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# Sex differences in dietary coping with gastrointestinal symptoms

Short title: Gastrointestinal symptoms and dietary coping

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## Abstract

**Aim** Nutritional changes are often considered first line treatment in public health diseases which apply to many gastrointestinal disorders, since different food and beverages may modulate gastrointestinal (GI) motor and sensory functions, and provoke GI symptoms. The aim of this study was to examine dietary coping and possible changes of food and beverages intakes in relation to GI symptoms reported by identified IBS patients compared to healthy controls and if any gender differences were seen in these respects.

**Methods** A population-based case-control design was used. Three primary health care centres in the city of Linköping in Sweden. The IBS cases were recruited from the studied primary health care centres based on diagnoses from computerized medical records. The controls were randomly selected from the general population in the same region. A questionnaire was used with specific questions about self-reported food and beverages increase or decrease of GI symptoms and self-reported changes in dietary habits.

**Results** Female IBS-cases appear to be more willing to change dietary habits due to their GI-problems than males. Effects of these nutritional behaviour changes were reported for almost all participants that had made dietary adjustments. Fatty food, certain vegetables, dairy products and egg were significantly more reported to cause GI complaints among IBS-cases compared to their controls.

**Conclusions** Female IBS-cases reported more changes in their dietary habits due to GI-problems than males with the disease. The majority of both females and males that changed their dietary habits due to GI problems experienced symptoms improvement.

**Keywords** Case-control study, diet, gastrointestinal disorders, gender.

## **Introduction**

Food and nutritional habits are often recognized as the principal environmental component affecting a wide range of public health diseases throughout the world. Lifestyle and nutritional changes are considered first line treatment in many public health diseases as cardiovascular diseases, non-insulin-dependent diabetes and many gastrointestinal disorders [1]. Irritable bowel syndrome (IBS) is a common public health problem, which affect up to 20% of the general population. This condition is characterized by lack of pathological or biological markers, and diagnostic definitions and classifications have so far relied on symptoms [2,3,4]. The aetiology of IBS is unclear, but has been recognized as complex. Psychological, social and biological factors may all play a role, although the impact of each of these factors on symptom development is likely to be different in different patients and may vary over time for the same person [5,6,7,8,9]. Patients' self-assessment of their symptoms is very important in treatment trials of IBS [10]. Due to lack of pathophysiologic markers in IBS, the majority of management practices are based on symptom control [10]. The interventions can vary from pharmaceutical treatment to non-drug therapies, e.g. hypnotherapy and cognitive behavioural therapy [12,13].

Different food items and beverages may modulate gastrointestinal (GI) motor and sensory functions, and provoke GI symptoms [14]. Two-third of IBS patients believes that their complaints are related to diet [15]. They often complain of postprandial worsening of symptoms as well as intolerance to certain foods [16,17,18]. Food intolerance, food allergy, bacterial overgrowth, altered colonic flora and alternations in gastrointestinal physiology after eating are mechanisms

for food-induced symptoms proposed, but the importance of these mechanisms are still unclear [19]. The mechanism on symptoms development caused by food intake is likely to be different in different patients and may vary over time for the same person. Patients with GI symptoms who reported food allergies or food related worsening of the symptoms is more likely to have functional rather than organic disease [20]. Studies have also reported that dietary elimination might be beneficial for IBS patients, however recently a study reported no differences in consumption of risk food that might worsen the symptoms between cases with functional gastrointestinal disorder and healthy controls [21,22]. Studies concerning self-reported food and beverages that positively or negatively affect GI symptoms among IBS patients, especially in primary care in comparison with healthy controls from the general population are not so common. With regard to this, we have implemented a population-based case-control study addressing nutritional behaviour concerning food and beverages that reports giving GI symptoms and reports of changes in dietary habits due to GI-complaints among IBS patients. The study, entitled “The Linköping IBS Population Study” (LIPS), is conducted in primary care and includes a population-based control group [23,24,25,26].

The aims of this study were to examine dietary coping, behaviour and adjustments of food and beverages intake in relation to GI symptoms reported by IBS patients in primary care compared to controls from the general population without the disease and further if any gender differences were seen in these respects.

## **Methods**

### *Study design*

A population-based case-control design was used for the LIPS [23,24,25,26]. The IBS cases were recruited from Swedish primary health care centres (PHC) on the basis of diagnoses stored in computerized medical records. Three PHC centres were selected in the city of Linköping, located in the south-east of Sweden with 135,000 inhabitants. These public PHC centres cover a total study population of more than 40,000 inhabitants and are responsible for all primary health care consultations for the population in the area studied. Only a negligible part of the population might have visited other providers of primary care. The control group was randomly selected from the population census register in the same region.

All cases with a recorded primary diagnosis of IBS given by the general practitioner (GP) were identified retrospectively in the computerized medical records over a 5-year period (1997–2001). The ICD-10-P code K-58.0 and K-58.9 for IBS were used to identify the cases in the medical records. In this study we focus on newly diagnosed IBS cases over a 5-year period. IBS cases (n=11) with non-accessible medical record were excluded, thus giving a total study group of n=723 IBS cases in all ages.

### *Study population*

Only identified new IBS cases in primary care during a 5-year period (1997 – 2001) in working ages (18-65 years) were selected for this case-control study.

This resulted in n=515 IBS cases. The severity of the disease could vary from mild or moderate to severe. The collection of baseline data from the IBS patients has been described elsewhere [24,25,26]. By using the local census population register N=4,500 controls in the age-group 18-65 years were randomly selected from the general population in same geographical area as the IBS cases. The number of controls was chosen proportionally according to the number of inhabitants living in the service areas of each of the 3 primary health care centers; up to 7 controls per case of IBS were used in this study. The questionnaire was mailed in 2003 to 5,015 study participants.

### *Questionnaire*

We constructed a mail questionnaire based primarily on established and validated instruments measuring quality of life and mental problems. Additionally, we designed specific questions derived from regional and national surveys of welfare and health, life style and standard of living, sleep disturbance, and nutritional habits, as well as exercise regimens and the demands of and degree of control at work. Development of the questionnaire has been described elsewhere [23,24,25,26]. Results from these analyses of the LIPS population have been previously published [23,24,25,26]. The questionnaire also included specific questions about self-reported food and beverages that increased or decreased GI symptoms and complaints. The responders reported the name of the food and beverages that gave GI-complaints and which dietary habits they had changed in terms of increasing or decreasing intake of this particular food or drink.

The questionnaire also included demographic data, such as gender, civil status, education level (primary school, secondary school and upper secondary school classified as low and University College and university classified as high education) and occupation. All the questions were subsequently dichotomized in the database. Prior to the survey, a pilot study described elsewhere was performed [23,24,25,26]. No difference was found in the severity of disease, defined as the proportion of referrals, between responders and non-responders among the IBS cases. Prior to the analysis, we checked to ensure that individuals in the control group did not have any recorded gastrointestinal diagnosis, including gastrointestinal cancer, 2 years prior to and during the study period because the controls needed to be free from known gastrointestinal diagnoses. After this additional review, we found 218 individuals in the control group who had received a gastrointestinal diagnosis during the study period, and these individuals were subsequently excluded from further analysis. This check was made possible through information obtained from a population-based administrative health care database where all visits, including patient diagnoses in both primary and hospital care, are stored for all individuals in the region. This database is a unique opportunity for collection of data in a Swedish perspective which are at hand within this region and County Council [27]. The final study population comprised the number of responders of the postal questionnaire, n=347 IBS cases and n=2,509 controls (**Table 1**).

### *Statistical analysis*

All data were stored in an SPSS database and statistically analyzed using the SPSS version 16.0 program (SPSS Inc., Chicago, IL, USA). The significance of

differences between cases and controls were measured in univariate analysis by chi<sup>2</sup>-test and a p-value of <0.05 was considered statistically significant. This was followed by multivariate logistic analysis for identification of food item and beverages that caused GI complaints. Cases and control was used as the dependent variable. The objective of the multivariate analysis was to identify certain food and beverages that were reporting giving GI complaints. In the multivariate logistic regression analysis, data were adjusted for age and calculated separately for males and females. Odds ratios and 95% confidence intervals were also calculated. Differences in reports of changes in food habits were measured by Spearman's correlation.

#### *Ethical approval*

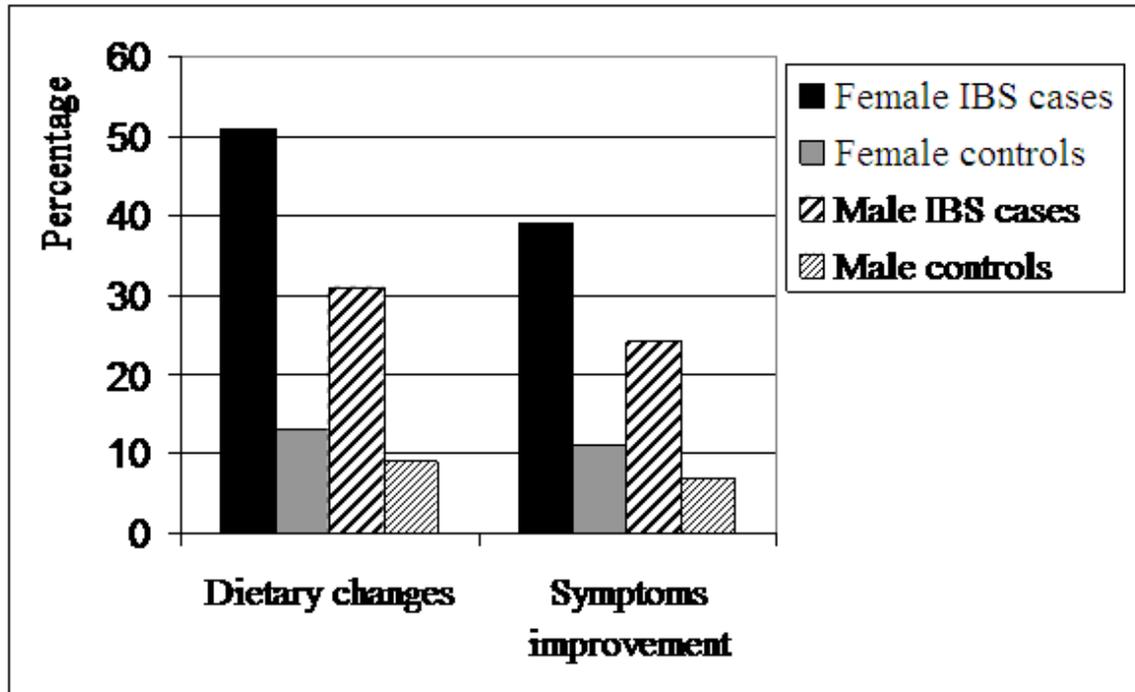
This study was approved in 2002 and 2007 by the Ethical Committee at the Faculty of Health Sciences, Linköping University, Sweden.

#### **Results**

Two third of the IBS-cases in this LIPS study were females compared to an almost equal gender distribution among the controls from the general population. There were no significant differences concerning civil status or educational level among IBS cases compared to their control group, see **table 2**.

Dietary changes in general due to GI-problems were reported among 50.7 % of the female IBS cases and among 12.8% of their female control group. For males changes of dietary habits were reported among 31.1% of IBS cases and in 8.8 % of their male controls. Good or very good symptoms improvement of their GI-

symptoms due to these dietary changes was reported for 39.0% of the female cases and for 11.1% of their controls. For males the corresponding figures were 24.0% for male IBS cases and 7.0% among their male controls, see **figure 1**.



**Figure 1. Dietary changes of habits due to GI-problems and achieved symptoms improvement reported among female and males IBS cases and controls.**

For reports of specific changes in food and drinking habits significant differences were seen between female IBS-cases and controls concerning increased fibre and fish consumption and decreased consumption of fatty food, red meat, alcohol, coffee and sweets. For males a decreased consumption of bread among IBS-cases was the only significant dietary change reported in comparison to male controls.

Females with IBS reported significantly more frequent that fatty food, certain vegetables, dairy and egg products and products containing wheat, worsened their GI-symptoms compared with their female controls. Red meat, sausages and pork, fried or grilled food were also reported giving more complaints among female

IBS cases compared to their female controls. For sweets and cakes, hot or spicy food as well as seafood, the difference was not that marked, but still significant. Significant differences were seen between female cases and controls for beverages like: coffee, alcohol, carbonated drinks and fruit juices. In the multivariate analysis concerning which type of food and beverages that was reporting giving GI-complaints, fatty food, dairy and egg products, vegetables and meat as well as coffee or tea remained significant in the model for females. These data are summarized in **table 3**.

For male IBS cases the same trend were seen concerning fatty food and dairy and egg products, in this group even included hot and spicy food. Minor, but significant differences were seen for vegetables, products containing wheat, fried or grilled food and sweets and cakes compared to the male control group. Fruit and juices and coffee or tea was significantly more reported giving GI-complaints compared to males in the control group. The multivariate analysis showed that fatty food, dairy and egg products, fruit and juices, hot and spicy food as well as products containing wheat remained in the model for males. These data are summarized in **table 4**.

## **Discussion**

In this population based case-control study, we identified self-reported food and beverages that increased or decreased GI symptoms and complaints among IBS cases compared to healthy controls. The main findings were that female IBS-cases reported dietary changes due to their GI-problems to a larger extent than males. Changes of dietary behaviour were reported to give improvement of

gastrointestinal symptoms among all performers i.e. both cases and controls that had made changes concerning our array of different food and beverages. However, significant differences between cases and controls were seen among females in terms of increased fibre and fish intake, decreased intake of fatty food, sweets, red meat, coffee and alcohol. The male IBS group only reported significantly decreased intake of bread compared to their male controls. This could be interpreted as females appear to be more willing and open for changes of their dietary habits. They might possibly also have more knowledge about the cause of the disease than males, or seem more willing to report dietary changes. The results should also be interpreted against common nutritional trends today consuming less fat food, more fibre, fish, fruit and also more vegetables. The minor differences in dietary changes among males compared to females may reflect a possible genuine gender difference concerning the willingness to change or even report one's diet in general.

Previous results from the LIPS study showed that 30% of the all IBS cases received life-style and dietary recommendations from their GP [25]. This follow-up 2 years later showed good improvement of the above mentioned dietary changes due to GI problems for all performers. In this respect, almost the entire control group that made dietary changes also reported improvements. Dietary elimination might possibly therefore be beneficial for some individuals with functional GI-problems. Another explanation or possibly a part of this improvement reported could be a placebo effect, believing that these changes actually improved their GI symptoms. Although, many individuals with functional GI-diseases often have chronic and poorly understood symptoms and

possibly believing that they are allergic or intolerant to certain food. It is understandable that such group of patients spends their time analyzing what they eat in order to identify dietary triggers [20].

Fatty food (including fast food), certain vegetables, dairy products and egg was reported to cause significantly more GI complaints among both female and male IBS-cases compared to their controls. Several studies reports that IBS cases consider their symptoms to be related to certain food or meals [15,28,29]. But, there are also studies reporting no differences in consumption of putative provoking symptoms food items between cases with functional gastrointestinal disorder and healthy controls [22]. In our present study, we could confirm what some previous studies have reported, that fatty food, vegetables like onion, garlic, cabbage beans, peas, dairy products, especially cream, food containing wheat, like pasta and white bread significantly exacerbated complaints among both female and male IBS cases compared to their respective control group. Also grilled or fried, hot and spicy food, coffee or tea, fruit and juices, sweets and cakes also caused more GI problems among both female and male IBS cases compared to their control group. Our hypothesis was that there might be gender differences in reporting risk food and beverages. The multivariate analysis showed some differences in relevant food and beverages that females and males reported giving GI complaints. These results might also reflect actual gender differences in food and drinking habits. Other explanations to this phenomenon like different biological mechanisms in the gastrointestinal canal between males and females are less likely and the questions of the role of different hormones in this respect will not be discussed in this paper. One consequence of these possible

gender differences might be to give different general dietary recommendations for female and male IBS cases in primary care. Of course, there will always be individual differences between people in terms of energy intake, amount of food needed and what kind of food people prefer.

Another factor to consider is food intolerance, which encompasses non-immunological mediated reaction to food, while food allergy/hypersensitivity, is used to describe conditions in which an immunological mechanism is present. Neither of these reactions in IBS-patients is clear, but many factors may be involved. Eating stimulates different colonic and motor activity that might explain postprandial gastrointestinal symptoms [30,31,32,33,34,35].

The general understanding of biological active substances in food items and their potential role in GI symptoms are improving, because food items are a complex mix of different proteins, fats, and vitamins minerals, carbohydrates that may vary in different region and seasons etc [22]. For example, one study reported that chocolate had a constipating effect [34]. In this study chocolate was included in the sweets and cake group, but some responders mentioned solely chocolate as a provoking item, while others used the general word sweets.

This study focused only on food and beverages reported to cause GI problems and not the amount of consumptions, food allergy or which specific substance that cause problems, which is a limitation in the study. Therefore we analysed the name and label of the self-reported food item from the responders and then categorized these in rather large range of different food and beverage groups.

Only a small fraction of the study population (less than 1 %) reported lactose or gluten intolerance. We did not ask which specific symptoms/complaints that worsen when eating certain food, but many responders reported more flatulence, abdominal pain, heartburn, constipation, rumbling in the stomach, bloating and diarrhoea and that these symptoms were improved after dietary changes. Further prospective studies are warranted in this field, analysing the dietary intake and role of biological active substances in food items among IBS cases compared to healthy controls and a follow-up of the improvement of dietary changes done. Heartburn and upper abdominal pain could indicate GI-co-morbidity like FD or GERD among this IBS cases. New incidence of gastrointestinal disorders might also have occurred among the control group during the follow-up or have underlying food hypersensitivity.

The population-based case control design with a quite large control group and use of validated questionnaires strengthens this study. Although we surveyed patients with IBS and controls regarding their current (2003) dietary habits, our survey was conducted among patients with diagnoses that were recorded up to 6 years previously (in 1997). Therefore, some patients in the IBS group might not have had IBS symptoms at the time that our survey was conducted. The diagnosis of IBS was based on diagnoses in medical records from general practitioners. Because general practitioners might not be considered to be experts in the diagnostic criteria for IBS, it is possible that some IBS patients were given false-positive diagnoses. However, studies have shown that general practitioners rarely misdiagnose IBS and their diagnoses are in close agreement with those made by gastroenterologist [36,37] in fact, there may be a tendency to under diagnosis IBS

in primary care [36,37,38,39].

## **Conclusions**

Female IBS-cases reported more changes in their dietary habits due to their GI-problems than males with the disease compared with their controls. The majority of both females and males that changed their dietary habits due to GI problems reported improvement of their symptoms. Dietary advices due to functional GI-problems could possibly be different for female and male IBS-patients in primary care. Fatty food (including fast food), certain vegetables (like onion, garlic, beans, peas, cabbage, and pepper), dairy products and egg was reported to cause significantly more GI-complaints among both female and male IBS-cases compared to their controls.

## **Conflict of interest**

None declared

## **Author's contributions**

Åshild Faresjö, Saga Johansson and Tomas Faresjö designed the study performed data analysis and wrote the manuscript. Claes Hallert and Susanne Roos contributed in the data analysis and writing of the manuscript.

## References

1. Shetty P. Food and nutrition. In *Oxford textbook of public health*, 4<sup>th</sup> ed.. (R Detels, J McEwan, R Beaglehole, H Tanaka, editors). Oxford: Oxford University Press; 2006, pp 149-170.
2. Thompson WG, Dotevall G, Drossman DA, Heaton KW, Kruis W. Irritable bowel syndrome: Guidelines for the diagnosis. *Gastroenterol Int* 1989; **2**:92-95.
3. Drossman DA, Thompson WG, Talley NJ, Funch-Jensen P, Janssen J, Whitehead WE. Identifications of subgroups of functional gastrointestinal disorders. *Gastroenterol Int* 1990; **3**:159-172.
4. Drossman DA. The functional gastrointestinal disorders. Rome II. Second edition. Degnon associates, Mclean, VA, USA, 2000.
5. Koloski NA, Talley NJ, Boyce PM. Predictors of health care seeking for irritable bowel syndrome and non-ulcer dyspepsia: a critical review of the literature on symptoms and psychological factors: *Am J Gastroenterol* 2001; **96**:1340-1349.
6. Herschbach P, Henrich G, von Rad M. Psychological factors in functional gastrointestinal disorders: characteristics of the disorder or of the illness behaviour? *Psychosom Med* 1999; **61**:148-153.
7. Whitehead WE, Crowell MD, Robinson JC, Heller BR, Schuster MM. Effects of stressful life events on bowel syndrome compared with subjects without bowel dysfunction. *Gut* 1992; **33**:825-830.
8. Mertz H, Naliboff B, Munkata J, Niazi N, Mayer EA. Altered rectal perceptions are a biological marker of patients with irritable bowel syndrome. *Gastroenterology* 1995; **109**:40-52.

9. Mertz H, Morgan V, Tanner G, Pickens D, Price R, Shyr Y, et al. Regional cerebral activation in irritable bowel syndrome and control subjects with painful and non-painful rectal distension. *Gastroenterology* 2000; **118**:842-848.
10. Lacy BE. Irritable bowel syndrome: a primer on management. *Rev Gastroenterol Disord* 2003; **3**:32-42.
11. Thielecke F, Bergmann-Maxion S, Abel F, Gonschior AK. Update in the pharmaceutical therapy of the irritable bowel syndrome. *Int J Clin Pract* 2004; **58**:374-381.
12. Heymann-Mönnikes I, Arnold R, Florin I, Herda C, Melfsen S, Mönnikes H. The combinations of medical treatment plus multicomponent behavioural therapy is superior to medical treatment alone in the therapy of irritable bowel syndrome. *Am J Gastroenterol* 2000; **95**:981-994.
13. Guthrie E, Creed F, Dawson D, Tomenson B. A randomized trial of psychotherapy in patients with refractory irritable bowel syndrome. *Br J Psychiatry* 1993; **163**:315-321.
14. Karamanolis G, Tack J. Nutrition and motility disorders. *Best Pract Res Clin Gastroenterol* 2006; **20**(3):485-505.
15. Lacy BE, Weiser K, Noddin L, Robertson DJ, Cromwell MD, Parratt-Engstrom C, et al. Irritable bowel syndrome: patients attitudes, concerns and level of knowledge. *Aliment Pharmacol Ther* 2007; **25**:1329-1341.
16. Ragnarsson G, Bodemar G. Pain is temporally related to eating but not to defecation in the irritable bowel syndrome (IBS). Patient's description of diarrhoea, constipation and symptoms variations during a prospective 6-week study. *Eur J Gastroenterol Hepatol* 1998; **10**:415-421.

17. Svedlund J, Sjödin I, Dotevall G, Gillber R. Upper gastrointestinal and mental symptoms in the irritable bowel syndrome. *Scand J Gastroenterol* 1985; **20**:595-601.
18. Dainese R, Galliani EA, DeLazzari F, DiLeo V, Naccarato R.. Discrepancies between reported food intolerance and sensitization test findings in irritable bowel syndrome patients. *Am J Gastroenterol* 1999; **94**:1892-1897.
19. Friedman G. Diet and the irritable bowel syndrome. *Gastroenterol Clin North Am* 1991; **20**(2):313-324.
20. Bhat K, Harper A, Gorad DA. Perceived food and drug allergies in functional and organic gastrointestinal disorders. *Aliment Pharmacol Ther* 2002; **16**:969-973.
21. Niec AM, Frankum B, Talley NJ. Are adverse food reactions linked to irritable bowel syndrome? *Am J Gastroenterol* 1998; **93**(11):2184-2190.
22. Saito YA, Locke GR III, Weaver AL, Zinsmeister AR, Talley NJ. Diet and Functional Gastrointestinal Disorders: A populations-based case-control study. *Am J Gastroenterol* 2005; **100**:2743-2748.
23. Faresjö Å, Grodzinsky E, Johansson S, Wallander MA, Timpka T, Åkerlind I. Psychosocial factors at work and in everyday life are associated with irritable bowel syndrome. *Eur J Epidemiol* 2007; **22**(7):473-480.
24. Faresjö Å. Grodzinsky E, Johansson S, Wallander MA, Foldevi M. Patients with irritable bowel syndrome in Swedish primary care. *Eur J Gen Pract* 2006; **12**:88-90.
25. Faresjö Å. Grodzinsky E, Foldevi M, Johansson S, Wallander MA. Patients with IBS in primary care appear not to be heavy health care utilisers. *Aliment Pharmacol & Ther* 2006; **23**(6):807-811.

26. Faresjö Å, Grodzinsky E, Johansson S, Wallander MA, Timpka T, Åkerlind I. A population based case-control study of work and psychosocial problems in patients with irritable bowel syndrome-women are more seriously affected than men. *Am J Gastroenterol* 2007; **102**(2):371-379.
27. Wiréhn A-B, Karlsson M, Carstensen J. Estimating disease prevalence using a population-based administrative health care database. *Scand J Public Health* 2007; **35**:424-31.
28. Simrèn M, Månsson A, Langkilde AM, Svedlund J, Abrahamsson H, Bengtsson U et.al. Food-related gastrointestinal symptoms in irritable bowel syndrome. *Digestion* 2001; **63**(2):108-115.
29. Halpert A, Dalton CB, Palsson O, Morris C, Hu Y, Bangdiwata S et.al. What patients know about irritable bowel syndrome (IBS) and what they would like to know. National survey on patient educational needs in IBS and development and validation of patient educational needs questionnaire (PEQ). *Am J Gastroenterol* 2007; **102**:1972-1982.
30. Snape WJ jr, Matarazzo SA, Cohen S. Effect of eating and gastrointestinal hormones on human colonic myoelectrical and motor activity. *Gastroenterology* 1978; **75**:373-378.
31. Wright SH, Snape WJ jr, Battle W, Cohen S, London RL. Effect of dietary components on gastrocolonic response. *Am J Physiol* 1980; **238**:G228-232.
32. Wiley J, Tatum D, Keinath R, Chung OY. Participation of gastric mechanoreceptors and intestinal chemoreceptors in the gastrocolonic response. *Gastroenterology* 1988; **94**:1144-1149.
33. Steadman CJ, Phillips SF, Camilleri M, Haddad AC, Hanson RB. Variation of muscle tone in human colon. *Gastroenterology* 1991; **101**:373-381.

34. Müller-Lissner SA, Kaatz V, Brandt W, Keller J Layer P. The perceived effect of various food and beverages on stool consistency. *Eur J Gastroenterol Hepatol* 2005; **17**:109-112.
35. Zar S, Kumar D, Benson MJ. Review article: Food hypersensitivity and irritable bowel syndrome. *Aliment Pharmacol & Ther* 2001; **15**:439-449.
36. Bellini M, Tosetti C, Costa F, Biagi S, Costa F, Bruzzi P, et.al. The general practitioner's approach to irritable bowel syndrome: From intention to practice. *Dig liver Dis* 2005; **37**:934-939.
37. Thompson WG, Heaton KW, Smyth GT, Smyth C. Irritable bowel syndrome: the view from general practice. *Eur J Gastroenterol Hepatol* 1997; **9**:689-692.
38. Talley NJ. When to conduct testing in patients with suspected irritable bowel syndrome. *Rev Gastroenterol Disord* 2003; **3**(Suppl.3):18-24.
39. Agreùs L. Rome? Manning? Who Care? *Am J Gastroenterol* 2000; **95**(10):2679-2680.

**Table 1. Derivation of Survey Sample and Respondents.**

Criteria	IBS Cases	IBS Cases	Control	Control Cases
	n	after Exclusion n	Cases n	after Exclusion n
Questionnaire mailed	515		4,500	
Unknown address or diseased	-29	486	-73	4,427
Respondents (%)	351 (68.2%)		2,786 (61.9%)	
Refused to participate in study	-4	347	-59	2,727
Follow-up of possible GI diagnosis among controls after study period ended <sup>*)</sup>			-218	2,509
Final total	347 (67.4%)		2,509 (55.8%)	

<sup>\*)</sup>Follow-up was conducted to ensure that controls were free from known GI diagnoses. GI=gastrointestinal; IBS=irritable bowel syndrome.

**Table 2. Sociodemographic data for IBS cases compared to controls.**

	IBS cases (N=347)		Controls (N=2,509)	
	n	%	n	%
<b>Sex:</b>				
Male	96	27.7	1208	48.1
Female	251	72.3***	1301	51.9
<b>Age:</b>				
18 to 24	36	10.4	404	16.1
25 to 44	147	42.4	1075	42.8
45 to 64	164	47.3	1030	41.1
<b>Civil status:</b>				
Living alone	56	16.3	494	19.9
Married/cohabitant	258	75.0	1824	73.4
Divorced	26	7.6	139	5.6

Widow/widower	4	1.2	27	1.1
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**Educational level:**

Primary school (low)	57	16.6	323	13.0
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Secondary school	60	17.5	471	18.9
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Upper secondary school	80	23.3	659	26.5
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University College or University	146	42.6	1033	41.6
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\*\*\*  $p < 0.0001$

**Table 3. Reported food and beverages that gives GI complaints among female IBS cases compared to female controls from the general population. Data was adjusted for age in the multivariate analysis.**

	Female IBS Cases								
	Univariate analysis				Multivariate analysis				
	Case (N=251)		Control (N=1301)		OR	95% Ci	p-value	OR	95% CI
	n	%	n	%					
Food rich in fat	59	23.5	119	9.1***	3.05	(2.16-4.32)	0.0001	2.09	(1.44-3.06)
Vegetables <sup>1</sup>	55	21.9	147	11.3***	2.20	(1.56-3.11)	0.037	1.50	(1.02-2.20)
Coffee or tea	52	20.7	142	10.9***	2.13	(1.50-3.03)	0.004	1.78	(1.20-2.64)
Dairy and egg products	52	20.7	105	8.1***	2.97	(2.07-4.29)	0.0001	2.26	(1.52-3.36)
Fruit and juices <sup>2</sup>	29	11.6	86	6.6 *	1.84	(1.18-2.88)	0.74	1.09	(0.66-1.80)
Alcohol <sup>3</sup>	23	9.2	66	5.1 *	1.88	(1.15-3.09)	0.55	1.19	(0.67-2.09)
Flour products <sup>4</sup>	22	8.8	47	3.6***	2.56	(1.51-4.34)	0.06	1.72	(0.96-3.07)
Sweets and cakes	21	8.4	48	3.7**	2.38	(1.40-4.05)	0.43	1.27	(0.70-2.29)

Hot or spicy food	21	8.4	52	4.0 *	2.19 (1.29-3.71)	0.53	1.21 (0.67-2.17)
Meat <sup>5</sup>	13	5.2	19	1.5****	3.68 (1.79-7.56)	0.05	2.21 (1.00-4.63)
Fried or grilled or deep fried food	13	5.2	19	1.5****	3.68(1.79-7.56)	0.08	2.02 (0.92-4.41)
Seafood	8	3.2	16	1.2*	2.64 (1.11-2.64)	0.65	1.24 (0.48-3.20)
Carbonated drinks	8	3.2	13	1.0*	3.26 (1.34-7.95)	0.27	1.71 (0.66-4.42)
Sour products	7	2.8	14	1.1*	2.63 (1.05-6.60)	0.33	1.64 (0.60-4.45)
Smoked food	6	2.4	14	1.1	2.25 (0.85-5.92)	----	-----
To much fibre	3	1.2	22	1.7	0.70 (0.21-2.37)	----	-----
Miscellaneous products	14	5.6	36	2.8*	2.07 (1.10-3.90)	0.20	1.57 (0.79-3.14)

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<sup>1</sup>Vegetables, mainly onion, garlic, beans, peas, cabbage, pepper or cucumber. <sup>2</sup>Fruit, mainly orange, apple, banana or kiwi. <sup>3</sup>Alcohol i.e. wine, beer or liqueur.

<sup>4</sup>Flour products, mainly white bread or pasta. <sup>5</sup>Red meat, sausages or pork. \*p=0.05 \*\*p= 0.001,\*\*\*p<0.0001

**Table 4. Reported food and beverages that gives GI complaints among male IBS cases compared to male controls from the general population. Data was adjusted for age in the multivariate analysis.**

	Male IBS Cases						
	Univariate analysis				Multivariate analysis		
	Case (N=96)		Control (N=1208)		OR 95% Ci	p-value	OR 95% Ci
n	%	n	%				
Coffee or tea	16	16.7	116	9.6*	1.88 (1.06-3.33)	0.13	1.60 (0.86-2.98)
Food rich in fat	14	14.6	47	3.9***	4.21 (2.23-7.98)	0.004	2.80 (1.39-5.61)
Dairy and egg products	12	12.5	53	4.4***	3.11 (1.60-6.05)	0.034	2.21 (1.06-4.59)
Vegetables <sup>1</sup>	11	11.5	72	6.0*	2.04 (1.04-3.99)	0.69	1.16 (0.56-2.40)
Fruit and juice	9	9.4	31	2.6***	3.92 (1.81-8.51)	0.009	3.05 (1.32-7.04)
Hot or spicy food <sup>2</sup>	9	9.4	32	2.6***	3.80 (1.76-8.21)	0.010	3.03 (1.30-7.07)
Alcohol <sup>3</sup>	8	8.3	54	4.5	1.94 (0.89-4.21)	----	-----
Flour products <sup>4</sup>	5	5.2	14	1.2*	4.69 (1.65-13.3)	0.024	3.61 (1.19-11.00)

Fried or grilled or

deep fried food	5	5.2	18	1.5*	3.63 (1.31-10.0)	0.42	1.61 (0.51-5.02)
Sweets and cakes	4	4.2	16	1.3*	3.24 (1.06-9.88)	0.94	1.05 (0.28-3.86)
To much fibre	3	3.1	11	0.9	3.51 (0.96-12.8)	----	-----
Sour products	2	2.1	7	0.6	3.65 (0.75-17.8)	----	-----
Smoked food	2	2.1	10	0.8	2.55 (0.55-11.8)	----	-----
Meat <sup>5</sup>	1	1.0	10	0.8	1.26 (0.15-9.95)	----	-----
Seafood	1	1.0	5	0.4	2.53 (0.29-21.9)	----	-----
Carbonated drinks	1	1.0	12	1.1	1.05 (0.13-8.15)	----	-----
Miscellaneous products	6	6.2	31	2.6*	2.53 (1.03-6.22)	0.19	1.91 (0.72-5.11)

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<sup>1</sup>Vegetables, mainly onion, garlic, beans, peas, cabbage, pepper or cucumber. <sup>2</sup>Fruit, mainly orange, apple, banana or kiwi. <sup>3</sup>Alcohol i.e. wine, beer or liqueur,

<sup>4</sup>Flour products, mainly white bread or pasta. <sup>5</sup>Red meat, sausages or pork. \*p=0.05. \*\*p= 0.001, \*\*\*p=0.000