

**IRRITABLE BOWEL SYNDROME AND PHYSICAL
ACTIVITY**

by

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A DISSERTATION

Presented to the Department of Public Health

And the Oregon Health Sciences University

School of Medicine

in partial fulfillment of

the requirement for the degree of

Master of Public Health

May 2001

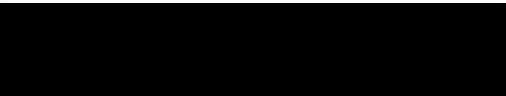
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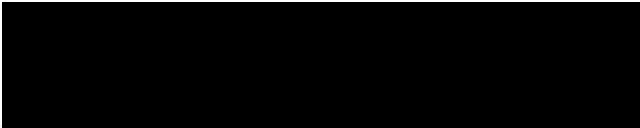
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Acknowledgments

I am grateful to David H. Hickam, M.D., M.P.H. Professor, Department of Medicine, V.A. Hospital, Portland, Oregon for his guidance and his ability to constructively criticize throughout the study.

I am also grateful to Sandra K. Joos, Ph.D., M.P.H., Assistant Professor, Department of Medicine, V.A Hospital, Portland, Oregon. Her constant supervision from the beginning of the study, constructive criticism and invaluable suggestions were of great help at every stage of my study.

My sincere appreciation to Linda H. Humphrey, M.D., M.P.H., Associate Professor, Department of Medicine, V.A. Hospital, Portland, Oregon for her encouragement and her help in editing the thesis.

I am obliged to Nicholas J. Talley, M.D., Ph.D., Professor, Department of Medicine, Division of Gastroenterology, University of Sydney, Nepean Hospital Penrith (NSW), Australia for his encouragements to do the study and his expert advice in the evaluation of bowel disease component of the study.

I also wish to tender my gratitude to Barbara Sternfeld, Ph.D., M.P.H., Division of Research, Kaiser Permanente, Oakland, California, for supplying us the physical activity questionnaire.

James Woehl, C.N.P. whose influence, hard work and participation in the study helped me complete this work. My gratitude is also due to Peter Henry, Director, V.A. Black Hills Health Care System, South Dakota, for allowing me to carry out the study in the Black Hills V.A. Medical Centers. I am very much indebted to Michael Davies, M.D. Chief of Staff, Black Hills Health Care System, who supported the this project, encouraged employees participation and took a keen interest throughout the study.

I sincerely thank Jill Britton and Clifford Schunot, R.T. from V.A. Black Hills Health Care System (Hot Springs), South Dakota for their role in the study including help in distribution and collection of the questionnaires. From V.A. Medical Center, Portland, OR. Theresa Whittenberg helped in formatting the questionnaire and scanning of data, Mary-Anne Thygesen conducted the statistical analyses.

A special word of thanks to my colleagues in the V.A. Black Hills Health Care System (Hot Springs) for their constant help and encouragement. My thanks are also due to all the employees of Black Hills Health Care System who made the study possible.

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Abstract

Background: Increased physical activity has been advocated as a treatment modality for irritable bowel syndrome (IBS), but there has been little examination of its effectiveness. IBS has a strong association with low quality of life and physical activity has been shown to enhance this. Physical activity might benefit IBS by directly affecting central nervous system gut hormones or by improving quality of life. We conducted a cross-sectional study evaluating the association among physical activity, quality of life (QOL) and IBS in a population of employed adults. Specific aims of the study were to: 1) assess the prevalence of irritable bowel syndrome in a defined population; 2) evaluate the physical activity of all the subjects in this population; 3) evaluate the association between physical activity and the prevalence of IBS and finally, 4) to evaluate the association between physical activity and the medical consultation behavior of the subjects with IBS. **Methods:** 1069 employees (age range 24 to 77) of the Veterans Affairs (VA) Black Hills Health Care System were mailed validated questionnaires inquiring about their bowel habits, QOL (SF-36) and physical activity (modified Baecke questionnaire). **Results:** The questionnaire response rate was 72%. Sixty-four subjects (9.1%) reported symptoms compatible with IBS by Rome I criteria. IBS subjects reported lower QOL on all subscales of the SF 36 except role emotional. Subjects with IBS who had consulted a physician for bowel symptoms within the last year (Consulters) reported poorer quality of life than non-consulters on the physical functioning, body pain, and health perception. Controlling for age and gender, there was no difference in any domain of physical

activity (household/ caregiving, occupational, active-living, sports or total activity) between IBS and non-IBS subjects. Total physical activity was no different between consulters and non-consulters; however non-consulters of IBS were more active in sports than consulters. Among IBS subjects, scores on the active-living, sports and total activity scales were positively associated with greater physical functioning and health perception. **Conclusions:** While level of physical activity was not associated with the overall prevalence of IBS symptoms in this population of employed adults, it was associated with improved physical functioning and health perception in IBS subjects. Increased physical activity is empirically recommended for IBS subjects. Exercise has many benefits and we would suggest that physical activity should be continued to be prescribed. However future studies should be done to demonstrate that increasing physical activity is efficacious in IBS subjects.

Chapter 1

INTRODUCTION

Irritable bowel syndrome (IBS) is the most common functional gastrointestinal disorder. It is characterized by abdominal pain or discomfort and disturbed defecation with absence of any structural or organic disorder (1). It affects 10-20% of the general population in adult westerners (2-6). In the United States there are between 2.5 and 3.5 million physicians' visits each year and 2.2 million prescriptions are written each year for IBS (7). Irritable bowel syndrome is one of the most common diagnoses made in the primary care setting and is responsible for up to 40 percent of referrals to a gastroenterologist (8). The etiology and pathogenesis of IBS are not known.

Up to 60 percent of subjects with IBS have a psychiatric disorder compared to those with organic gastrointestinal disorders and of healthy controls (25,29). Research on IBS has suggested that psychological factors play an important role in explaining the symptoms and outcomes of IBS. Co-morbid psychological disturbances have considerable negative impact on the severity of symptoms of IBS. Psychological factors are also known to influence gut physiology, the symptom experience and health behavior.

A significant association has been found between higher level of exercise participation and decreased symptoms of depression (13). It has been argued that some of the beneficial effects of exercise in the prevention and treatment of

cardiovascular and other health disorders may accrue from exercise-mediated psychological changes, that is decrease in depression and anxiety, and improved self-concept (14). Despite the suggested benefits of exercise training in the prevention and management of mental diseases, and a strong association of mental diseases with IBS, there is a paucity of knowledge linking IBS and physical activity. It is biologically plausible that exercise should reduce symptoms of IBS. Anxiety and depression have been shown to worsen the symptoms of IBS, and exercise has been shown to reduce symptoms of stress, anxiety, and depression. So, it is possible that exercise, by improving mental health, depression and anxiety, may decrease the prevalence or morbidity of IBS. Secondly, by directly affecting CNS gut hormones, exercise can possibly modulate enteric nervous system and intestine functions.

Various studies have assessed gastrointestinal symptoms during exercise. These studies have evaluated the effects of physical activity on the gastrointestinal tract in competitive athletes and volunteers in controlled experimental settings, but have not studied general population sample of subjects with different levels of physical activity (15-17). The only population-based study evaluating the relationship between physical activity and IBS enrolled only elderly subjects and demonstrated no association.

Despite the suggested benefits of exercise training in the prevention and management of chronic diseases, and that exercise has been advocated in the

management of IBS, the prior studies have not demonstrated an association between IBS and physical activity. Given the high prevalence and associated morbidity of IBS and the high cost and potential side effects of various drugs in the treatment of IBS, it is important to learn more about the effects of physical activity on IBS. A study was designed of community-based subjects with different levels of physical activity to evaluate whether a moderate to high level of physical activity is associated with lower prevalence of IBS and lower consultation habits among subjects with IBS.

Goal of the study

To determine whether there is an association between physical activity and IBS

Specific Aims of the study

This study will:

- Assess the prevalence of irritable bowel syndrome (IBS) in a defined population.
- Evaluate physical activity of all the people in this population.
- Evaluate the association between physical activity and the prevalence of IBS
- Evaluate the association between physical activity and the medical consultation behavior of the subjects with IBS.

Hypotheses

1. The prevalence of IBS will be lower in people reporting moderate to high levels of physical activity
2. People with IBS who are involved in moderate to high levels of physical activity will be less likely to consult a physician with their complaints.

Chapter 2

BACKGROUND

Irritable bowel syndrome

Irritable bowel syndrome is a functional disorder of the gastrointestinal tract characterized by abdominal pain, altered bowel habits and bloating in the absence of any structural or biochemical abnormality. Symptoms compatible with IBS are highly prevalent in otherwise healthy populations. IBS occurs in 10% to 20% of adults in the United States, however only 10 % of patients with IBS seek medical attention (19).

The symptoms of IBS generally appear in late adolescence or early adulthood and are common in the elderly (18). The prevalence of IBS is higher in women than men (2,3, 5-7). Some studies suggest that females are more likely to consult a physician (2, 6) while others do not (19). IBS is associated with no mortality but is important because of associated morbidity and expense. People with irritable bowel syndrome are more likely to have missed more days of work in the past year, and had more physician visits for gut complaints as well as of non-gastrointestinal complaints (2). Undergraduate students with IBS showed at least as much impairment of quality of life as patients with congestive heart failure (20) and elderly people also reported that functional status and quality of life were impaired by functional colonic symptoms (18). Such data emphasize the enormous social and economic impact of this disorder. An Olmsted County survey estimated the cost of management of IBS in community. The median

charges incurred by subjects with IBS in a year were \$742 compared with \$429 for controls with no gastrointestinal symptoms. Extrapolation of the results yielded estimated excess charges for IBS in the US white population of eight billion dollars yearly (21).

Pathophysiology:

Irritable bowel syndrome is a complex biopsychosocial disorder with no known pathophysiology. Symptoms of IBS have a physiological basis, but there is no single mechanism responsible for them. Various proposed mechanisms are:

- 1) Abnormal Motility: There is evidence for and against the existence of a primary disorder of intestinal^P motility in IBS. Before the 1980s, abnormalities in gastrointestinal motility were considered the main explanation of symptoms of IBS. Rogers et al noticed patients with IBS exhibit both increased amplitude and prolonged duration of the gastrocolonic response (22). Some abnormal patterns have been described under stimulated conditions in colon, ileocecal area, ileo-colonic junction, small intestine, esophagus, gall bladder, and urinary bladder, but there is no diagnostic marker of motor activity in patients with IBS. It is unclear whether these motor phenomena reflect a basic dysmotility or altered sensation or perception within the CNS (23).

- 2) Visceral hypersensitivity: As symptoms are not always associated with motor disturbances in IBS, increased sensation, termed visceral

hyperalgesia, has been implicated as a possible pathophysiological mechanism. Mertz and associates identified a special marker that would reliably identify this patient population (24). They determined rectal perception threshold to balloon distension in 100 patients with IBS. They found that altered rectal perception was present in almost all patients and that this alteration could be used as a reliable marker for IBS. Additionally, the interaction between visceral sensations and the perception of various stimuli by the central nervous system played a role in response to these symptoms over time. Identifying the underlying mechanism or neurotransmitters responsible for this brain-gut interaction may provide a key to understanding the symptoms associated with IBS.

- 3) Luminal factors: These include undigested components of food (lactose and fructose), bile acids, short chain fatty acids, food allergens and drugs. Luminal factors probably aggravate IBS symptoms rather than producing it. Bile acid malabsorption may account for unexplained functional diarrhea in up to 10 percent of patients whose diarrhea is attributed to IBS. The prevalence of sugar malabsorption in IBS subjects does not differ from that in healthy controls. Food allergens may be important in exacerbation of IBS and a trial of dietary exclusion for three weeks reported long term improvement of symptoms in 48 percent of subjects (25). However, the role of exclusion diets in management of IBS is not established.

- 4) Post-infectious neuromodulation: Epidemiological studies demonstrate that 25 percent of patients with infectious diarrhea continue to have IBS-like symptoms after three months (26). One third of patients with IBS also have a past history of gastroenteritis (27). It is possible that microscopic inflammation of enteric nervous system contributes to the development of IBS. However, psychological factors were predictive for the persistence of IBS.
- 5) Psychopathology and IBS: Strong evidence exists that IBS has an important psychological component. Most studies indicate that mood and personality disturbances, psychiatric disease and illness behavior are more common in IBS patients seen by a specialist than in other patients and normal subjects (9-12). Prevalence of psychological disorders in community samples is much lower than that found in tertiary care centers. It is possible that patients seen in tertiary care centers have more psychological distress than those seen by general physicians (28). Emotional stress is known to affect bowel functions (29,30). IBS may be normal perception of abnormal functions or abnormal perception of normal function (11). It has been hypothesized that previous inflammation or noxious influences may sensitize receptors in the gut so that previously silent nociceptors then trigger the central mechanism at a lower pain threshold (31). This visceral hyperalgesia may enhance and sustain the symptoms even after the stimulation ceases.

It has been postulated that psychological factors, including personality, stress, social support, and childhood experiences determine how gastrointestinal symptoms are perceived and acted upon. Patients with IBS consider themselves to be severely ill even when there are no objective clinical or biological abnormalities. Patients with IBS recall more family illness and more losses and family disruptions during childhood than normal. Subjects with functional bowel diseases report sexual and physical abuse more frequently. It is well documented that these patients report more illness absenteeism than healthy people. IBS non-patients show greater coping capabilities and psychological stability under stress; they experience their illness as less disabling. Psychosocial factors may contribute to symptoms or modulate them. (32).

Diagnosis:

There is no confirmatory test for the diagnosis of IBS. Manning et al were first to show that six symptoms in outpatients who had sought medical care could discriminate patients with IBS from patients with organic disease (33). These six symptoms are referred to as the Manning criteria and include: 1) abdominal pain relieved by defecation, 2) more frequent stools at the onset of pain, 3) looser stools at the onset of pain 4) visible abdominal distension, 5) passage of mucus, 6) sensation of incomplete evacuation.

A group of international investigators met in Rome In 1988 to develop criteria for

functional gastrointestinal disorders by consensus. These Rome criteria were updated in 1992 (34). In 1998 the working team proposed changes (Rome II criteria) to reflect new research data, and to improve clarity and internal consistency (32).

Talley et al have developed a simple validated questionnaire that discriminates IBS from organic disease and health (35, 36). This has been used in population studies. Given that in the foreseeable future we are unlikely to find any diagnostic pathophysiologic marker for IBS, these kinds of questionnaires remain the most practical tool for population based IBS research.

Treatment:

It is important to make a confident diagnosis of IBS. A confident diagnosis prevents over-investigation and reassures the patient that his or her symptoms are not due to cancer or another serious disease. Why the patient is coming now, the patient's agenda, should be assessed. A new diet, medication, or disease may precipitate a visit. Environmental stress, substance abuse, a recent life-threatening event, or psychiatric co-morbidity may need special attention. There may be some conscious or unconscious benefit from being ill, such as a disability pension or manipulation of a family member. One should also assess the patient's quality of life and the level of daily functioning. Sometimes cure is unattainable, and the therapeutic objective should be to improve the individual's functioning in society.

Many drugs have been proposed for the treatment of IBS, however there is no convincing evidence that any therapy is effective in treating the IBS symptoms complex (37). In a patient with diarrhea or painful gas-bloating symptoms, if no specific dietary intolerance is identified, diarrhea is treated symptomatically with diphenoxylate or loperamide. Tricyclic antidepressants, such as desipramine or amitriptyline, can relieve diarrhea and associated pain at least partly because of anti-cholinergic actions. In patients with IBS and constipation, dietary fiber supplementation or osmotic laxative are usually efficacious. Among patients with painful gas bloating, a therapeutic trial with a smooth muscle relaxant is reasonable. A new class of 5-hydroxytryptamine (5-HT₃) receptor antagonists and 5-HT₄ agonist are being developed for restoring visceral sensation and managing diarrhea or constipation.

Psychological treatments have been reported to be of value in a select, motivated group of patients with IBS. These treatments include cognitive-behavioral therapy, dynamically orientated psychotherapy, hypnotherapy, biofeedback, and relaxation techniques. Psychotropic medications influence functional gastrointestinal symptoms through direct effect and by improving comorbid psychiatric disorders (28).

Irritable bowel syndrome and physical activity

The effects of exercise on the gastrointestinal tract have been the subjects of debate for a long time (38). It is a widely held belief that physical exercise affects

bowel habits, and exercise is often recommended as therapy for constipation and IBS. Although Exercise does stimulate the secretion of many hormones that affect motility, there is scant direct evidence that exercise enhances colonic motility and evacuation.

Two population based studies of elderly people reported contradictory findings while evaluating the effect of physical activity on constipation. In a cross-sectional study of elderly people, 23 percent of the subjects living at home reported constipation, compared to 55 percent of subjects living in nursing home. Poor mobility was associated with more frequent complaints of constipation and the increased use of laxatives. Profound immobility was associated with the most severe constipation (39). In contrast, a population-based study of elderly people living in Olmsted County demonstrated no relation between physical activity and bowel symptoms. However, most of the elderly subjects in this study were fairly active (40).

Many studies have described gastrointestinal symptoms during exercise. Intestinal abdominal cramps, urge to have a bowel movement, diarrhea, bloody diarrhea, have been reported during exercise (41-43). A study of 707 respondents in a marathon run reported frequent gastrointestinal symptoms. Abdominal cramps occurred during and after running in 14 percent, and two percent had bloody diarrhea. There was higher frequency of symptoms in young runners and women reported these symptoms more frequently than men (43).

Alteration in intestine functions secondary to physical activity has been postulated as the cause of gastrointestinal symptoms. Small intestine transit was measured in nine healthy subjects at mild, moderate and severe levels of exercise and was found to be 4.5, 5.4 and 4.1 hours respectively, suggesting that small intestine transit is not affected by variation in normal daily activities (45).

Bingham and Cumming studied the effect of exercise and physical fitness on 14 healthy but normally sedentary men and women (46). Colonic function evaluation included stool weight and transit time. No change was observed in mean daily fecal weight. Overall transit time increased in 9 subjects and decreased in 5. They concluded that, when diet is kept constant, exercise has no consistent effect on large bowel function. In contrast, Cordain and colleagues (47) investigated the effect of six weeks of an aerobic running program on the bowel transit time of untrained college aged men. Bowel transit time was significantly reduced in people who had the aerobic exercise training.

Rao et al (48) studied the effect of acute graded exercise on ambulatory colonic motility in 11 untrained subjects. Exercise decreased colonic motility, and a higher intensity of exercise was associated with a greater reduction in colonic motor activity. The median number of propagating and simultaneous pressure waves decreased during each level of exercise and during recovery there was a significant increase in the number and amplitude of these pressure waves. None of their subjects reported any gastrointestinal symptoms during exercise.

Keeling and Martin evaluated the effect of mild exercise on oro-cecal transit of a liquid meal on 12 healthy men (49). Mild exercise increased mouth-to-cecum transit of a liquid meal by 20-25 percent. The greatest effect was seen in subjects with relatively slow transit time at baseline. Because constipated subjects do exhibit abnormally slow mouth-to cecum transit in some studies, it can be speculated that exercise might be therapeutic for patients with idiopathic slow-transit constipation.

In summary the review of literature illustrates that IBS is a highly prevalent disorder causing significant morbidity. The etiopathogenesis of IBS remains unknown and the management is unsatisfactory. Various clinical and experimental studies have attempted to define the effect of physical activity on bowel functions. The only population based study evaluating the relation between physical activity and IBS only enrolled elderly people and demonstrated no relationship (40). IBS is most common in younger individuals, and exercise is being widely recommended for IBS. IBS is a multifaceted disorder and multidimensional approach to management is imperative. Regular exercise may affect IBS by its direct effect on gastrointestinal tract. It can also change the course of the patient's response to the illness by improving associated psychological morbidity and maintaining or improving a level of physical functioning within the context of the disease.

Chapter 3

MATERIALS AND METHODS

Study design

This is a cross-sectional study of people having different levels of physical activity.

Description of the setting

The setting for this study was the Veterans Affairs (VA) Black Hills Health Care System. This system consists of two VA hospitals that are situated 90 miles apart and a VA outpatient clinic in the western section of South Dakota. The hospitals are referred to as the Fort Meade VA Medical Center and Hot Springs VA Medical Center, and the clinic is called the VA Rapid City Clinic. The study was approved by the Humans Subjects Committee of the Black Hills Health Care System.

Study Subjects

The subjects were selected using a convenience method. The primary advantage of this method is the availability of subjects and the main disadvantage is that it may not be representative of the general population.

The population of this convenience sample consisted of 1069 employees of the VA Black Hills Health Care System in South Dakota. This population is predominantly white. All current paid employees were included in the study.

Research Tools

Questionnaires

Bowel Disease Questionnaire (BDQ)

To identify patients with functional gastrointestinal symptoms, the BDQ developed by Talley et al was used (appendix C) (35,36). The Bowel disease questionnaire can discriminate between functional bowel disease and organic disease (sensitivity 85%, specificity 60%), and between functional disease and health (sensitivity 83%, specificity 76%). The bowel disease questionnaire addresses 46 gastrointestinal symptoms, 16 past or present health items, 1 childhood question, 3 sociodemographic items and 5 health habits questions. The time period measured is the previous 12 months. The BDQ has been shown to be easy to understand, reliable, and valid (35, 36).

The symptom criteria for IBS used in this study were based on the modified Rome Criteria (34). These criteria are continuous or recurrent symptoms for at least three months of:

1. Abdominal pain or discomfort, relieved with defecation, or associated with change in frequency or consistency of stool; and
2. An irregular (varying) pattern of defecation (three or more of the following at least 25% of the time):
 - a) Altered stool frequency;
 - b) Altered stool form (hard or loose/watery stool)
 - c) Altered stool passage (straining or urgency), feeling of incomplete evacuation);

- d) Passage of mucus;
- e) Bloating or feeling of abdominal distension

Subjects who met the criteria of IBS were further subdivided into:

- Consulter: had consulted a doctor for bowel symptoms within the past six months.
- Non-consulter: had not consulted a doctor for bowel symptoms in the past six months.

Subjects' bowel pattern were also classified as chronic constipation and chronic diarrhea as per the Rome criteria:

Chronic constipation: was defined as having two or more of the following complaints 25 percent or more of the time in the prior 12 months: hard stools; straining; feeling of incomplete evacuation; less than 3 stools per week.

Chronic diarrhea: was defined as passing loose or watery stools and/or stool frequency of more than 3 stools per day more than 25 percent of the time.

Medical Outcome Study Short Form (SF36)

The Medical Outcome Study Short Form (SF-36) (Appendix A) is a standardized questionnaire for assessing health related quality of life and has also been used to assess quality of life in IBS subjects (50). It is a self administered, 36-items questionnaire that measures health-related functions in eight domains: physical functioning (10 items); social functioning (2 items); role limitation due to physical problems (4 items); role limitation due to emotional problems (3 items);

mental health (5 items); energy/vitality (4 items); pain (2 items); and general health perception (5 items). For each dimension, item scores are coded, summed, and transformed on a scale from 0 (worst possible health state measured by the questionnaire) to 100 (best possible health state). Median internal consistency and test-retest reliability for the SF36 scales ranges from 0.76 to 0.95.

Assessment of physical activity

The physical activity questionnaire used for this study is referred to as the Kaiser Physical Activity Survey (KPAS) (Appendix B). This is a modified version of the Beacke questionnaire (51). It is designed to assess usual activity during the past year. Additional questions were added to the Baecke questionnaire to assess housecare/ caregiving activities, and an index was created from those items (52). This instrument was selected for the present study because it is suitable for a large mail survey, assesses physical activity in several domains, and includes few open ended questions requiring coding. All questions were given a time frame of the past year. Four domains of physical activity were assessed.

- 1) Occupational activities (5 items). Work activity was based on the subject's usual occupation. Occupation was coded using 1980 census codes. Occupations were given intensity codes (low, medium and high) as assigned by the ARIC (Atherosclerosis Risk in Communities Study) to the Labor Department's Dictionary of Occupation Titles (53). The overall work activity score was also based on how often the subject sat, stood, walked, lifted

heavy objects, was physically tired, and sweated at work. Responses to these questions were recorded using a five point scale; never, seldom, sometimes, often, always. Subjects were then asked whether they judged their work as lighter or heavier in comparison with others their own age (much lighter, lighter, as heavy, heavier, much heavier). The occupational index consisted of responses to all work related questions plus the intensity code assigned to the census code of the occupation divided by total number of items.

- 2) Sports activity (5 items): Respondents who participated in sports or exercise were asked to specify the sports activities they did (up to two) during the past year. The intensity of specific sport activities was rated as low, medium, or high using codes developed for the ARIC study (53). The subjects were also asked the number of hours per week and the number of the months of the year they did the activity. The specific activities were coded by intensity and multiplied by hours and months. The resulting score is mapped to an ordinal scale from 1 to 5.
- 3) Active-living (4 items): This domain included non-sports leisure-time physical activity including how often participants watched television, walked, rode a bicycle, and how many flights of stairs they climbed each day.
- 4) Household and Family Care Activities (5 items): This domain of physical activity regarding household and child or elder care activities was added to Baecke's questionnaire in KPAS. A housework/care-giving activity index was constructed in a manner analogous to other indices.

The Baecke questionnaire and its variants have good short-term test/retest reliability, ranging from a low of 0.74 for the work index to a high of 0.92 among men and 0.90 among women for a combined sports, exercise, and leisure activity index. (54). Longer-term reliability is of comparable magnitude, and has been demonstrated among individuals of all age groups (55). Ainsworth et al have demonstrated the reliability and validity of the KPAS (52).

Data analysis

The Statistical Package for the Social Sciences (SPSS) computer software was utilized for statistical analysis of the data. Categorical data were analyzed using chi-square test. Measurements based on continuous scales were analyzed using one-way analysis of variance (ANOVA). Multiple logistic regression analysis was used to estimate adjusted odds ratio and 95% confidence intervals (CI) of factors associated with IBS. Separate and composite scores were calculated for occupation, household activities, and active-living and sports activity. All analysis was performed separately by gender. All p values calculated were two tailed; the alpha level of significance was set at 0.05.

Chapter 4

RESULTS

The results of this study are presented in two sections; the first section illustrated the general health profile of the study subjects (general demographic characteristics, bowel habits, quality of life and physical activity), and the second section presents data pertaining to IBS subjects.

Section I

Demographic characteristics of the study subjects:

A total of 1069 questionnaires were sent out via VA internal mail. A reminder electronic mail was sent at one and two months later to all employees to request their participation in the study. Out of the total, 68 subjects (36 females and 32 males) were not eligible to participate in the study (25 subjects retired, 28 resigned, 7 transferred, 6 were not regular VA employees, and 1 person died). Of the 1001 (390 males and 609 females) eligible subjects, 723 employees (72.23%) returned the survey. Respondents' characteristics are summarized in table 1. Of all respondents, 284 (39.3%) were males, and 439 (60.7%) were females. The response rate was equal in male (72.82%) and female (72.09%) employees. Respondents' age ranged from 24 to 77 years (mean 46 years, median 47 years). Most of the employees were between 36-55 years of age (74.5%) and were married (72.9%). Seventy eight percent of employees had some college or higher education. Fifty percent of subjects never smoked, and 55% denied consuming alcohol. About 50% of the employees used one or more

tablets of aspirin or acetaminophen in a week. Certain characteristics were significantly different between male and female employees. Women employees were more likely to be college graduates, but more men had education beyond college ($p=0.002$). More men than women were married ($p=0.048$) and men were more likely to have three or more alcoholic drinks per week ($p=0.000$). Men took more aspirin ($p=0.000$), whereas women used more acetaminophen ($p=0.000$).

Table 1.Characteristics of study subjects

	Total N=723	Male n284(39.3)	Female n439 (60.7)	p- value
Age				.000
Range (years)	24-77	25-77	24-71	
Median (yrs)	47.00	48.00	45.00	
Mean (years)	46.35	47.44	45.64	
24-35	82 (11.5)	26 (9.3)	56 (13.0)	
36-45	236 (33.1)	74 (26.3)	162 (37.6)	
46-55	295 (41.4)	144 (51.2)	151 (35.0)	
56-65	84 (11.8)	28 (10.0)	56 (13.0)	
66-77	15 (2.1)	9 (3.2)	6 (1.4)	
Marital status				.048
Married	521 (72.9)	217 (77.0)	304 (69.4)	
Un-married	194 (27.1)	65 (23.0)	129 (29.8)	
Education				.002
High school grad or less	154 (21.6)	53 (18.9)	101 (23.3)	
Some college	261 (36.6)	96 (34.2)	165 (38.1)	
College grad	147 (20.6)	52 (18.5)	95 (21.9)	
Beyond college	152 (21.3)	80 (28.5)	72 (16.6)	
Smoking				.049
Never	357 (49.8)	125 (44.3)	232 (53.5)	
Ex-smoker	199 (27.8)	90 (31.9)	109 (25.1)	
Current-smoker	161 (22.5)	67 (23.8)	94 (21.6)	
Alcohol drinks per week				.000
None	395 (55.2)	131 (46.5)	264 (61.0)	
1-2 (%)	204 (28.5)	75 (26.6)	129 (29.8)	
3-6	73 (10.2)	41 (14.5)	31 (7.2)	
7 or more	44 (6.1)	35 (12.4)	9 (2.1)	
Aspirin use (tab/ week)				.000
None	346 (48.6))	111 (39.4)	235 (54.7)	
1-2	161 (22.6)	69 (24.5)	92 (21.4)	
3-6	84 (11.8)	39 (13.8)	45 (10.5)	
7 or more	121 (17.0)	63 (22.3)	58 (13.5)	
Acetaminophen use (tab/ week)				.000
None	376 (52.9)	178 (63.6)	198 (45.9)	
1-2	194 (27.3)	65 (23.2)	129 (29.9)	
3-6	70 (9.8)	19 (6.8)	51 (11.8)	
7 or more	71 (10.0)	18 (6.4)	53 (12.3)	

Bowel symptoms of study subjects:

In assessment of bowel symptoms, 9% of the employees reported having less than 3 stools per week, and 20% had to strain at stool often (table 2). These symptoms were more common in women than men ($p < 0.05$). Twenty one percent of employees reported bloating and 19% reported a feeling of incomplete evacuation. These symptoms were also more common in women than men ($p < 0.05$). Seven percent of employees reported more than 3 bowels per day, and 19% had urgency often. These two symptoms were no different between gender.

Table 2: Bowel symptoms in males and females

	Total 723 (%)	Males n=284 (%)	Females n= 439 (%)	P value
Mucus in stool	104 (14.8)	36 (13.1)	68 (16.0)	.296
> Than 3 bowel/ day	51 (7.2)	22 (7.8)	29 (6.8)	.614
< Than 3 bowels/ wk	65 (9.1)	16 (5.6)	49 (11.5)	.008
Strain at stool often	146 (20.5)	39 (13.7)	107 (25.0)	.000
Hard stool often	176 (24.8)	62 (21.9)	114 (26.6)	.153
Loose or watery stool often	98 (13.8)	40 (14.1)	58 (13.6)	.849
Feeling of incomplete evacuation	135 (19.0)	42 (14.8)	93 (21.7)	.021
Urgency often	135 (19.0)	49 (17.3)	86 (20.1)	.344
Bloating often	149 (20.9)	48 (16.9)	101 (23.6)	.031

Prevalence of diarrhea, constipation and IBS were analyzed separately (Table 3). Nine percent of subjects reported symptoms of IBS, 11 percent reported diarrhea and 19 percent of subjects reported symptoms of constipation.

Table 3: Bowel habits in study subjects

	Total (n=723)	Males n=284 (39.3)	Females n=439 (60.7)	p- value
Diarrhea	79 (10.9)	30 (10.6)	49 (11.2)	.80
Constipation	140 (19.4)	37 (13.00)	103 (23.5)	.001
IBS	64 (8.9)	20 (7.0)	44 (10.0)	.17

Limitation of activities in study subjects:

Limitation of activities in study subjects is presented in table 4. Problems with bowels caused limitation of activities in 8.8 percent of employees and 13.3 percent had their activities limited because of abdominal pain. Of all the subjects, 38 percent of employees had their activities limited in the past year because of some illness. Limitation of activities was no different between gender.

Table 4. Limitations of activities in study subjects

	Total 723 (%)	Males N=284(%)	Females N=439(%)	p- Value
Activities limited because of problems with bowel	63 (8.8)	22 (7.8)	41 (9.4)	.448
Activities limited because of abdominal pain	95 (13.3)	31 (11.0)	64 (14.7)	.148
Activities limited because of any illness	276 (38.5)	103 (36.4)	173 (40.0)	.339

Health care seeking behavior for gastrointestinal symptoms:

Doctor visits and missed days of work in the study subjects in the past year is presented in table 5. Eighty three percent of subjects had visited a doctor one or more times and 78 percent of employees had missed work for some illness in the past year. Doctor visits for any illness and missed days of work in the past year

were more common in females than males. Doctor visits for abdominal pain and problems with bowels were no different between gender.

Table 5. Doctor visits and missed work in the past year study subjects

	Total 723 (%)	Males N=284(%)	Females N=439(%)	p
Doctor visits for problems with bowel	43 (7.2)	15 (6.9)	28 (7.5)	.797
Doctor visits for abdominal pain	79 (13.2)	26 (11.8)	53 (14.1)	.431
Doctors visit for any illness				.021
None	121 (16.8)	63 (22.2)	58 (13.3)	
1-2	310 (43.1)	114 (40.1)	196 (45.1)	
3-5	182 (25.3)	68 (23.9)	113 (26.0)	
6 or more	107 (14.9)	39 (13.7)	68 (15.6)	
Number of times missed work for any illness				.000
never	158 (21.9)	84 (29.7)	74 (17.1)	
1-2 times	298 (41.2)	118 (41.7)	180 (41.6)	
3-5 times	156 (21.6)	46 (16.3)	109 (25.2)	
6 or more times	105 (14.5)	35 (12.4)	70 (16.2)	

Quality of Life in study subjects:

Table 6 shows mean and standard deviations for the SF-36 sub-scales for all subjects. Males report better physical functioning ($p=0.023$), and vitality ($p=0.002$) whereas women report better health perception ($p=0.033$).

Table 6. Quality of life (SF-36) mean and standard deviations study subjects

	Total n=723 Mean (SD)	Males n=284 Mean (SD)	Females n=439 Mean (SD)	P
Physical functioning	88.02 (16.07)	89.71 (14.54)	86.92 (16.9)	.023
Role physical	86.52 (27.98)	86.96 (28.39)	86.24 (27.74)	.737
Role emotional	83.33(31.24)	85.83 (30.02)	81.72 (31.93)	.086
Bodily pain	71.80 (22.25)	72.16 (21.83)	71.57 (22.54)	.728
Social functioning	83.95 (21.26)	84.47 (20.93)	83.61 (21.49)	.599
Vitality	59.95 (20.85)	62.99 (20.92)	58.00 (20.60)	.002
Mental health	74.87 (16.26)	75.68 (17.16)	74.35 (15.66)	.286
Health perception	74.11 (18.16)	72.31 (18.64)	75.27 (17.77)	.033

*Higher scores indicate better functioning.

Physical activity in study subjects:

Table 7 summarizes the median activity index in each domain of activity. Women were physically more active in household ($p=0.000$) and occupation activities ($p=0.007$). Men reported higher active-living ($p=0.007$) and sports activities ($p=0.019$). However total physical activity did not differ by genders ($p=0.487$).

Table7. Physical activity in study subjects

	Total N=723 Mean (SD)	Males N=284 Mean (SD)	Females N=439 Mean (SD)	p
House care activity index	1.92 (.42)	1.82 (.43)	1.98 (.40)	.000
Occupational activity index	2.55 (.72)	2.46 (.68)	2.61 (.74)	.007
Activities of living index	2.70 (.72)	2.79 (.71)	2.64 (.73)	.007
Sports activity index	1.98 (1.51)	2.15 (1.57)	1.88 (1.45)	.019
Total activity index	2.28 (.57)	2.30 (.57)	2.27 (.56)	.487

Variability in Physical activity in study subjects:

The minimum- maximum and 95% confidence interval for mean for various subsets of physical activity are presented in table 8. There is narrow variability between males and females subjects in all sub-scales of physical activity.

Table 8. Variability in physical activity in study subjects.

	95% CI for mean		Minimum	Maximum
	Lower bound	Upper bound		
House care				
Male	1.78	1.88	1.00	3.00
Females	1.95	2.03	1.00	3.00
Total	1.89	1.96	1.00	3.00
Occupation				
Male	2.39	2.55	1.30	4.40
Female	2.55	2.69	1.10	4.70
Total	2.51	2.61	1.10	4.70
Active-living				
Male	2.71	22.88	1.00	4.75
Female	2.58	2.69	1.00	4.75
Total	2.24	2.33	1.00	4.75
Sports				
Male	1.97	2.34	.00	4.67
Female	1.74	2.02	.00	4.67
Total	1.88	2.10	.00	4.67
Total Activity index				
Male	2.24	2.37	.93	3.56
Female	2.22	2.33	.90	3.61
Total	2.24	2.33	.90	3.61

Physical activity and quality of life

Table 8 shows Pearson's correlation coefficient between various sub-sets of physical activity and SF 36 in all study subjects. There was no difference between parametric and non-parametric correlation and for the purpose of discussion all correlation refer to Pearson's correlation coefficients. Total activity was positively correlated with physical functioning ($r = .29$ in males, $.27$ in females, $p < .001$), vitality ($r = .20$ in males, $.186$ in females, $p < .001$), and health perception ($r = .28$ in males, and $.29$ in females, $p < .001$). Active-living and sports activity were also positively correlated with physical functioning, vitality and health perception. There was a negative correlation between occupational and

house care activities with quality of life, though this relationship was not significant in most of domains (Table 9).

Table 9: Correlation between Physical Activity and Quality of Life in study subjects.

	Phy Fx		R. Phy		R. Emo		Pain		Soc Fx		Vitality		Mental		Hth Prec		
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
House care																	
r	-.008	.073	-.061	.052	.003	-.089	-.047	-.056	-.006	-.091	.062	-.052	-.005	-.110	.098	-.009	
p	.890	.132	.308	.285	.957	.064	.437	.242	.927	.059	.297	.279	.930	.023	.104	.859	
Occup																	
r	.017	-.036	-.096	-.054	-.032	-.054	-.135	-.100	-.148	-.064	-.055	-.111	-.116	-.131	.045	-.067	
p	.777	.458	.111	.271	.592	.271	.024	.041	.014	.188	.362	.023	.054	.007	.460	.173	
Activity of Living																	
r	.303	.239	.061	.121	.189	.078	.138	.178	.093	.186	.239	.259	.158	.155	.282	.303	
p	.000	.000	.311	.012	.002	.180	.021	.000	.120	.000	.000	.000	.008	.001	.000	.000	
Sports index																	
r	.282	.283	.128	.111	.134	.055	.173	.154	.144	.167	.192	.225	.142	.122	.265	.321	
p	.000	.000	.035	.022	.027	.263	.004	.001	.017	.001	.001	.000	.019	.012	.000	.000	
Total Activity																	
r	.290	.271	.082	.107	.157	.029	.102	.120	.085	.133	.201	.186	.117	.068	.278	.292	
p	.000	.000	.181	.029	.010	.561	.092	.014	.163	.007	.001	.000	.055	.169	.000	.000	

SECTION II

IRRITABLE BOWEL SYNDROME:

Prevalence of IBS

A total of 64 subjects (8.9%) reported symptoms compatible with IBS. Of these 64 subjects with IBS, 44 were women (10.02% of the all women subjects) and 20 were men (7.04 % of all study men). The mean age of IBS subjects was 45 years (age range 29-59) (Table 10). Most of the IBS subjects (83%) were between 36-55 years of age.

General characteristics and Factors related to IBS subjects

Table 10 shows the general demographic, social habits and analgesic use in IBS and non-IBS subjects. Using chi square test, males with IBS were more likely to be un-married ($p=.02$) compared to non-IBS subjects. There was no difference in marital status in female IBS and non-IBS subjects. No difference in education level, smoking and alcohol use was noticed between gender in IBS and non-IBS subjects. Females with IBS were more likely to use acetaminophen ($p=.01$).

Table 10: General characteristics of males and females IBS and Non-IBS subjects

	Males (n=284)			Females (n=439)		
	IBS (n=20)	No IBS (n=264)	p	IBS (n=44)	No IBS (n=395)	p
Age			.59			.41
Range	29-59			29-58		
Mean	46			45		
24-35	1 (5.0)	25 (9.6)		5 (11.9)	51 (13.1)	
36-45	8 (40.0)	66 (25.3)		19 (45.2)	143 (36.8)	
46-55	9 (45.0)	135 (51.7)		16 (38.1)	135 (34.7)	
56-65	2 (10.0)	26 (10.0)		2 (4.8)	54 (13.9)	
66-77	--	9 (3.4)		--	6 (1.5)	
Marital status			.02			.44
Married	11 (55.0)	206 (78.6)		28 (65.1)	276 (70.8)	
Un-married	9 (45.0)	56 (21.4)		15 (34.9)	114 (29.2)	
Education			.43			.90
High school grad or less	3 (15.0)	50 (19.2)		12 (27.9)	89 (22.8)	
Some college	9 (45.0)	87 (33.3)		15 (34.9)	150 (38.5)	
College grad	5 (25.0)	47 (18.0)		9 (20.9)	86 (22.1)	
Beyond college	3 (15.0)	77 (29.5)		7 (16.33)	65 (16.7)	
Smoking			.12			.44
Never	5 (25.0)	120 (45.8)		23 (52.3)	209 (53.5)	
Ex-smoker	7 (35.0)	83 (31.7)		14 (31.8)	95 (24.3)	
Current-smoker	8 (40.0)	59 (22.5)		7 (15.9)	87 (22.3)	
Alcohol drinks/ wk			.69			.62
None	10 (50.0)	121 (46.2)		29 (65.9)	235 (60.3)	
1-2	5 (25.0)	70 (26.7)		11 (25.0)	118 (30.3)	
3-6	4 (20.0)	37 (14.1)		4 (9.1)	28 (7.2)	
7 or more	1 (5.0)	34 (13.0)		0 (0)	9 (2.3)	
Aspirin use (tabs/wk)			.08			.49
None	5 (25.0)	106 (40.5)		21 (48.8)	214 (55.3)	
1-2	9 (45.0)	60 (22.9)		12 (27.9)	80 (20.7)	
3-6	4 (20.0)	35 (13.4)		6 (14.0)	39 (10.1)	
7 or more	2 (10.0)	61 (23.3)		4 (9.3)	54 (14.0)	
Acetaminophen use (tabs/wk)			.22			.01
None	9 (45.0)	169 (65.0)		12 (27.9)	186 (47.9)	
1-2	6 (30.0)	59 (22.7)		13 (30.2)	116 (29.9)	
3-6	2 (10.0)	17 (6.5)		7 (16.3)	44 (11.3)	
7 or more	3 (15.0)	15 (5.8)		11 (25.6)	42 (10.8)	

Using the above general characteristics we did multiple logistic regression and table 11 shows the odds ratio and 95% confidence interval of the factors related to IBS. Controlling for age, IBS was more prevalent in females (OR=1.4), but this difference was not statistically significant ($p = .28$). Controlling for gender, IBS was less prevalent with increasing age (OR=.98), but this was also not statistically significant. Controlling for age and gender, IBS was not associated with education level, smoking, and aspirin use or alcohol consumption. Adjusting for age and gender, un-married subjects and subjects taking acetaminophen were more likely to have IBS.

Table 11: Factors associated with IBS

	Odds Ratio	95% Confidence Intervals	P
F:M	1.4	.78- 2.38	.28
Age	.98	.95- 1.01	.24
Marital status	1.3	1.04- 1.55	.02
Education	.95	.73- 1.25	.73
Aspirin use	.96	.75- 1.23	.74
Acetaminophen use	1.6	1.28- 2.09	.01
Smoking	1.1	.77- 1.49	.69

Bowel symptoms in males and females IBS and non-IBS subjects:

All Manning criteria were more prevalent in IBS subjects than non-IBS subjects ($p=0.000$). Straining at stool and feeling of incomplete evacuation were statistically more common in females than males ($p < .001$) (Table 12).

Table 12: Bowel symptoms in IBS and non-IBS subjects

	Males			Females		
	IBS n=20	No IBS n=263	p	IBS n=44	No IBS n=384	p
Mucus in stool	10 (50.0)	26 (10.2)	.00	16 (36.4)	52 (13.6)	.00
> than 3 bowels/ day	6 (30.0)	16 (6.1)	.00	14 (31.8)	15 (3.9)	.00
< than 3 bowels/day	4 (20.0)	12 (4.5)	.00	9 (20.5)	40 (10.4)	.05
Strain at stool often	5 (25.0)	34 (12.9)	.13	25 (56.8)	82 (21.4)	.00
Hard stool often	8 (40.0)	54 (20.5)	.04	26 (59.1)	88 (22.9)	.00
Loose or watery stool often	10 (50.0)	30 (11.4)	.00	19 (43.2)	39 (10.2)	.00
Feeling of incomplete evacuation	8 (40.0)	34 (12.9)	.00	29 (65.9)	64 (16.7)	.00
Urgency often	12 (60.0)	37 (14.0)	.00	29 (45.3)	57 (14.8)	
Bloating often	13 (65)	35 (13.3)	.00	28 (63.6)	73 (19.0)	.00

Limitation of activities in males and females IBS and non-IBS subjects:

Table 13 shows the limitation of activities in male and female BS and non-IBS subjects. Both male and female IBS subjects had more limitation of activities than non-IBS subjects because of problems with bowels, abdominal pain and because of any illness ($p < .03$). Sixty percent of male IBS subjects had limitation of activities because of any illness compared to 34.6 percent of non-IBS subjects. Similarly 59 percent of female IBS subjects had limitation of activities because of any illness compared to 38 percent of non-IBS subjects.

Table 13: Limitation of activities in IBS and non-IBS subjects

	Males			Females		
	IBS	No IBS	P	IBS	No IBS	P
Activities limited because of problems with bowels	7 (35.0)	15 (5.7)	.00	17 (38.6)	24 (6.2)	.00
Activities limited because of abd pain	8 (40.0)	23 (8.8)	.00	23 (52.3)	41 (10.5)	.00
Activities limited because of any illness	12 (60.0)	91 (34.6)	.02	26 (59.1)	147 (37.8)	.01

Health care seeking behavior in males and females IBS and non-IBS subjects:

Table 14 shows doctor visits and days of missed work in male and female IBS and non-IBS subjects. Both male and female IBS subjects were more likely to visit a doctor for problems with bowel, abdominal pain and even for any other illness.

Table 14: Health care seeking behavior in IBS and non-IBS subjects

	Males			Females		
	IBS	No IBS	P	IBS	No IBS	P
Doctor visits for problems with bowels	4 (22.2)	11 (5.5)	.01	14 (34.1)	14 (4.2)	.00
Doctor visits for abd pain	8 (44.4)	18 (8.9)	.00	18 (43.9)	35 (10.4)	.00
Doctor visits for any illness			.02			.00
None	2 (10.0)	61 (23.1)		3 (6.8)	55 (14.0)	
1-2	6 (30.0)	108 (40.9)		11 (25.0)	185 (47.2)	
3-5	8 (40.0)	60 (22.7)		17 (38.6)	97 (24.7)	
6 or more	4 (20.0)	35 (13.3)		13 (29.5)	55 (14.0)	
Number of times missed work for any illness			.02			.02
Never	3 (15.0)	81 (30.8)		3 (6.8)	71 (18.2)	
1-2 times	5 (25.0)	113 (43.0)		15 (34.1)	165 (42.3)	
3-5 times	7 (35.0)	39 (14.8)		13 (29.5)	97 (24.9)	
6 or more times	5 (25.0)	30 (11.4)		13 (29.5)	57 (14.6)	

Quality of life in males and females IBS and non-IBS subjects

Table 15 shows the quality of life in males and females IBS and non-IBS subjects. IBS subjects reported poorer quality of life than non-IBS subjects on most of the sub-scales of SF 36. Role emotional did not differ between IBS and non-IBS subjects ($p > .6$).

Table 15: Quality of life in male and female IBS and non-IBS subjects

	Males			Females		
	IBS Mean (SD)	No IBS Mean (SD)	P	IBS Mean (SD)	No IBS Mean (SD)	P
Pain	59.0 (26.7)	73.2(21.1)	.005	59.9 (21.6)	72.9 (22.3)	.000
Social functioning	70.0 (23.1)	85.6 (20.4)	.001	76.4(24.9)	84.4 (20.9)	.019
Vitality	51.0 (25.8)	63.9 (20.3)	.008	49.9 (22.6)	58.9 (20.2)	.006
Mental	68.6 (24.3)	76.2 (16.4)	.055	67.4 (16.2)	75.1 (15.4)	.002
Health Perception	62.1 (17.3)	73.1 (18.5)	.011	64.2(21.5)	76.5 (16.9)	.000
Role emotional	83.3 (31.5)	86.0 (29.9)	.700	84.1 (30.1)	81.5 (32.2)	.604
Role physical	68.8 (37.1)	88.4 (27.2)	.003	74.4 (35.9)	87.6 (26.4)	.003
Physical Functioning	84.5 (18.8)	90.1 (14.1)	.096	80.7 (19.6)	87.7 (16.5)	.010

Quality of life in IBS consulters/ non-consulters:

Out of 64 subjects with IBS, twelve males (60 percent of all males with IBS) and twenty-five females (57 percent of all female subjects with IBS) consulted with a physician about their IBS symptoms in the past one-year. Consulters reported significantly poorer quality of life than non-consulters on the physical functioning, body pain, and health perception sub-scales of the SF-36 ($p < 0.05$). There was no significant difference between consulters and non-consulters on other sub-scales of SF 36 (Table 16). There were differences between males and females consulters in different sub-scales of SF 36, but this difference did not turn out to be statistically significant (Table 16).

Table 16: Quality of life in IBS consulters and non-consulters

	IBS (consulters) N=27 Mean (SD)	IBS (non-consulters) N=37 Mean (SD)	p-value
Physical functioning	75.92 (20.42)	86.21 (17.53)	.034
Role physical	65.74 (38.69)	77.70 (33.79)	.193
Role emotional	87.65 (29.45)	81.08 (30.97)	.395
Bodily pain	49.85 (21.50)	66.75 (21.81)	.003
Social functioning	69.90 (25.77)	77.70 (23.03)	.208
Vitality	47.30 (23.16)	52.29 (23.16)	.410
Mental health	66.00 (17.86)	69.08 (19.81)	.529
Health perception	56.15 (21.50)	68.91 (17.48)	.013

Table 17: Mean SF-36 scores in IBS consulters

	Male N=12 Mean (SD)	Females N=25 Mean (SD) °	p-value
Physical functioning	78.75 (20.46)	74.60 (24.01)	.610
Role physical	56.25 (46.61)	75.00 (34.61)	.177
Role emotional	83.33 (33.33)	88.00 (30.24)	.673
Bodily pain	46.50 (21.38)	55.04 (22.42)	.279
Social functioning	66.66 (23.43)	78.00 (25.07)	.198
Vitality	45.41 (21.04)	54.37 (21.63)	.246
Mental health	63.66 (17.18)	69.83 (17.69)	.327
Health perception	53.58 (17.77)	61.79 (23.15)	.289

Physical activity in males and females IBS and non-IBS subjects:

The average total physical activity scores of IBS and non-IBS subjects did not differ ($p=0.942$). Nor did IBS and non-IBS subjects differ in household, occupational, active-living and sports activity. Male and female IBS subjects were no different in any of the physical activity sub-scales (Table 18).

Table 18: Physical activity in males and females IBS and non-IBS subjects

	Males			Females		
	IBS	No IBS	P	IBS	No IBS	P
House-care activity index	1.85(.5)	1.82(.4)	.800	2.0 (.4)	1.9 (.4)	.419
Occupational activity index	2.6 (.8)	2.5 (.7)	.605	2.7 (.8)	2.6 (.7)	.498
Active-living activity Index	2.8 (.7)	2.7 (.7)	.775	2.7 (.7)	2.6 (.6)	.888
Sports activity index	1.9 (1.6)	2.2 (1.6)	.397	1.8 (1.4)	1.9 (1.5)	.769
Total activity index	2.3 (.6)	2.4 (.6)	.759	2.3 (.7)	2.2 (.6)	.729

Physical activity in IBS consulter/ non-consulters

Total activity index was not different between consulters and non-consulters.

Non-consulters of IBS were more active in sports than consulters (p=0.022).

There was no significant difference in consulters and non-consulters in any other activity index. Among consulters, there was no difference between genders in any measure of physical activity.

Table 19: Physical activity in IBS consulters and non-consulters

	IBS consulters N =27 Mean (SD)	IBS non-consulters N = 37 Mean (SD)	p
House hold activity index	1.96 (.37)	1.98 (.49)	.810
Occupational activity index	2.85 (.85)	2.49 (.76)	.090
Activity of living index	2.70 (.72)	2.72 (.71)	.916
Sports index	1.41 (1.59)	2.30 (1.36)	.022
Total activity index	2.18 (.66)	2.37 (.61)	.266

Table 20: Physical activity in IBS consulters

	Males N =12 Mean (SD)	Females N = 25 Mean (SD)	p-value
House hold activity index	1.80 (.23)	2.03 (.40)	.142
Occupational activity index	2.63 (.86)	2.95 (.85)	.402
Activity of living index	2.93 (.56)	2.60 (.76)	.283
Sports index	1.58 (1.73)	1.35 (1.57)	.736
Total activity index	2.23 (.69)	2.16 (.67)	.788

Physical activity and Quality of Life in IBS subjects

Table 21 shows Pearson's correlation between various sub-sets of physical activity and quality of life in subjects with IBS. We found that active-living, sports and total activity scales were positively associated with greater physical functioning and health perception ($r = .246$ to $.431$, $p = .056$ to $.0001$) in IBS subjects.

Table 2.1: Correlation between Physical Activity and Quality of Life in IBS subjects

	Phy Fx		R. Phy		R. Emo		Pain		Soc Fx		Vitality		Mental		Hth Prec	
	IBS	-IBS	IBS	-IBS	IBS	-IBS	IBS	-IBS	IBS	-IBS	IBS	-IBS	IBS	-IBS	IBS	-IBS
House care																
r	.043	.028	.071	.000	.012	-.070	-.100	-.043	-.109	-.048	-.102	-.012	-.188	-.053	.009	.063
p	.737	.481	.578	.995	.923	.074	.434	.278	.396	.224	.431	.754	.144	.179	.945	.111
Occup																
r	.083	-.036	.141	-.096	.052	-.064	.106	-.133	.079	-.114	-.116	-.095	-.097	-.127	.137	-.024
p	.530	.360	.284	.015	.692	.105	.421	.001	.549	.004	.383	.016	.465	.001	.303	.546
Active Living																
r	.431	.252	.148	.095	-.033	.140	.208	.162	.168	.153	.181	.271	.076	.172	.272	.292
p	.000	.000	.244	.016	.796	.000	.100	.000	.184	.000	.156	.000	.552	.000	.032	.000
Sports index																
r	.382	.276	.114	.119	-.187	.118	.185	.158	.147	.159	.104	.231	.038	.145	.246	.297
p	.002	.000	.376	.003	.145	.003	.150	.000	.255	.000	.427	.000	.773	.000	.056	.000
Total Activity																
r	.405	.262	.150	.091	-.113	.100	.194	.106	.140	.113	.070	.209	-.034	.107	.305	.288
p	.001	.000	.249	.022	.386	.013	.134	.008	.283	.005	.594	.000	.798	.007	.018	.000

Chapter 5

DISCUSSION OF THE FINDINGS

We identified the frequency of self-reported bowel habits, health related quality of life and the level of physical activity of the employees of the VA Hospitals in South Dakota. This is the first population-based study to including subjects of a broad age range that examines the association between physical activity and irritable bowel syndrome. Our study demonstrated that physical activity was not associated with the overall prevalence of IBS symptoms in this population of employed adults; however, it was associated with improved physical functioning and health perception in IBS subjects.

The lack of association between levels of physical activity and the presence of irritable bowel syndrome is consistent with the literature. Evans et al in their population-based study of elderly people demonstrated that physical activity had no relation with constipation and IBS (40). Similarly Mushinpour et al. found no relationship between constipation and regular physical activity (56). They enrolled eight subjects with constipation in an exercise program and found that exercise did not improve the constipation score of these subjects. A cross-sectional study of elderly subjects mostly confined to home however, demonstrated that physically active subjects were less likely to be constipated (39). This study recruited subjects who were mostly confined to home and were wheelchairs-bound, with maximal level of activity being able to go out of home

alone. The studies showing no association between physical activity and constipation enrolled subjects who were normally active.

The impact of physical activity on gastrointestinal transit has been the subject of several studies. While in some studies exercise shortens the transit time (49), in others exercise either did not change the transit time (57) or in fact prolonged it (47,58, 59). There is conflicting information regarding the effect of exercise on colonic motility. The study by Ceskin et al. reported an increase in colon motility and increased incidence of 4-9/cycles/min-pressure activity and a reduction in the 1-4 cycle/min activity (60). However a recent study by Rao et al using ambulatory recording of colonic motility showed that acute graded exercise decreased phasic colonic motor activity (48). The higher the intensity of exercise was associated with a greater reduction in motor activity.

An increase in exercise is associated with increase intake of food and it has been argued that effect of physical activities on bowel habit is mediated by change in diet. Bingham and Cummings studied the effect of exercise on large bowel functions on 14 subjects while keeping their diet constant. They found marked effect of exercise on physical fitness but no physiologically important effect on colonic function (46).

There may be an effect of exercise on bowel habits when compared with complete inactivity, but the present study suggests that variations in physical

activity within the range encountered in daily life are without effect. The relationship between physical activity and bowel habits also may be non-linear. Total inactivity is associated with constipation, and a slight increase in activity, like walking, may be enough to improve bowel habits. People involved in usual, regular physical activity show no association between physical activity and bowel habits.

The effect of exercise on the bowel habits could be secondary to neurohumoral mechanisms. During exercise there is an increase in sympathetic innervations, which inhibits activity in the gastrointestinal tract thereby reducing the segmentation of the colon. Reduced segmentation in conjunction with the up and down bouncing motion associated with jogging could conceivably cause the contents to the colon to be moved into the rectum and provide a stimulus for defecation. Parasympathetic innervation of the gastrointestinal tract causes an increase in bowel motility; however, parasympathetic innervation to the gastrointestinal tract is reduced during an acute bout of exercise. It is possible that a chronic effect of exercise would be to increase parasympathetic innervations of the gut during periods of rest, thereby decreasing bowel transit time by increasing gastrointestinal tract motility. Changes in plasma concentration of various gastrointestinal peptides have been described. Sullivan et al noted increase in gastrin, motilin, somatostatin, pancreatic glucagon, pancreatic polypeptide and vasoactive intestinal polypeptide in runners (61). The increase in motilin was sufficient to stimulate gastric emptying and colonic

motility. Why these changes in plasma concentrations of regulatory peptides occur, and whether they can they account for the alteration in bowel functions known to occur with exercise is not known.

In the present study, we found that active-living, sports and total physical activity were associated with improved health perception and physical functioning in subjects with IBS. The US Surgeon General's report on physical activity and health (62) states that people of all ages, both males and females, benefit from a moderate level of physical activity. The report also presented evidence of the benefits of physical activity on health and disease: specifically, reduction of the risk of cardiovascular disease; prevention or delay in the development of hypertension and reduction of blood pressure in those with hypertension; maintenance of normal muscle strength, joint structure, and function; preservation of the ability to maintain independent living status, and reduction of the risks for falling in the elderly; relief of symptoms of depression and anxiety and improving mood; an improvement in health-related quality of life by enhancing psychological well-being and by improvement in physical functioning in persons compromised by poor health. Although not specifically mentioned in the report, many persons with chronic diseases and disability can benefit from increased physical activity in similar ways. It has been shown that physical functioning and health related quality of life improved with exercise training in hemodialysis patients (63), in liver transplant recipients (64) and in subjects with multiple sclerosis (65). IBS is a chronic disorder and it is consistent with above

findings that physical activity was associated with improved quality of life in our study. However, no cause and effect relationship can be drawn from our study.

Study Limitations:

That we did not find an association between presence of IBS and physical activity in our study could be that our assessment of physical activity was not an adequate measure of physical activity. As expected we found that house-care activity was higher female subjects and sports activity was higher is men. This would indicate that our measure of physical activity was acceptable and the lack of association in our subjects is either because there is no association or due to other factors. There was not much variability in physical activity in our study population. The range of total physical activity in our subjects ranged from 2.24 to 2.33 (Mean 95% CI). The narrow range of physical activity between subjects may have constrained us in finding an association between physical activity and IBS.

Surveys are associated with recall bias, leading to under or over-reporting of gastrointestinal symptoms. The validity of our findings is enhanced by the fact that more than 70 percent of subjects completed our survey and the instrument used to measure bowel habits has been shown to be a valid measure of gastrointestinal symptoms (34). Information on physical activity was collected entirely by self-report, but it has been shown that self-report provides reasonably accurate and reliable information on physical activity. Some investigators argue that symptom-based diagnostic criteria for IBS are not valid. They require that

there be abnormal physiological measures to make a diagnosis. The criteria developed by the Rome international working team for functional bowel diseases are widely used and have been shown to be reliable and valid. Symptoms based diagnostic criteria have achieved worldwide acceptance in other medical fields. The American Rheumatologic Association and American Psychiatric Association of Diagnostic and Statistical Manual of Mental Disorders simplify clinical diagnosis and provide a reliable means to select patients for research. It is possible that organic disease (e.g. inflammatory bowel disease, lactose intolerance) can produce a clinical picture similar to that of IBS, and a definite diagnosis of functional gastrointestinal disease can only be made following a medical evaluation to rule out structural and biochemical abnormalities. However, because organic diseases are very uncommon in the general population, it is likely that any misclassification error is small.

As ours was a cross-sectional study, we demonstrate only an association between physical activity and quality of life in IBS subjects. Future clinical studies would be needed to demonstrate cause and affect relationships. Besides this study was conducted on mostly white subjects living in the mid-west America and these finding may not hold true in other set ups.

Chapter 6

CONCLUSION

This study was carried out on the hospital employees of the VA Hospitals in South Dakota. It is the first population-based study including subjects of all age groups to examine the association between physical activity and irritable bowel syndrome. Our study demonstrated that physical activity was not associated with the overall prevalence of IBS symptoms in this population of employed adults; however, it was associated with improved physical functioning and health perception in IBS subjects.

It is generally believed that exercise has a beneficial effect on gastrointestinal function. However the literature is full of contradictory findings. There is little scientific evidence that exercise promotes regular bowel function. Many of the older studies are flawed because of insufficient numbers or subjects or done of animals, absence of controls or un-physiological methodology. Numerous variables need to be considered before one can properly understand the effect of exercise on bowel functions.

It is possible that the relation between physical activity and bowel habits is non-linear. Slight increase in physical activity from inactivity helps bowel habits and moderate increase in physical activity helps consultation behavior. There is threshold beyond which exercise does not affect bowel functions. This hypothesis may explain the positive effect of exercise in subjects living in

institutions or confined to home and not in subjects who are normally active. This will also explain the experimental finding of increased propulsion in the large intestine when subjects sit up and move about and in-consistent effect with more active physical exercise. The subjects in our study were fairly active and we found that physical activity was not associated with the prevalence of IBS.

Our study demonstrates that increased physical activity was associated with improved quality of life in IBS subjects. This could mean that IBS subjects with improved quality of life are more likely to be physically active or physically active subjects have improved quality of life. This is a cross-sectional study and only reveals an association. Longitudinal studies are required to demonstrate cause and effect relationships. These clinical studies would demonstrate whether physical activity is efficacious in subjects with IBS. Additional research also is needed to explore barriers and facilitators to increasing physical activity in persons with IBS and whether activity is synergetic with other therapies. A combination of health promotion strategies including physical activity, good nutrition and stress management remains vitally important in maintaining quality of life in persons with this common and chronic disabling condition.

IBS is a chronic disorder and physical activity has been shown to improve quality of life in other chronic diseases and it is likely that physical activity would improve symptoms of IBS. Increased physical activity is empirically recommended for IBS subjects. Exercise has many benefits and we would suggest that physical activity

should be continued to be prescribed. However, future studies should be done to scientifically document the role of physical activity in irritable bowel syndrome.

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CURRENT HEALTH QUESTIONNAIRE

1. In general, would you say your health is: (*& Mark one box only*)
- Excellent
 - Very good
 - Good
 - Fair
 - Poor
2. **Compared to one year ago**, how would you rate your health in general **now**?
(*& Mark one box only*)
- Much better now than one year ago
 - Somewhat better now than one year ago
 - About the same
 - Somewhat worse now than one year ago
 - Much worse now than one year ago

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much? (*& Mark one box for each question*)

	Yes, limited a lot	Yes, limited a little	No, not limited at all
3. <u>Vigorous activities</u> , such as running, lifting heavy objects, participating in strenuous sports	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. <u>Moderate activities</u> , such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Lifting or carrying groceries	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Climbing <u>several</u> flights of stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Climbing <u>one</u> flight of stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Bending, kneeling, or stooping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Walking <u>more than a mile</u>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Walking <u>several blocks</u>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Walking <u>one block</u>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Bathing or dressing yourself	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of your physical health?** (& Mark one box for each question)

- | | Yes | No |
|---|--------------------------|--------------------------|
| 13. Cut down the <u>amount of time</u> you spent on work or other activities | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. <u>Accomplished less</u> than you would like | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. Were limited in the <u>kind</u> of work or other activities | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. Had <u>difficulty</u> performing the work or other activities (for example, it took extra effort) | <input type="checkbox"/> | <input type="checkbox"/> |

During the **past 4 weeks**, have you had any of the following problems with your work or other regular activities **as a result of any emotional problems** (such as feeling depressed or anxious)? (& Mark one box only)

- | | Yes | No |
|--|--------------------------|--------------------------|
| 17. Cut down the <u>amount of time</u> you spent on work or other activities | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. <u>Accomplished less</u> than you would like | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. Didn't do work or other activities as <u>carefully as usual</u> | <input type="checkbox"/> | <input type="checkbox"/> |
20. During the **past 4 weeks**, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?
(& Mark one box only)
- Not at all
 - Slightly
 - Moderately
 - Quite a bit
 - Extremely

21. How much **bodily** pain have you had during the **past 4 weeks?** (& Mark one box only)

- None
- Very mild
- Mild
- Moderate
- Severe
- Very severe

22. During the **past 4 weeks**, how much did **pain** interfere with your normal work (including both work outside the home and housework)? (*& Mark one box only*)

- Not at all
- A little bit
- Moderately
- Quite a bit
- Extremely

These questions are about how you feel and how things have been with you **during the past 4 weeks**. For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the **past 4 weeks...** (*& Mark one box only in each line*)

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
23. Did you feel full of pep?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. Have you been a very nervous person?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. Have you felt so down in the dumps that nothing could cheer you up?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26. Have you felt calm and peaceful?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. Did you have a lot of energy?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. Have you felt downhearted and blue?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29. Have you felt worn out?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. Have you been a happy person?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31. Did you feel tired?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

32. During the past 4 weeks, how much of the time has your physical health or emotional problems

interfered with your social activities (like visiting with friends, relatives, etc.)?

(*& Mark one box only*)

- All of the time
- Most of the time
- Some of the time
- A little of the time
- None of the time

Please choose the answer that best describes how **true** or **false** each of the following statements is for you.

(*& Mark one box only in each line*)

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
33. I seem to get sick a little easier than other people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34. I am as healthy as anybody I know	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35. I expect my health to get worse	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36. My health is excellent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please mark one box for each question

	Yes	No
37. In the past year, have you had 2 weeks or more during which you felt sad, blue, or depressed? or when you lost all interest or pleasure in things that you usually cared about or enjoyed.	<input type="checkbox"/>	<input type="checkbox"/>
38. Have you had 2 years or more in your life when you felt depressed? or sad most days, even if you felt okay sometimes?	<input type="checkbox"/>	<input type="checkbox"/>
39. Have you felt depressed or sad much of the time in the past year?	<input type="checkbox"/>	<input type="checkbox"/>

Appendix B

PHYSICAL ACTIVITY QUESTIONNAIRE

OCCUPATIONAL ACTIVITIES

First, we have some questions about your employment situation.

1. Are you currently. . . . (*mark only one*)

- Employed at least 32 hours a week
- Employed less than 32 but at least 20 hours a week
- Employed less than 20 but at least 8 hours a week
- Other (describe)_____

2. What is your job title? (*if more than one job, describe your title for the job with the most hours worked per week*)

FOR OFFICIAL USE: OCCUPATIONAL CODE _____
--

3. Compared to others your age, do you think your work is physically: (*mark one*)

- | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Much lighter | Lighter | The same | Heavier | Much heavier |
| Don't know | | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | | | | |

4. After work, are you physically tired: (*mark one*)

- | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Never | Seldom | Sometimes | Often | Always |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

5.	In your current job(s), on a typical day or shift, how often do you do each of the following ? (Mark one answer on each line)	Never	Less than half of the time	About half of the time	More than half of the time	Always
	a. Sit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b. Stand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c. Walk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	d. Lift heavy loads greater than 15 pounds (more than the weight of 2 gallons of milk)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	e. Stoop and bend	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	f. Push or move heavy equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	g. Sweat from exertion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

HOUSEHOLD AND FAMILY CARE ACTIVITIES

We would like to know about your activities at home, NOT including activities you may do for pay at your home or other people's homes. Please mark only one answer for each question.

During the past year (in the last 12 months), how much time did you spend on average...

6. Caring for a child or children 5 years of age or less, a disabled child or an elderly person? Only count time actually spent doing physical activities like feeding, dressing, moving, playing or bathing. (If child turned 6 less than 6 months ago, consider him/her age 5 for the whole year.)

- None or less than 1 hour a week
- At least 1 hour but less than 20 hours a week
- 20 hours or more a week

7. **During the past year** (in the last 12 months), how much time did you spend preparing meals or cleaning up from meals?

- 1 hour or less per day
- Between 1 and 2 hours per day
- More than 2 hours per day

8. **During the past year** (in the last 12 months), how often did you do routine chores requiring light physical effort, such as dusting, laundry, changing linens, grocery shopping or other shopping?

(Mark one answer)

- Once per week or less
- More than once per week but less than daily
- Daily or more

9. **During the past year** (in the last 12 months), how often did you do chores requiring moderate physical effort, such as vacuuming, washing floors, or gardening/yard work, such as mowing the lawn or raking leaves? *(Mark one answer)*

- Once a month or less
- 2-3 times per month
- 4 or more times per month

10. **During the past year** (in the last 12 months), how often did you do chores at home requiring vigorous physical effort, such as chopping wood, tilling soil, shoveling snow, shampooing carpets, washing walls or windows, plumbing, tiling or outdoor painting? *(Mark one answer)*

- Once a month or less
- 2-3 times per month
- 4 or more times per month

Now we want to ask about the general level of physical activity involved in your daily routine

11. In comparison with other people of your age do you think your recreational physical activity is....

(Mark one answer)

- Much less
- Somewhat less
- The same
- Somewhat more
- Much more

During the past year, when you were not working or doing chores around the house....

12. Did you watch television... *(mark one answer)*

- Never or less than 1 hour a week
- At least 1 hour a week but less than 1 hour a day
- 1-2 hours a day
- 2-4 hours a day
- More than 4 hours a day

13. Did you walk or bike to and from work, school or errands.... *(mark one answer)*

- Never or less than 5 minutes per day
- 5-15 minutes per day
- 16-30 minutes per day
- 31-45 minutes per day
- more than 45 minutes per day

14. Did you sweat from exertion.... *(mark one answer)*

- Never or less than once a month
- Once a month
- 2-3 times a month
- Once a week
- More than once a week

PARTICIPATION IN SPORTS AND EXERCISE

15. Did you play sports or exercise during the past year? (*Mark one answer*)

- No → *Please go to question 1 on page 11.*
- Yes → *Please answer the following questions*

16. Which sport or exercise did you do most frequently during the past year? (Specify only one)

17. When you did this activity, did your heart rate and breathing increase? (*Mark one answer*)

- | | | | |
|--------------------------|--------------------------|-----------------------------|--------------------------|
| No | Yes, a
small increase | Yes, a
moderate increase | Yes, a
large increase |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

18. How many months in this past year did you do this activity? (*Mark one answer*)

- | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Less than
1 month | 1 to 3
months | 4 to 6
months | 7 to 9
months | More than
9 months |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

19. During these months, on average, how many hours a week did you do this activity? (*Mark one answer*)

- Less than 1 hour/week
- At least 1 but less than 2 hours/week
- At least 2 but less than 3 hours/week
- At least 3 but less than 4 hours/week
- More than 4 hours/week

20. Did you do any other exercise or play any other sport during the past year?

- No → *Please go to question 1 on page 11*
- Yes → *Please answer the following questions*

21. What was the second most frequent sport or exercise you did? (Specify only one)

22. When you did this activity, did your heart rate and breathing increase? (*Mark one answer*)

- | | | | |
|--------------------------|--------------------------|-----------------------------|--------------------------|
| No | Yes, a
small increase | Yes, a
moderate increase | Yes, a
large increase |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

23. How many months in this past year did you do this activity? (*Mark one answer*)

- | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Less than
1 month | 1 to 3
months | 4 to 6
months | 7 to 9
months | More than 9
months |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

24. During these months, on average, how many hours a week did you do this activity? (*Mark one answer*)

- Less than 1 hour/week
- At least 1 but less than 2 hours/week
- At least 2 but less than 3 hours/week
- At least 3 but less than 4 hours/week
- More than 4 hours/week

Appendix C

Bowel Disease Questionnaire

First, we would like to ask you some questions about stomach, belly or tummy pain in the last year.

1. Have you had an ache or pain in your *stomach or belly* (gut) in the *last year*? (*Mark one answer*). (Please do NOT count cramps or pain with menstrual periods, and do NOT count pain in your chest).

- No → Please go to question 22 on page 14.
 Yes → Please answer the following questions.

Stomach or belly pain can be difficult to describe and sometimes more than one type of pain can occur. Please think about the usual or primary type of pain you have. We would like to ask you some questions *only* about the USUAL or PRIMARY pain in your stomach or belly.

2. How many times have you had this *ache or pain in the last year*? (*Mark one answer*)

- 1 → Please go to question 22 on page 14.

- | | |
|--|---|
| <input type="checkbox"/> 2 | } → Please answer the following questions |
| <input type="checkbox"/> 3 | |
| <input type="checkbox"/> 4 | |
| <input type="checkbox"/> 5 | |
| <input type="checkbox"/> 6 | |
| <input type="checkbox"/> More than 6 times | |

3. How bad is the ache or pain *usually*? (*Mark one answer*)

- MILD: *can* be ignored, if you don't think about it.
 MODERATE: *cannot* be ignored, but does not affect your life-style.
 SEVERE: affects your life-style.
 VERY SEVERE: *markedly* affects your life-style.

4. Pain can occur mainly in the upper belly (stomach), lower belly, or in both the upper and lower belly. Concerning your primary pain, has this ache or pain in the belly *usually* been: (*Mark one answer*)

- ABOVE the navel, that is in the *UPPER BELLY*?
 BELOW the navel, that is in the *LOWER BELLY*?
 In different places in *BOTH* the upper *AND* lower belly?

5. Does your usual ache or pain **EVER WAKE YOU FROM SLEEP AT NIGHT**? (*Mark one answer*)

- No Yes

6. Does this pain come and go periodically? Periodically here means periods of at least a month with *no pain*, with periods in between of weeks to months *when there is pain*.
(Mark one answer)

- No Yes

7. How *many times* did you get this pain **in the last year**? (Mark one answer)

- Less than once a month
 About once a month
 About once a week
 Several times a week
 Daily

8. When this pain occurs, *how long* does it usually last? (Mark one answer)

- Less than 30 minutes.
 30 minutes to 2 hours.
 More than 2 hours to 6 hours
 More than 6 hours.

9. When in your life did this ache or pain *FIRST* begin, as close as you can recall? (Mark one answer)

- In the last 6 months
 7 months to 1 year ago
 More than 1 year to 2 years ago
 More than 2 years to 5 years ago
 More than 5 years to 10 years ago
 More than 10 years to 20 years ago
 More than 20 years ago.

FOR QUESTIONS 10 TO 21: WHEN WE SAY **OFTEN**, WE MEAN MORE THAN 25% OF THE TIME

10. Does this ache or pain **often** occur *BEFORE* meals or when hungry? (*Mark one answer*)
- No Yes
11. Does this ache or pain **often** occur *IMMEDIATELY AFTER* (less than 30 minutes) meals? (*Mark one answer*)
- No Yes
12. Does this ache or pain **often** occur 30 minutes to 2 hours *AFTER* meals? (*Mark one answer*)
- No Yes
13. Is this pain **often** made *BETTER* (relieved) by burping (bringing up air through the mouth)? (*Mark one answer*)
- No Yes
14. Is this pain **often** made *BETTER* by having a bowel movement? (*Mark one answer*)
- No Yes
15. Is this pain **often** made *BETTER* by eating? (*Mark one answer*)
- No Yes
16. Is this pain **often** made *BETTER* by taking antacids (like Tums, Riopan, Mylanta, Maalox, Gaviscon, or Rolaids)? (*Mark one answer*)
- No Yes I don't take antacids
17. Is this pain **often** made *BETTER* (relieved) by having a bowel movement? (*Mark one answer*)
- No Yes
18. Is this pain **often** made *WORSE* by food or milk? (*Mark one answer*)
- No Yes

19. Is this **pain often** made *WORSE* by drinking alcohol like beer, wine or other liquors? (Mark one answer)

- No
- Yes
- I don't drink alcohol

20. Do you **often** have *MORE* bowel movements when this pain begins? (Mark one answer)

- No
- Yes

21. Do you **often** have *LOOSER* bowel movements (stools) when this pain begins? (Mark one answer)

- No
- Yes

22. Has your bowel pattern changed in the *last year*? (Mark one answer)

- No
- Yes

23. How would YOU describe your *usual* bowel pattern in the last one year? (Mark one answer)

- | | | | |
|--------------------------|--------------------------|--------------------------|--|
| Normal | Constipated | Diarrhea | Alternating constipation
and diarrhea |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

24. How many bowel movements do you **usually** have in a *WEEK*? (Mark one answer)

- | | | | | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 or
less | 2 | 3-4 | 5-8 | 9-12 | 13-16 | 17-21 | 22-26 | More than 26 |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

25. Do you take *anything* (e.g. bran, fiber, laxatives) because of constipation? (Mark one answer)

No → Please go to question 26 on the next page.

Yes → What do you take? _____

How often do you take it? (Mark one answer)

- | | | | | | |
|---------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Less than
once a month | 1-3 times
a month | 1-3 times
a week | 4-6
times a week | Once
a day | More than
once a day |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

26. Have you seen *MUCUS* in your stools in the last year (that is, white or green slimy material)? (*Mark one answer*)

- No Yes

FOR QUESTIONS 27 TO 33: WHEN WE SAY **OFTEN**, WE MEAN MORE THAN 25% OF THE TIME

27. Do you **often** have *MORE* than 3 bowel movements each *DAY*? (*Mark one answer*)

- No Yes

28. Do you **often** have *LESS* than 3 bowel movements each *WEEK*? (*Mark one answer*)

- No Yes

29. Do you **often** *STRAIN* to have a bowel movement? (*Mark one answer*)

- No Yes

30. Are your stools **often** *LOOSE* or *WATERY*? (*Mark one answer*)

- No Yes

31. Are your stools **often** *HARD*? (*Mark one answer*)

- No Yes

32. After finishing a bowel movement, do you **often** feel there is still stool that needs to be passed? (*Mark one answer*)

- No Yes

33. Do you **often** experience an *URGENT* need to open your *BOWELS* that makes you rush to a toilet? (*Mark one answer*)

- No Yes

34. Have you noticed ANY BLOOD in your stools or in the toilet bowl in the last year?

(Mark one answer)

No → Please go to question 38.

Yes → Please answer the following questions.

35. Is the blood coating the stools? No Yes

36. Is the blood dark and mixed in the stools? No Yes

37. Is the blood on the toilet paper? No Yes

38. How many times have you had a feeling of *WANTING TO THROW UP (nausea)* in the last year? (Mark one answer)

None

Less than once a month

About once a month

About once a week

Several times a week

Daily

39. How many times have you *ACTUALLY THROWN UP (vomited)* in the last year?

(Mark one answer)

None

Less than once a month

About once a month

About once a week

Several times a week

Daily

40. Do you **often** feel bloated and actually see your *belly swell up*? (Mark one answer)

No

Yes

41. Have you **often** had difficulty swallowing (*food sticking in your throat*) in the last year? (Mark one answer)

No

Yes

42. Have you had *HEARTBURN* (a burning or ache behind the breast bone *in the chest*) in the last year?

(Do *not* count pain from angina or heart trouble.) (Mark one answer)

Never → Please go to question 44

Less than once a month

About once a month

About once a week

Several times a week

Daily

→ Please answer question 43

43. Is your heartburn *made better* by taking antacids (like Tums, Riopan, mylanta, Maalox, Gaviscon or Rolaid's)? (Mark one answer)

No

Yes

I don't take antacids

44. Have you noticed a very sour or *acid tasting fluid* at the back of your throat in the last year? (Mark one answer)

Never

Less than once a month

About once a month

About once a week

Several times a week

Daily

45. Have you lost weight in the last year without deliberately dieting? (Mark one answer)

No

Yes, less than 7 pounds

Yes, 7 pounds or more

46. Compared with before, has your appetite in the last year: (Mark one answer)

Decreased?

Stayed about the same?

Increased?

Now we have some questions about your previous health and visits to the doctor.

47. Did you have many bouts of stomach or belly pain as a *child* (before age 15)?
(Mark one answer)

- No Yes

48. Have you had your appendix out? (Mark one answer)

- No Yes

49. Have you had your gall bladder taken out? (Mark one answer)

- No Yes

50. Have you *ever* had a stomach (gastric) or duodenal *ulcer*? (Mark one answer)

- No
 Yes → When (Year)? _____

How was it diagnosed (by x-rays, endoscopy)? _____

51. Have you *ever* had an operation on your stomach? (Mark one answer)

- No
 Yes → When (Year)? _____

What operation? _____

52. Have you *ever* had any other type of bowel/ belly surgery? (Mark one answer)

- No
 Yes → When (Year)? _____

What operation? _____

53. How many times have you visited a doctor or physician IN THE LAST YEAR? (Mark one answer)

None → Please go to question 59

1-2 Times

3-5 Times

6-10 Times

More than 10 times

} → Please go to question 54

54. If you visited a doctor in the last year, was it for aches or pains in your belly? (Mark one answer)

No → Please go to question 58

Yes → Please answer the following questions

55. When you visited the doctor for belly pain, was it because the symptoms were severe or very severe? (Mark one answer)

No

Yes

56. When you visited the doctor for belly pain, was it because the symptoms worried you a lot? (Mark one answer)

No

Yes

57. When you visited the doctor for belly pain, was it because you believed you might have a serious illness? (Mark one answer)

No

Yes

58. If you visited a doctor in the last year, was it for problems with your bowels? (Mark one answer)

No

Yes

59. Have your activities been interrupted in the last year because of aches or pains in your stomach or tummy? (Mark one answer)

No

Yes

60. Have your activities been interrupted in the last year because of problems with your bowels? (Mark one answer)

No

Yes

61. Have your activities been interrupted in the last year because of other illnesses? (Mark one answer)

No

Yes → What illnesses? _____

62. How often have you missed days from work **in the last year** because you were ill? (Mark one answer)

Never

1-2 times

3-5 times

6-10 times

More than 10 times

63. Do you *smoke cigarettes REGULARLY NOW*? (Mark one answer)

No, never smoked

No, ex-smoker

Yes → On average, HOW MANY cigarettes a DAY do you *usually* smoke?

Less than 5

5-15

More than 15

Next, there is a question about drinks which contain alcohol (that is, beer, wine, or other liquors like whisky, vodka, gin or brandy). One drink is equal to a can of beer, a glass of wine or a shot of spirits.

64. How many drinks a WEEK have you had on average in the past year? (Mark one answer)

None

1-2 drinks a week

3-6 drinks a week

7-10 drinks a week

More than 10 drinks a week

65. How many ASPIRIN (that is, tablets like Bayer Aspirin, Bufferin, Anacin, Ascriptin, Excedrin, Alka-Seltzer) have you taken on *average* each WEEK in the past year? (*Mark one answer*)
- None
 - 1-2 tablets or capsules a week
 - 3-6 tablets or capsules a week
 - 7-10 tablets or capsules a week
 - More than 10 tablets or capsules a week
66. How many TYLENOL or PANADOL or ANACIN 3 have you taken on *average* each WEEK in the past year? (*Mark one answer*)
- None
 - 1-2 tablets or capsules a week
 - 3-6 tablets or capsules a week
 - 7-10 tablets or capsules a week
 - More than 10 tablets or capsules a week
67. What is your current marital status? (*Mark one answer*)
- Married
 - Never married
 - Widowed
 - Divorced
 - Separated
68. What is the highest level of education you have completed? (*Mark one answer*)
- Some high school
 - High school graduate
 - Some college
 - College graduate (4 years)
 - Professional training beyond college
69. What is your gender? (*Mark one answer*)
- Male
 - Female
70. What is your age? _____ years