

tility treatment go well beyond those invested in the specific procedures.²⁷

We may be only in the beginning of a new pattern for multiple pregnancies as the rate has increased each year in the 1990s. It should be noted that the mortality data presented here pertain only to the first years of this new trend. With longer follow up and an increasing proportion of multiple births, it may well turn out that the births related to fertility treatment have a greater impact on the national mortality rates. It seems essential that the trends in multiple pregnancies and infant mortality are monitored in future years to detect unwarranted consequences of these treatments.

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Prevalence of gastrointestinal symptoms six months after bacterial gastroenteritis and risk factors for development of the irritable bowel syndrome: postal survey of patients

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Abstract

Objective: To measure the prevalence of gastrointestinal symptoms six months after bacterial gastroenteritis and determine risk factors and associations with postdysenteric symptoms.

Design: Postal questionnaire.

Setting: Nottingham Health Authority.

Subjects: 544 people with microbiologically confirmed bacterial gastroenteritis between July 1994 and December 1994.

Main outcome measures: Prevalence of gastrointestinal symptoms and relative risks for development of the irritable bowel syndrome and self reported altered bowel habit.

Results: A quarter of subjects reported persistence of altered bowel habit six months after an episode of infective gastroenteritis. Increasing duration of

diarrhoea, younger age, and female sex increased this risk, whereas vomiting as part of the illness reduced the risk. One in 14 developed the irritable bowel syndrome with an increased risk seen in women (relative risk 3.4; 95% confidence interval 1.2 to 9.8) and with duration of diarrhoea (6.5; 1.3 to 34 for 15-21 days).

Conclusions: Persistence of bowel symptoms commonly occurs after bacterial gastroenteritis and is responsible for considerable morbidity and health care costs.

Introduction

As social patterns of eating change episodes of food poisoning continue to rise, with campylobacter accounting for 40 750 and salmonella for 30 800 laboratory confirmed cases each year in the United

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Bowel questionnaire

- 1 Do you suffer from abdominal pain?
- 2 Do you pass loose or watery stools (motions)?
- 3 Does your bowel habit vary from day to day?
- 4 Do you have to strain to open your bowels?
- 5 Do you rush to the toilet to open your bowels?
- 6 After opening your bowels do you ever feel the need to go to the toilet again?
- 7 Do you pass slime or mucus when opening your bowels?
- 8 Do you feel bloated or that your abdomen is swollen after eating a meal?
- 9 Do you have to loosen your clothing after eating a meal?

All of the above questions were followed by "If yes, on how many days a week"

Kingdom.¹ Although these episodes are usually brief, self limiting illnesses, the long term effects have rarely been analysed in detail. Functional bowel diseases, particularly the subgroup known as the irritable bowel syndrome, have by contrast been subjected to much study because of their great clinical importance, accounting as they do for up to 40% of outpatient gastroenterological consultations. About a fifth of such patients describe an acute onset of symptoms, often with diarrhoea, vomiting, and fever, which has been taken to indicate an infectious origin. Several series have suggested that this particular group differs from other sufferers in several characteristics, including less psychiatric morbidity and better overall prognosis, most improving over a five year period.^{2,3} A recent study of 38 patients with salmonella enteritis reported that 12 still had bowel dysfunction a year after the acute infection despite documented clearance of the organism.⁴

We examined the prevalence and severity of bowel symptoms in a much larger, unselected group of patients who suffered from infectious gastroenteritis and were notified to Nottingham Health Authority.

Subjects and methods

The notifications records of Nottingham Health Authority were used to identify 544 people who had a laboratory confirmed diagnosis of a bacterial gastrointestinal pathogen notified during the period July 1994 to December 1994 among residents within the authority. The laboratory routinely informs the public health department of all positive isolates from faecal specimens.

A questionnaire was designed and piloted before the survey to assess patients' understanding. It included questions on the episode of food poisoning six months before, their bowel habit a year ago (six months before the food poisoning), and the same questions about their current bowel habit, together with questions about their general health, diet, medical history, allergies, and whether they had sought medical attention after their episode of food poisoning. The questionnaire asked specifically how many days a week they experienced a range of symptoms (see box) and whether they experienced a variable bowel habit. A diagnosis from the questionnaires of the irritable bowel syndrome was made separately by two experienced clinicians with the modified Rome criteria. Interobserver agreement was excellent, and in

Modified Rome criteria for the irritable bowel syndrome

Abdominal pain relieved by defecation or associated with change in frequency or consistency of stool and Irregular pattern of defecation for at least two days a week (three or more of the following):

- Altered stool frequency
- Altered stool form (hard/loose)
- Altered stool passage (straining/urgency/sense of incomplete evacuation)
- Mucus per rectum
- Bloating or feeling of abdominal distension

only two cases was there need for a consensus diagnosis. The first questionnaire was sent to the address given at the time of notification and a reminder sent one month later. A prepaid envelope was enclosed.

Statistics—Data were entered on an Epi-Info database, which was also used for the analysis of 2 × 2 tables. All other statistical analyses were undertaken by using SPSS for Windows, version 6.1. The individual significance of risk factors for predicting self reported change in bowel habit and development of the irritable bowel syndrome by the Rome criteria (excluding those who already had it) was determined by using multiple logistic regression analyses in two separate models.

Results

A total of 386 questionnaires were returned, a further six patients had died and nine envelopes were returned by the post office, making an overall response rate of 72%. Table 1 shows the age, sex, and microbiological diagnosis for the patients in the notifications database and those who returned the questionnaires. People over the age of 30 had a significantly better response rate ($P < 0.001$). No difference was seen by sex or infecting organism.

Although the median duration of diarrhoea was 7 days, this varied widely from 1-90 days with an interquartile range of 5-14 days. Severity of disability also varied widely with 318 (73%) reporting time off work or regular duties such as housework and 168 (39%) reporting more than 7 days' incapacity. At the more severe end of the spectrum, 90 (21%) reported more than 6 kg weight loss while 49 (11%) required admission to hospital. One of these patients died from salmonella

Table 1 Details of subjects questioned about gastroenteritis

Detail	All notified cases	No (%) who returned questionnaire
Sex:		
Men	259	175 (68)
Women	285	211 (74)
Age (years)*:		
18-29	180	107 (59)
30-44	143	106 (74)
45-59	132	98 (74)
≥60	89	75 (84)
Organism:		
Campylobacter	349	251 (72)
Salmonella	166	117 (70)
Shigella	29	18 (62)
Total	544	386 (71)

* $P < 0.001$.

infection, and one patient with colonic perforation required a laparotomy and a period in intensive care.

At six months we found 90 (25%) subjects reported persistently altered bowel habits compared with before the illness. The symptoms listed in table 2 indicate that for most this was a change towards looser stools and more frequent and urgent defecation. There were also features suggesting rectal irritability, such as needing to return to the toilet soon after defecation and having to rush to the toilet. By using the modified Rome criteria⁵ 20 had pre-existing irritable bowel syndrome and 23 developed new irritable bowel syndrome after infection.

The duration of diarrhoea was an important predictor of altered bowel habit (table 3), with a relative risk of 3.5 in those with diarrhoea lasting more than 22 days compared with those with diarrhoea for less than a week. Female sex was also a significant independent risk factor for altered bowel habit with a relative risk of 2.9 (1.6 to 5.1). Older subjects had a lower relative risk for persistent symptoms after we controlled for sex and length of initial episode of diarrhoea. Although all subjects suffered from diarrhoea, the pattern of associated symptoms also seemed significant as those with vomiting had a lower risk of developing persistent symptoms (relative risk 0.5; 0.3 to 0.9).

Twenty subjects seemed to have had the irritable bowel syndrome before the bout of food poisoning, 17 had persistent symptoms while three seemed to have improved at six months. There were no significant differences in changes in bowel habit in these 20 patients compared with the rest of the group.

We then considered the more restricted group of 23 subjects who developed the irritable bowel syndrome as defined by our modified Rome criteria⁵ when we questioned them six months after their infection. Significant risks factors were female sex (relative risk 3.4; 1.2 to 9.8) and duration of diarrhoea (6.5; 1.3 to 34) for those with diarrhoea lasting 15-21 days; the risk was even greater for those whose symptoms lasted more than three weeks (table 4).

There were no differences in change of bowel habit or development of the irritable bowel syndrome by bacterial species.

Discussion

Prevalence of symptoms

This survey clearly shows that bacterial food poisoning is not only a serious cause of acute illness in a community but is also responsible for considerable ongoing disability. Six months after a documented episode of bacterial food poisoning about one quarter reported persistently altered bowel habit, a figure in keeping with the results from a smaller series of patients with salmonella enteritis.⁴ While a few (eight) were pleased to be relieved from lifelong constipation, most described more frequent and inconveniently urgent defecation. In 5% these were sufficiently troublesome to have merited further investigations, including referral to a medical outpatients clinic. It is noteworthy that only a few (7%) met the Rome criteria for new irritable bowel syndrome, while a quarter developed loose, urgent defecation, which we prefer to call "postdysenteric bowel disturbance."

Why some patients develop this syndrome is undoubtedly multifactorial with both host and pathogen factors contributing. Previous studies of campylobacter

Table 2 Mean number of days each week with symptoms six months before and six months after gastroenteritis in people who reported altered bowel habit

Symptom	Mean days/week (median)		P value (Wilcoxon matched pairs)
	Before illness	After illness	
Abdominal pain	0.7 (0)	1.7 (0)	0.0009
Loose or watery stools	0.8 (0)	2.4 (2)	<0.0001
Hard or lumpy stools	1.6 (1)	1.4 (1)	0.9
Straining	1.0 (0)	1.0 (0)	0.5
Rushing to toilet	0.7 (0)	1.8 (1)	<0.0001
Reopening bowels	0.7 (0)	1.9 (1)	<0.0001
Slime or mucus	0.43 (0)	1.1 (0)	0.002
Bloated abdomen	1.3 (0)	2.7 (2)	<0.0001
Loosening clothing	0.8 (0)	1.8 (0)	<0.0001

Table 3 Relative risks for predictors of self reported changes in bowel habits after gastroenteritis

Factor	Altered bowel habit (n = 90)	No alteration (n = 267)	Unadjusted relative risk (95% CI)	Adjusted relative risk (95% CI)
Duration of diarrhoea (days):				
0-7	17	93	1.0	1.0
8-14	35	80	1.97 (1.2 to 3.3)	1.67 (0.9 to 3.3)
15-21	19	25	2.83 (1.6 to 4.9)	2.43 (1.1 to 5.5)
≥22	9	22	1.88 (0.9 to 3.8)	3.45 (1.5 to 8.0)
Sex:				
Men	29	134	1.0	1.0
Women	61	133	1.77 (1.2 to 2.6)	2.86 (1.6 to 5.1)
Vomiting as part of original illness:				
No	66	172	1.0	1.0
Yes	24	93	0.7 (0.5 to 1.0)	0.47 (0.3 to 0.9)
Age (years):				
19-29	31	63	1.0	1.0
30-44	23	72	0.84 (0.6 to 1.3)	1.75 (1.1 to 2.7)
45-59	28	72	0.73 (0.5 to 1.1)	0.51 (0.3 to 0.9)
≥60	8	60	0.46 (0.2 to 0.9)	0.36 (0.1 to 0.9)

Table 4 Relative risks for development of the irritable bowel syndrome in people after gastroenteritis

Factor	Onset of syndrome after illness (n = 23)	No syndrome (n = 324)	Unadjusted relative risk (95% CI)	Adjusted relative risk (95% CI)
Sex:				
Men	6	153	1.0	1.0
Women	17	171	2.54 (1.01 to 5.9)	3.39 (1.2 to 9.8)
Duration of diarrhoea (days):				
0-7	2	104	1.0	1.0
8-14	7	123	2.85 (0.6 to 13.5)	2.94 (0.6 to 15)
15-21	7	44	7.27 (1.6 to 34)	6.46 (1.3 to 34)
≥22	7	38	8.24 (1.89 to 38)	11.37 (2.2 to 58)

enteritis suggest that the clinical type of illness (watery versus bloody diarrhoea) can be predicted from the invasiveness of the bacteria as assessed by *in vitro* testing.⁶ Undoubtedly there are other pathogenic factors such as cytotoxins, which merit further study.

Risk factors and associations

The present survey has, by virtue of large numbers, enabled us to identify by logistic regression several factors that can be used to predict who will develop ongoing symptoms. Host factors are female sex (relative risk 2.9) and advancing years, which seem to provide a modest degree of protection. Factors that may be related to either pathogen or host include prolonged duration of the initial illness (3.5) and vomiting as part of the initial illness, which seems to be protective. When it comes to consider the smaller group meeting

Key messages

- Bacterial gastroenteritis (food poisoning) is an important and common cause of morbidity in the community
- Bowel habit remains altered six months after bacterial gastroenteritis in a quarter of infected people
- About one in 14 of cases develop classic irritable bowel syndrome
- Severity of illness and female sex predict prolonged bowel disturbance

the Rome criteria for the irritable bowel syndrome, only female sex and duration of initial illness remain significant risk factors.

The association of persistent bowel dysfunction with markers of initial severity of illness is perhaps not surprising. The more severe episodes are likely to be associated with deeper penetration of the organism and hence more severe mucosal inflammation and disruption to both epithelium and mucosal nerves,^{7,8} which would be predicted to take longer to subside. Several studies have suggested that there is a subgroup of patients with the irritable bowel syndrome who have persistently increased concentrations of inflammatory cytokines including interleukin 1,⁹ which by inhibiting absorption of sodium and water could contribute to persistent diarrhoea. The slight reduction in risk of persistent bowel dysfunction associated with vomiting may be because organisms that mainly affect the upper gut are less likely to interfere with colonic function. Alternatively, vomiting may reduce the infecting dose and hence be protective.

The strong influence of female sex is less easily explained and cannot be due to women suffering more severe initial illness as these factors were controlled for in the logistic regression analysis. Notification data indicate that young men are more likely to have food poisoning,¹⁰ but in our study young women were much more likely to suffer continuing symptoms. As shown in many other studies young men were less likely to reply to our questionnaire but people with persistent symptoms are more likely to respond. This would probably lead to an underestimate of the observed difference between men and women. Patients who submit faecal specimens may not be typical of all those with bacterial gastroenteritis. They probably include the more severe cases and those admitted to hospital, where faecal culture is routine. Even if our case series is biased it is the most extensive one available, and even if the findings apply only to this group they remain an important cause of morbidity. The age and sex distribution of our patients is similar to a large study of diarrhoea episodes in the community in the United Kingdom,¹¹ and this study did not report differences in any factors on the rates of submitting faecal samples. We can not exclude the possibility that people obsessed with their bowels were more likely to submit a specimen, but they would be included only if they had an infection. The prevalence of the irritable bowel syndrome before infection was 5.4% (3.4% to 8.3%), consistent with other prevalence reports in the United Kingdom.¹²

Previous studies

Other studies have similarly reported that women are more likely to develop the postdysenteric irritable

bowel syndrome, in keeping with the known predominance for the irritable bowel syndrome in women generally.⁴ This group also reported that patients admitted to hospital who developed the irritable bowel syndrome were more anxious, depressed, and scored higher on somatisation and neuroticism, both within a few days of admission and three months later. Although some have argued that this association of psychological features with the irritable bowel syndrome is because such patients are more likely to present themselves to a doctor,¹² it is also possible that such people are more vulnerable to the effect of infectious enteritis¹³ and other as yet unknown insults that lead to the syndrome. Alternatively, they may be more likely to complain given the same level of symptoms. Animal models have shown that mental stress can impair the recovery from inflammatory colitis,¹⁴ and similar studies in rats have also suggested that female sex does increase susceptibility to the acceleration of colonic transit by stress induced by restraint.¹⁵

Most of the subjects in our survey had been treated in the community and only a minority had sought hospital assistance. Our findings are thus independent of the bias towards those exhibiting "illness behaviour"¹² found in surveys based in hospital and suggest that female sex is a risk factor for the irritable bowel syndrome independent of associated illness behaviour.

Only around 5% of diarrhoeal episodes are investigated by stool culture.¹¹ Food poisoning is therefore much commoner than the reported figures suggest,¹ with estimated incidence rates between 1% and 10% a year. Given the high prevalence of altered bowel habit six months after bacterial food poisoning that we have demonstrated, postdysenteric bowel disturbance seems to be an important cause of total population morbidity and is worthy of further study.

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