

frequency of occurrence of abdominal pain. Younger and middle aged patients were significantly more likely than older patients to report a higher frequency of occurrence of abdominal bloating, as well as a higher frequency of occurrence of incomplete bowel evacuations and pain with evacuation.

Age differences in bowel and dietary habits

As shown in Table 4, no age differences were found in the amount of time spent per bowel movement; the use of anal digitations; or in the frequency of the use of laxatives, stool softeners, or enemas; or in the use of foods, drinks, or other aids to facilitate bowel evacuations. Compared with older patients, a significantly higher percentage of younger and middle aged patients reported more frequent use of position changes to evacuate.

As shown in Table 5, no age differences were found in the reported daily intake of dietary fiber or water with over 84% of the patients reporting dietary intake of fiber and nearly 50% reporting that they drank ≥ 6 glasses of water. However, a significantly higher percentage of older patients reported using a daily fiber supplement than either the younger or middle aged groups.

Multivariate findings on age differences

In the univariate analyses, significant age differences were found in the frequency of seven of 13 characteristics of constipation (i.e., duration of symptoms, bowel movement frequency), bowel symptoms (i.e., frequency of abdominal pain, abdominal bloating, incomplete evacuation, pain with evacuation), and bowel habits (i.e., frequency of position changes to evacuate). Multiple logistic regression analyses were done to determine if the age differences in these outcomes remained significant, after controlling

for twelve potential confounding variables (i.e., gender, use of daily fiber supplements and antidepressants, past medical history of urinary incontinence, thyroid disease, arthritis, depression, chronic back pain, hemorrhoids, other medical conditions, as well as, prior hemorrhoid or anorectal surgery) whose occurrence rates were significantly different among the age groups. As shown in Table 6, age differences found in the univariate analyses remained significant in the multivariate analyses for four (i.e., frequency of bowel movements, abdominal pain, abdominal bloating, use of position changes to evacuate) of the seven outcomes.

Younger and middle aged patients were over two times more likely than older patients to report the occurrence of fewer bowel movements (OR=2.67 and 2.12, respectively). In addition, patients with chronic back pain (OR=1.64) and females (OR = 2.19) were significantly more likely to report a decreased stool frequency. In contrast, those patients who reported a history of anorectal surgeries were significantly less likely (OR=0.52) to report a decrease in stool frequency.

Younger patients were nearly three times more likely than older patients to report a higher frequency of occurrence of abdominal pain (OR=2.89). In addition, patients with chronic back pain (OR=1.75) and females (OR=2.86) were significantly more likely to report a higher frequency of occurrence of abdominal pain. However, patients with arthritis were less likely to report frequent occurrences of abdominal pain (OR=0.43).

Younger patients were over five times more likely than older patients and two times more likely than middle aged patients to report an increased frequency of occurrence of abdominal bloating (OR=5.26 and 2.15, respectively). Middle age patients were over two times more likely (OR=2.45) than older patients to report an increased

frequency of occurrence of abdominal bloating. Patients with depression (OR=2.26) or those with previous hemorrhoid surgery (OR=2.51) or who were female (OR=2.65) were significantly more likely to report an increased frequency of occurrence of abdominal bloating.

Both younger and middle aged patients were significantly more likely than older patients to report an increased frequency of occurrence of changing positions to facilitate stool evacuation (OR=2.92 and 2.02, respectively). Female patients were significantly more likely to report a higher frequency of position changes (OR=1.93). In contrast, patients with thyroid disease were significantly less likely (OR=0.49) to report higher frequencies of position change.

Discussion

To our knowledge, this study is the first to perform a detailed evaluation of age differences in constipation characteristics, symptoms, and bowel and dietary habits in a large sample of patients who were evaluated in a pelvic physiology center. While results from population-based surveys suggest that the prevalence of constipation increases with age in those over 65, the largest percentage of patients (53.5%) in this study was in the middle aged category. While population-based surveys suggest that the prevalence of constipation increases with age, the fact that over 50% of the sample was middle aged may reflect the demographic characteristics of individuals who are seen in a specialty clinic rather than the age distribution of constipation in the general population. While previous studies from specialty clinics did not report on the percentage of patients by age group (Koch, Voderholzer, Klauser, & Muller-Lissner, 1997; Mertz, Naliboff, & Mayer, 1999), the mean age across samples was comparable.

A unique aspect of this study was the inclusion of younger patients. It is interesting to note that in the univariate analyses both the younger and middle aged patients had higher frequencies of occurrence of two characteristics (i.e., duration of symptoms, BM frequency), four symptoms (i.e., abdominal pain, abdominal bloating, incomplete evacuation, pain with evacuation), and one bowel habit (i.e., use of position change). In multivariate analyses, these age group differences persisted only for bowel movement frequency, frequency of abdominal bloating, and frequency of position change. In addition, younger patients compared to older patients reported a higher frequency of abdominal pain.

While no studies were found on age differences in constipation characteristics, symptoms, or bowel habits the findings on age differences reported here are supported by two lines of inquiry. First, in several studies in the oncology literature younger patients report higher levels of pain (Caraceni & Portenoy, 1999; Valeberg, Rustøen, Bjordal, Hanestad, Paul, & Miaskowski, In press 2007). Second, several studies found that older individuals reported lower levels of acute (Gagliese & Katz, 2003; Gagliese, Gauthier, Macpherson, Jovellanos, & Chan, 2008), chronic (Benbow, Cossins, & Bowsher, 1995; Lichtenberg, Skehan, & Swensen, 1984; Rustøen, Wahl, Hanestad, Lerdal, Paul, & Miaskowski, 2005), cancer (Valeberg et al., In press, 2007) and non-cancer (Papagallo, 2001) pain than younger patients. Potential reasons why older persons report fewer symptoms and less pain include: a belief that pain and other symptoms is an expected part of aging; fears of diagnostic tests and treatments; and concerns about taking opioid analgesics for pain (Gagliese & Melzack, 2003; Hale, Perkins, May, Marks, & Stewart, 1986; Prohaska, Keller, Leventhal, & Leventhal, 1987).

While it is known that women report constipation more frequently than men (Pare et al., 2001; Talley, Zinsmeister, Van Dyke, & Melton, 1991; Talley et al., 1993; Talley et al., 1996), in our sample, this gender difference was found across all age groups. This finding may be partially explained by the fact that in community based samples women seek health care more frequently than men (Verbruggge, 1985) and report higher levels of symptoms than men (van Wijk & Kolk, 1997). In addition, the prevalence of female patients traditionally is high in specialty practices (Pare et al., 2001).

Across all three age groups, the prevalence of depression in this study was higher than the 21% to 26% reported for the general population (Kessler et al., 2003). In addition, between 14% and 31% of the patients in this study reported that they were taking antidepressants. However, while rates of depression were comparable across age groups, older individuals were less likely to be taking antidepressants than middle aged patients. The association between constipation and depression found in this study is consistent with previous reports (Donald, Smith, Cruikshank, Elton, & Stoddart, 1985; Everhart et al., 1989; Mason, Serrano-Ikkos, & Kamm, 2000; Nehra, Bruce, Rath-Harvey, Pemberton, & Camilleri, 2000). For example, in one study (Mason, Serrano-Ikkos, & Kamm, 2000) patients with functional constipation reported higher rates of depression than healthy controls (Mason, Serrano-Ikkos, & Kamm, 2000).

In the multivariate analyses, an independent association was found between depression and increased frequency of abdominal bloating. This relationship may be partially explained by the use of antidepressant medications. In fact, between 46% and 53% of the patients who reported depression were taking antidepressants.

The independent association between chronic back pain and increased frequency of occurrence of abdominal pain is consistent with clinical experience. For example, patients with this medical condition may be taking medications (e.g., opioid or nonsteroidal anti-inflammatory (NSAIDS) analgesics, antidepressants) that have constipation as a side effect. In fact, 38% of the younger, 35% of the middle aged, and 19% of older patients with chronic back pain were taking analgesic medications.

It is interesting to note, that for the majority of constipation characteristics, symptoms, and bowel and dietary habits, no age differences were found. These findings may be related to the fact that these patients were seen in a specialty practice. These findings warrant confirmation in population-based studies.

Thyroid disease and arthritis were found to have negative associations with increased frequency of abdominal pain. The reasons for these associations are not readily apparent and warrant investigation in future studies.

Position change to facilitate evacuation was the only bowel habit evaluated in the multivariate analyses. Of note, younger and middle aged patients were over twice as likely as older patients to report an increased frequency of use. While specific information about the nature of the position changes was not obtained, it is reasonable to hypothesize that limitations in mobility may make it more difficult for older patients with constipation to use this habit.

Several limitations of this study need to be acknowledged. The cross sectional design does not permit the determination of causality. While self-report data were available from a large cohort of patients, the analyses were limited to the variables contained in the database. For example, the date of onset of symptoms, as well as data on

chronic cardiovascular and neurologic diseases, and specific medications were not available. In addition, these self-report data are subject to recall bias. While standardized questionnaires were utilized, validated measures of constipation, physiological tests, and bowel diaries would strengthen the interpretation of our results.

Despite these limitations, the findings from this study suggest that age differences in some of the characteristics and symptoms of constipation do exist. In fact, younger patients, who present at specialty clinic may report a higher frequency of infrequent stools, abdominal pain, abdominal bloating, and use of position change to evacuate. In contrast, older patients may be at risk for under treatment because they report a lower frequency of symptom occurrence. Based on the high prevalence of depression in this sample additional research is warranted to determine the severity of depression and its association with various aspects of constipation. Finally, these findings from this study need to be replicated in both population- and specialty clinic based samples. These types of studies may lead to a better understanding of this common problem as well as to more effective and individualized age based interventions for constipation.

References

Benbow, S. J., Cossins, L., & Bowsher, D. (1995). A comparison of young and elderly patients attending a regional pain center. *Pain Clinic, 8*, 323-332.

Caraceni, A., & Portenoy, R. K. (1999). An international survey of cancer pain characteristics and syndromes. IASP Task Force on Cancer Pain. International Association for the Study of Pain. *Pain, 82*, 263-274.

Chang, J. Y., Locke, G. R., Schleck, C. D., Zinsmeister, A. R., & Talley, N. J. (2007). Risk factors for chronic constipation and a possible role of analgesics. *Neurogastroenterology and Motility, 19*, 905-911.

Donald, I. P., Smith, R. G., Cruikshank, J. G., Elton, R. A., & Stoddart, M. E. (1985). A study of constipation in the elderly living at home. *Gerontology, 31*, 112-118.

Drossman, D. A., Li, Z., Andruzzi, E., Temple, R. D., Talley, N. J., Thompson, W. G., et al. (1993). U.S. householder survey of functional gastrointestinal disorders. Prevalence, sociodemography, and health impact. *Digestive Diseases Science, 38*, 1569-1580.

Everhart, J. E., Go, V. L. W., Hohannes, R. S., Fitzsimmons, S. C., Roth, H. P., & White, L. R. (1989). A longitudinal study of self-reported bowel habits in the United States. *Digestive Diseases and Sciences, 34*, 1153-1162.

Gagliese, L., Gauthier, L. R., Macpherson, A. K., Jovellanos, M., & Chan, V. W. (2008). Correlates of postoperative pain and intravenous patient-controlled analgesia use in younger and older surgical patients. *Pain Medicine, 9*, 299-314.

Gagliese, L., & Katz, J. (2003). Age differences in postoperative pain are scale dependent: a comparison of measures of pain intensity and quality in younger and older surgical patients. *Pain, 103*, 11-20.

Gagliese, L., & Melzack, R. (2003). Age-related differences in the qualities but not the intensity of chronic pain. *Pain, 104*, 597-608.

Hale, W. E., Perkins, L. L., May, F. E., Marks, R. G., & Stewart, R. B. (1986). Symptom prevalence in the elderly. An evaluation of age, sex, disease, and medication use. *Journal of the American Geriatrics Society, 34*, 333-340.

Hammond, E. (1964). Some preliminary findings on physical complaints from a prospective study of 1,064,004 men and women. *American Journal of Public Health, 54*, 11-23.

Harari, D., Gurwitz, J. H., Avorn, J., Bohn, R., & Minaker, K. L. (1996). Bowel habit in relation to age and gender. Findings from the National Health Interview Survey and clinical implications. *Archives of Internal Medicine, 156*, 315-320.

Johanson, J. F., & Kralstein, J. (2007). Chronic constipation: A survey of the patient perspective. *Alimentary Pharmacology and Therapeutics, 25*, 599-608.

Johanson, J. F., Sonnenberg, A., Koch, T. R., & McCarty, D. J. (1992). Association of constipation with neurologic diseases. *Digestive Diseases and Sciences, 37*, 179-186.

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Koretz, D., Merikangas, K. R., et al. (2003). The epidemiology of major depressive disorder: Results from the National Comorbidity Survey Replication (NCS-R). *Journal of the American Medical Association, 289*, 3095-3105.

Koch, T. R., Voderholzer, W. A., Klauser, A. G., & Muller-Lissner, S. (1997). Symptoms in chronic constipation. *Diseases of the Colon and Rectum, 40*, 902-906.

Lichtenberg, P. A., Skehan, M. W., & Swensen, C. H. (1984). The role of personality, recent life stress and arthritic severity in predicting pain. *Journal of Psychosomatic Research, 28*, 231-236.

Locke, G. R., 3rd, Pemberton, J. H., & Phillips, S. F. (2000). AGA technical review on constipation. American Gastroenterological Association. *Gastroenterology, 119*, 1766-1778.

Mason, H. J., Serrano-Ikkos, E., & Kamm, M. A. (2000). Psychological morbidity in women with idiopathic constipation. *American Journal of Gastroenterology, 95*, 2852-2857.

Mertz, H., Naliboff, B., & Mayer, E. A. (1999). Symptoms and physiology in severe chronic constipation. *American Journal of Gastroenterology, 94*, 131-138.

Nehra, V., Bruce, B. K., Rath-Harvey, D. M., Pemberton, J. H., & Camilleri, M. (2000). Psychological disorders in patients with evacuation disorders and constipation in a tertiary practice. *American Journal of Gastroenterology, 95*, 1755-1758.

Pappagallo, M. (2001). Incidence, prevalence, and management of opioid bowel dysfunction. *American Journal of Surgery, 182*, 11S-18S.

Pare, P., Ferrazzi, S., Thompson, W. G., Irvine, E. J., & Rance, L. (2001). An epidemiological survey of constipation in Canada: Definitions, rates, demographics, and predictors of health care seeking. *American Journal of Gastroenterology, 96*, 3130-3137.

Prohaska, T. R., Keller, M. L., Leventhal, E. A., & Leventhal, H. (1987). Impact of symptoms and aging attribution on emotions and coping. *Health Psychology, 6*, 495-514.

Rustøen, T., Wahl, A. K., Hanestad, B. R., Lerdal, A., Paul, S., & Miaskowski, C. (2005). Age and the experience of chronic pain: differences in health and quality of life among younger, middle-aged, and older adults. *Clinical Journal of Pain, 21*, 513-523.

Sandler, R. S., & Drossman, D. A. (1987). Bowel habits in young adults not seeking health care. *Digestive Diseases and Sciences, 32*, 841-845.

Sandler, R. S., Jordan, M. C., & Shelton, B. J. (1990). Demographic and dietary determinants of constipation in the US population. *American Journal of Public Health, 80*, 185-189.

Stewart, W. F., Liberman, J. N., Sandler, R. S., Woods, M. S., Stemhagen, A., Chee, E., et al. (1999). Epidemiology of constipation (EPOC) study in the United States: Relation of clinical subtypes to sociodemographic features. *American Journal of Gastroenterology, 94*, 3530-3540.

Sweeney, W. B., Krafte-Jacobs, B., Britton, J. W., & Hansen, W. (1993). The constipated serviceman: Prevalence among deployed U.S. troops. *Military Medicine, 158*, 546-548.

Talley, N. J., Zinsmeister, A. R., Van Dyke, C., & Melton, L. J., 3rd. (1991). Epidemiology of colonic symptoms and the irritable bowel syndrome. *Gastroenterology, 101*, 927-934.

Talley, N. J., Weaver, A. L., Zinsmeister, A. R., & Melton, L. J., 3rd. (1992). Onset and disappearance of gastrointestinal symptoms and functional gastrointestinal disorders. *American Journal of Epidemiology, 136*, 165-177.

Talley, N. J., Weaver, A. L., Zinsmeister, A. R., & Melton, L. J., 3rd. (1993). Functional constipation and outlet delay: A population-based study. *Gastroenterology, 105*, 781-790.

Talley, N. J., Fleming, K. C., Evans, J. M., O'Keefe, E. A., Weaver, A. L., Zinsmeister, A. R., et al. (1996). Constipation in an elderly community: A study of prevalence and potential risk factors. *American Journal of Gastroenterology, 91*, 19-25.

Talley, N. J., Jones, M., Nuyts, G., & Dubois, D. (2003). Risk factors for chronic constipation based on a general practice sample. *American Journal of Gastroenterology, 98*, 1107-1111.

Valeberg, B. T., Rustoen, T., Bjordal, K., Hanestad, B. R., Paul, S., & Miaskowski, C. (2007). Self-reported prevalence, etiology, and characteristics of pain in oncology outpatients. *European Journal of Pain*, doi:10.1016/j.ejpain.2007.09.004.

van Wijk, C. M., & Kolk, A. M. (1997). Sex differences in physical symptoms: The contribution of symptom perception theory. *Social Science and Medicine, 45*, 231-246.

Verbrugge, L. M. (1985). Gender and health: An update on hypotheses and evidence. *Journal of Health and Social Behavior, 26*, 156-182.

Whitehead, W. E., Drinkwater, D., Cheskin, L. J., Heller, B. R., & Schuster, M. M. (1989). Constipation in the elderly living at home. Definition, prevalence, and

relationship to lifestyle and health status. *Journal of the American Geriatrics Society, 37*, 423-429.

Table 1. Differences among the three age groups in demographic and clinical characteristics

Characteristic	**< 40 years Group 1 n= 123 Mean (SD)**	**40 to < 65 years Group 2 n= 277 Mean (SD)**	**≥ 65 years Group 3 n= 118 Mean (SD)**	**Statistics and post hoc contrasts**
Mean age	31.5 (5.9)	51.7 (6.5)	76.0 (6.3)	$F(2,515)=1491.69$ $p<0.0001$ 3>2>1
# Comorbid conditions	2.7 (1.8)	3.79 (2.2)	4.3 (2.3)	$F(2,515)=18.49$, $p<0.0001$ 2 and 3 >1
# Medications	3.4 (3.0)	5.8 (4.8)	7.7 (4.9)	$F(2,508)=26.85$, $p<0.0001$ 3>2>1
	n (%)	**n (%)**	**n (%)**	
Gender				$\chi^2=7.18$, $p=0.028$
Female	92 (74.8)	231 (83.4)	86 (72.9)	
Male	31 (25.2)	46 (16.6)	32 (27.1)	
Ethnicity				$\chi^2=6.34$, $p=0.386$
White	75 (72.8)	177 (76.6)	79 (79.0)	
Employment status				$\chi^2=32.60$, $p<0.0001$ 1 and 2 >3[a]
Employed	77 (62.6)	185 (66.8)	43 (36.4)	
Not employed	46 (37.4)	92 (33.2)	75 (63.6)	
Arthritis	9 (7.4)	71 (25.9)	63 (54.3)	$\chi^2=66.262$, $p<0.0001$ 3>2>1[a]
Chronic back pain	27 (22.1)	99 (36.1)	42 (35.6)	$\chi^2=8.11$, $p=0.017$ 2>1[a]
Depression	43 (35.2)	115 (41.7)	34 (28.2)	$\chi^2=6.11$, $p=0.047$
Diabetes	2 (1.6)	21 (7.6)	11 (9.3)	$\chi^2=6.75$, $p=0.034$ 3>1[a]
Hemorrhoids	42 (35.3)	146 (53.3)	71 (60.2)	$\chi^2=16.27$, $p<0.0001$ 2 and 3 >1[a]
Irritable Bowel Syndrome	53 (44.5)	107 (39.6)	40 (35.4)	$\chi^2=2.03$, $p=0.362$
Thyroid disease	9 (7.4)	58 (21.0)	23 (19.5)	$\chi^2=11.37$, $p=0.003$ 2 and 3 >1[a]
Urinary incontinence	31 (25.4)	111 (40.5)	53 (44.9)	$\chi^2=11.34$, $p=0.003$ 2 and 3 >1[a]

Characteristic	< 40 years Group 1 n= 123 n (%)	40 to < 65 years Group 2 n= 277 n (%)	≥ 65 years Group 3 n= 118 n (%)	Statistics, Post hoc contrasts
Other medical conditions	60 (50.0)	170 (62.0)	91 (77.1)	χ^2=18.82; p<0.0001 3>1 and 2[a]
Surgery for hemorrhoids	6 (5.0)	37 (13.5)	27 (23.1)	χ^2=16.59; p<.001 3>2 >1[a]
Anorectal Surgery	22 (18.2)	77 (27.8)	48 (41.0)	χ^2=15.38, p<0.0001 3>1 and 2[a]
Use of antidepressants	29 (27.4)	77 (30.8)	16 (13.8)	χ^2=12.12, p=0.002 3<2 [a]
Use of pain medications	21 (19.6)	62 (24.8)	17 (14.7)	χ^2=5.08, p=0.079
History of Sexual assault	14 (13.5)	38 (15.2)	7 (7.1)	χ^2=4.16, p=0.125

[a]= Fisher's Exact Test, significance=p<0.0167
Abbreviations: SD=Standard deviation

Table 2. Differences among the three age groups in the frequency of occurrence of specific characteristics of constipation

	<40 years Group 1 n (%)	**40 to <65 years Group 2** n (%)	**≥ 65 years Group 3** n (%)	**Statistics, Post hoc contrasts**
Frequency of the complaint of constipation				KW=0.45, p=0.80
Never	6 (5.2)	11 (4.3)	9 (8.0)	
< Monthly	9 (7.7)	13 (5.1)	9 (8.0)	
≥1 time per month	34 (29.3)	77 (30.1)	24 (21.5)	
≥1 time per week	67 (57.8)	155 (60.5)	70 (62.5)	
Mean rank (SD)	3.40 (0.8)	3.47 (0.8)	3.38 (0.9)	
Duration of symptoms at least 1 time/month				KW= 10.67, p=0.005 2>1[a]
< 1 year	25 (21.9)	34 (13.5)	15 (14.0)	
1 to <5 years	37 (32.5)	70 (27.9)	38 (35.5)	
5 to <10 years	16 (14.0)	38 (15.1)	18 (16.8)	
10 to <20 years	20 (17.6)	31 (12.4)	17 (15.9)	
≥20 years	16 (14.0)	78 (31.1)	19 (17.8)	
Mean rank(SD)	2.69 (1.4)	3.20 (1.5)	2.88 (1.3)	
Bowel movement (BM)frequency				KW=21.27; p<0.0001 1 and 2 >3[a]
≥1 BM per day	59 (48.4)	146 (53.8)	86 (74.1)	
≤2 BMs per week	40 (32.8)	76 (28.0)	25 (21.6)	
<1 BM per week	10 (8.2)	24 (8.9)	2 (1.7)	
<2 BMs per 2 weeks	11 (9.0)	24 (8.9)	2 (1.7)	
Varies	2 (1.6)	1 (0.4)	1 (0.9)	
Mean rank (SD)	1.83 (1.0)	1.74 (1.0)	1.34 (0.7)	
Stool consistency without laxatives				KW=0.83; p=0.660
Liquid/loose	9 (7.5)	7 (2.6)	5 (4.3)	
Formed Soft	29 (24.1)	81 (29.9)	32 (27.8)	
Formed Hard	17 (14.2)	35 (12.9)	15 (13.0)	
Very hard or pellet like	32 (26.7)	77 (28.4)	22 (19.2)	
Varies	18 (15.0)	37 (13.7)	20 (17.3)	
Don't know always use laxatives	15 (12.5)	34 (12.5)	21 (18.4)	
Mean rank (SD)	3.55 (1.5)	3.58 (1.4)	3.72 (1.6)	

[a]= Mann Whitney U, significance=p<0.0167

Abbreviations: KW=Kruskal Wallis; SD=Standard deviation

Table 3. Differences among the three age groups in bowel symptom frequencies

Bowel symptom	**<40 years Group 1 n (%)**	**40 to <65 years Group 2 n (%)**	**≥ 65 years Group 3 n (%)**	**Statistics, Post hoc contrasts**
Abdominal pain				KW=40.144 $p<0.0001$, 1>2>3[a]
Never	6 (5.3)	32 (12.5)	31 (27.9)	
Rarely	8 (7.1)	36 (14.2)	21 (18.9)	
Occasionally	29 (25.7)	73 (28.6)	30 (27.0)	
Usually	39 (34.5)	76 (29.8)	17 (15.4)	
Always	31 (27.4)	38 (14.9)	12 (10.8)	
Mean rank (SD)	3.72 (1.1)	3.20 (1.2)	2.62 (1.3)	
Abdominal bloating				KW=39.341 $p<0.0001$, 1 >2 and 2>3[a]
Never	9 (8.0)	18 (7.0)	24 (21.8)	
Rarely	8 (7.1)	17 (6.6)	13 (11.8)	
Occasionally	15 (13.3)	58 (22.6)	34 (30.9)	
Usually	34 (30.0)	81 (31.5)	24 (21.8)	
Always	47 (41.6)	83 (32.3)	15 (13.7)	
Mean rank (SD)	3.90 (1.3)	3.75 (1.8)	2.94 (1.3)	
Incomplete evacuation				KW=11.333 $p=0.003$, 1 and 2 >3[a]
Never	2 (1.7)	6 (2.3)	4 (3.5)	
Rarely	5 (4.4)	8 (3.1)	8 (7.0)	
Occasionally	23 (20.0)	47 (18.1)	31 (27.2)	
Usually	37 (32.2)	109 (42.1)	45 (39.5)	
Always	48 (41.7)	89 (34.4)	26 (22.8)	
Mean rank (SD)	4.08 (1.0)	4.03 (0.9)	3.71 (1.0)	
Unsuccessful attempts at evacuation				KW=4.344 $p=0.114$
Never	2 (1.8)	8 (3.1)	7 (6.3)	

Bowel Symptom	<40 years Group 1 n (%)	40 to <65 years Group 2 n (%)	≥ 65 years Group 3 n (%)	Statistics, Post hoc contrasts
Rarely	10 (8.8)	15 (5.7)	12 (10.7)	
Occasionally	30 (26.3)	64 (24.5)	29 (25.9)	
Usually	35 (30.6)	98 (37.5)	38 (33.9)	
Always	37 (32.5)	76 (29.2)	26 (23.2)	
Mean rank (SD)	3.83 (1.0)	3.84 (1.0)	3.57 (1.2)	
Pain with evacuation				KW=17.739 p<0.0001, 1 and 2 >3[a]
Never	9 (8.0)	47 (18.3)	36 (31.9)	
Rarely	22 (19.5)	46 (17.9)	24 (21.2)	
Occasionally	33 (29.2)	72 (28.0)	21 (18.6)	
Usually	25 (22.1)	56 (21.8)	20 (17.7)	
Always	24 (21.2)	36 (14.0)	12 (10.6)	
Mean rank (SD)	3.29 (1.2)	2.95 (1.3)	2.54 (1.4)	
Straining with evacuation				KW= 2.863 p=0.239
Never	2 (1.7)	11 (4.2)	4 (3.5)	
Rarely	5 (4.3)	3 (1.2)	9 (7.8)	
Occasionally	23 (19.8)	66 (25.5)	26 (22.6)	
Usually	35 (30.2)	85 (32.8)	35 (30.4)	
Always	51 (44.0)	94 (36.3)	41 (35.7)	
Mean rank (SD)	4.10 (1.0)	3.96 (1.0)	3.87 (1.1)	

[a]= Mann Whitney U, significance=p<0.0167

Abbreviations: KW=Kruskal-Wallis; SD=Standard deviation

Table 4. Differences among the three age groups in the frequency of bowel habits

Bowel habit	**<40 years Group 1 n (%)**	**40 to <65 years Group 2 n (%)**	**≥ 65 years Group 3 n (%)**	**Statistics, Post hoc contrasts**
Time spent per BM				KW=1.189 p=0.552
<5 minutes	33 (27.5)	59 (22.3)	27 (23.5)	
5 to 10 minutes	33 (27.5)	76 (28.7)	41 (35.7)	
10 to 30 minutes	28 (23.3)	86 (32.5)	31 (27.0)	
≥30 minutes	26 (21.7)	44 (16.5)	16 (13.8)	
Mean Rank (SD)	2.39 (1.1)	2.43 (1.0)	2.31 (1.0)	
Anal digitation				KW=0.807 p=0.668
Never	79 (71.8)	167 (68.7)	63 (64.9)	
<Monthly	5 (4.5)	16 (6.6)	7 (7.2)	
Monthly (1-3 times per month)	5 (4.5)	19 (7.8)	7 (7.2)	
Weekly (1-6 times per week)	8 (7.4)	15 (6.2)	9 (9.4)	
Daily	13 (11.8)	26 (10.7)	11 (11.3)	
Mean rank (SD)	1.83 (1.5)	1.84 (1.4)	1.95 (1.5)	
Change position				KW=18.914 p<0.0001, 1 and 2 >3[a]
Never	18 (16.1)	52 (21.1)	38 (35.5)	
Rarely	13 (11.6)	20 (8.1)	16 (15.0)	
Occasionally	15 (13.4)	50 (20.2)	18 (16.8)	
Usually	35 (31.3)	63 (25.5)	20 (18.7)	
Always	31 (27.6)	62 (25.1)	15 (14.0)	
Mean rank (SD)	3.43 (1.42)	3.26 (1.46)	2.61 (1.48)	
Stool softeners				KW=3.165 p=0.205
Never	59 (54.1)	114 (47.5)	52 (47.7)	
<Monthly	11 (10.1)	21 (8.8)	11 (10.1)	
Monthly (1-3 times per month)	7 (6.4)	16 (6.7)	3 (2.8)	
Weekly (1-6 times per week)	12 (11.1)	16 (6.7)	10 (9.2)	
Daily	20 (18.3)	73 (30.3)	33 (30.3)	
Mean rank (SD)	2.29 (1.6)	2.64 (1.8)	2.64 (1.8)	

Bowel habit	<40 years Group 1 n (%)	40 to <65 years Group 2 n (%)	≥ 65 years Group 3 n (%)	Statistics, Post hoc contrasts
Laxatives				KW=0.821 p=0.663
Never	39 (34.2)	90 (36.3)	51 (48.1)	
<Monthly	16 (14.0)	28 (11.3)	6 (5.7)	
Monthly (1-3 times per month)	20 (17.6)	34 (13.7)	7 (6.6)	
Weekly (1-6 times per week)	13 (11.4)	34 (13.7)	12 (11.3)	
Daily	26 (22.8)	62 (25.0)	30 (28.3)	
Mean Rank (SD)	2.75 (1.6)	2.80 (1.6)	2.66 (1.8)	
Enemas				KW=0.721 p=0.697
Never	58 (52.7)	138 (55.6)	59 (54.1)	
<Monthly	21 (19.1)	53 (21.4)	19 (17.4)	
Monthly (1-3 times per month)	12 (10.9)	22 (8.9)	9 (8.3)	
Weekly (1-6 times per week)	13 (11.8)	19 (7.6)	13 (11.9)	
Daily	6 (5.5)	16 (6.5)	9 (8.3)	
Mean Rank (SD)	1.98 (1.3)	1.88 (1.2)	2.03 (1.4)	.
Foods, drinks, or other aids				KW=0.894 p=0.639
Never	37 (39.8)	83 (38.1)	36 (46.2)	
<Monthly	6 (6.5)	23 (10.6)	2 (2.6)	
Monthly (1-3 times per month)	7 (7.5)	16 (7.3)	7 (9.0)	
Weekly (1-6 times per week)	13 (14.0)	26 (11.9)	12 (15.4)	
Daily	30 (32.2)	70 (32.1)	21 (26.8)	
Mean Rank (SD)	2.92 (1.8)	2.89 (1.7)	2.74 (1.8)	

[a]= Mann Whitney U, significance=p<0.0167;
Abbreviations: KW=Kruskal-Wallis; SD=Standard deviation; BM=bowel movement

Table 5. Differences among the three age groups in dietary habits

Dietary Habits	**<40 years Group 1 n (%)**	**40 to <65 years Group 2 n (%)**	**≥ 65 years Group 3 n (%)**	**Statistics, Post hoc contrasts**
Daily dietary fiber	96 (78.0)	237 (85.6)	105 (89.0)	χ^2=5.973 p=0.050
Daily fiber supplement	39 (33.1)	97 (37.3)	63 (54.8)	χ^2=13.563 p=.001, 3>2 and 1[a]
Water ≥ 6 glasses per day	66 (55.5)	133 (48.2)	58 (50.0)	χ^2=1.765 p=0.414

[a]=Fisher's Exact Test, significance=p<0.0167

Table 6. Results of Multiple Logistic Regression Analyses for Dichotomized Characteristic, Symptoms, and Bowel Habit

	Bowel movement frequency††			Frequency of abdominal pain±			Frequency of abdominal bloating±			Frequency of change position¥		
	p value	OR	95%CI	*p* value	OR	95%CI	*p* value	OR	95%CI	*p* value	OR	95%CI
AGE	.011			.010			<.0001			.007		
Younger vs. Older	.005*	2.67	1.35, 5.29	.003*	2.89	1.44, 5.80	<.0005*	5.26	2.53, 10.94	.002*	2.92	1.47, 5.82
Middle aged vs. Older	.008*	2.12	1.21, 3.69	.176	1.47	0.84, 2.56	.0001*	2.45	1.41, 4.25	.012*	2.02	1.17, 3.51
Younger vs. Middle aged	.390	1.26	0.74, 2.16	.020	1.37	1.12, 3.85	.014*	2.15	1.17, 3.95	.187	1.35	0.34, 2.49
Female	.007†	2.19	1.24, 3.85	.001†	2.86	1.58, 5.19	.001†	2.65	1.50, 4.68	.019†	1.93	1.11, 3.36
Daily fiber supplement	.095	0.70	0.45, 1.07	.180	0.74	0.47, 1.15	.351	0.81	0.52, 1.26	.835	1.05	0.68, 1.61
Arthritis	.677	0.90	0.53, 1.50	.003†	0.43	0.25, 0.75	.199	0.70	0.41, 1.21	.484	0.83	0.49, 1.41
Chronic back pain	.042†	1.64	1.02, 2.62	.028†	1.75	1.06, 2.87	.278	1.32	0.80, 2.17	.287	1.30	0.80, 2.08
Depression	.280	1.31	.80, 2.12	.189	1.41	0.85, 2.34	.002†	2.26	1.34, 3.81	.136	1.45	0.89, 2.38
Hemorrhoids	.629	0.89	0.57, 1.41	.705	1.10	0.68, 1.76	.174	0.72	0.44, 1.16	.607	1.13	0.71, 1.79
Thyroid disease	.069	0.60	0.34, 1.04	.011†	.48	0.27, 0.85	.358	0.77	0.44, 1.34	.011†	0.49	0.28, .85
Urinary incontinence	.408	1.21	0.77, 1.88	.437	.83	0.53, 1.32	.254	1.32	0.82, 4.25	.350	1.24	0.79, 1.94
Other medical conditions	.55	1.15	0.73, 1.83	.232	1.35	0.83, 2.19	.136	1.46	0.89, 2.39	.475	1.19	0.74, 1.90
Prior hemorrhoid surgery	.798	1.12	0.48, 2.62	.758	.87	0.37, 2.05	.035†	2.51	1.07, 5.92	.208	1.69	0.75, 3.80
Prior anorectal surgery	.041†	0.52	0.28, .97	.671	.87	0.46, 1.65	.713	0.89	0.48, 1.66	.891	0.96	0.52, 1.77
Use of antidepressants	.550	1.18	0.69, 2.00	.190	1.45	0.83, 2.52	.799	1.08	0.60, 1.93	.869	1.05	0.61, 1.80

*$p<.0167$ (.05/3); †$p<.05$

††Bowel movement frequencies identified as one or more times per day were coded as 0; frequencies of ≤ two times

per week, < one time per week, <one time per two weeks, < one time per two weeks, and varies were coded as 1.

[±]Symptom frequencies identified as never, rarely, and occasionally were coded as 0; symptoms identified as usually and always were coded as 1.

[¥]Bowel habit frequencies identified never, less than monthly, and monthly were coded 0; frequencies identified as weekly and daily were coded 1.

Outcome Variables Not Significant by Age Recode: Incomplete Evacuation, Pain with BM; Duration of Constipation Symptoms

Conclusion and Recommendation for Future Research

The purposes of the reviews and studies presented in this dissertation were to explore and describe how age and gender influence the characteristics and symptoms of constipation. Constipation is not a straightforward problem. Based on a limited amount of conflicting data, changes in gastrointestinal (GI) function associated with aging appear to be relatively subtle. Additional research is warranted on the effects of aging on GI function, as well as on the timing of these changes. Recent research on the mechanisms and affects of constipation on the elderly is extremely sparse. Dysmotility and pelvic floor dysfunction are clearly important mechanisms associated with constipation, but further work is needed to understand the anatomic, physiologic, and lifestyle factors that affect these mechanisms. In addition, longitudinal data on gastrointestinal motility are needed to determine the effects of aging on normal lower GI and pelvic floor anatomy and function. Studies are needed that evaluate for changes in the physiology of the pelvic floor in women over the menopause transition and whether these changes contribute to functional outcomes seen at that time and into old age.

While significant progress has occurred in the development of consensus criteria for the assessment of constipation, the definition is not standardized. The Rome criteria constitute a self-reported, complaint-based diagnostic system with a significant overlap between the criteria for dysmotility and pelvic dysfunction disorders. Studies are needed to clarify the discrete differences between colonic motor dysfunction and functional defecation disorders.

Additional research to refine or develop a more comprehensive self-report measure to evaluate constipation in adults is warranted. As the review paper highlights,

no one ideal measure is currently available. A measure is needed that evaluates the complex constellation of symptoms that encompasses constipation with the ability to evaluate the symptom experience more comprehensively, taking into account not only symptom frequency but severity and distress.

Findings on gender and age differences in the characteristics of constipation (i.e., diagnostic subtypes, symptoms) are inconsistent, primarily because of the paucity of research; lack of clarity in the definition of constipation; and reliance on primarily population-based surveys. This lack of research is a significant issue given the magnitude of this problem in women and in the older adult. Research is needed on gender and age differences in the symptoms of constipation as well as on differences in the physiologic mechanisms that underlie various types of constipation.

While the results of the study in this dissertation indicated that women are not only more likely to report constipation, they are more likely to report increased frequencies of a number of characteristics of constipation, symptoms, and bowel habits than men. In addition, women reported more chronic diseases than men which might make the management of their constipation more difficult.

Patients who seek treatment for constipation may present with differing characteristics related to their age. Patients with constipation who present at a younger age may report a higher frequency of certain characteristics, symptoms, and bowel habits. While older patients reported more chronic diseases than the younger patients, they did not have a dramatically different constipation profile than middle aged patients. Though differences were found among three age groups in the frequency of occurrence of a number of characteristics of constipation, symptoms, and bowel habits, the striking

finding was how similar the age groups were in their reports of symptoms and bowel habits.

The high prevalence of depression in this study warrants further investigation. While this finding is not new in patients seen for constipation, more in depth evaluation of depression using validated instruments would be useful to determine the inter-relationships between these symptoms.

The findings from the two studies presented in this dissertation warrant replication in both population- and specialty clinic based studies that examine gender and all age ranges. These types of studies may lead to a better understanding of this common problem as well as to more effective and individualized gender and age based interventions.

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