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Domestic and travel-related foodborne gastrointestinal illness in a population health survey

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SUMMARY

Routine surveillance data underestimate incidence of foodborne gastrointestinal (FGI) illness and provide little information on illness related to travel. We analysed data from the Welsh Health Survey to estimate population incidence, and to examine risk factors for FGI and factors associated with consulting a doctor. Reported frequency of any FGI in the 3 months before interview was 20·0% [95% confidence interval (CI) 19·5–20·4; equivalent to 0·8 episodes per person-year], and for travel-related FGI was 1·6% (95% CI 1·5–1·8). In the final model, sex, age group, marital status, self-reported health, long-term illness, smoking and alcohol consumption were all independent predictors of FGI. People who consulted a doctor were likely to be older, in poorer health, taking regular medication, or to report mental illness. FGI is common but risk factors for illness and consultation differ and impressions of the epidemiology of the disease based on surveillance data are therefore distorted.

INTRODUCTION

Foodborne gastrointestinal illness (FGI) is a major cause of morbidity and economic loss all over the world [1]. In the United States, foodborne disease is estimated to cause 76 million illnesses, 325 000 hospitalizations and 5000 deaths each year [2], and in England around 20% of the population may suffer infectious intestinal disease each year [3]. Estimates of the incidence of FGI are generally based on three main data sources: statutory notifications from doctors, isolates reported by laboratories, and outbreaks reported by public health departments [4]. However, these sources underestimate the extent of illness in the community since many patients do not consult a doctor, faecal specimens are often not obtained, and most cases are sporadic rather than part of an outbreak. Reports may also misrepresent the kind of person affected, for example, by being biased towards patients with severer symptoms.

A significant proportion of FGI occurs following travel abroad [5]. Most estimates of the incidence of travel-related illness rely on surveys of returning travellers or travel clinic attendees [6–9]. This makes it difficult to ascertain the true population burden of infection and may be biased toward certain types of travellers. Symptoms of FGI are mostly self-limiting, but a minority of patients may get severe or prolonged symptoms and require medical attention. Relatively little is known about the characteristics of patients who consult, particularly for travel-related illness. Some studies have gathered information at the holiday destination itself [10] and, whilst this helps identify the aetiology of infection, it cannot provide

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data on consultation rates after travellers return home. We analysed data from a population health survey to estimate the general population incidence of domestic and travel-related FGI, to examine risk factors for illness, and to investigate factors associated with consulting a doctor.

METHODS

Data source

Our study is based on data from the 1998 Welsh Health Survey. This was a general health survey carried out by the National Assembly for Wales on a 2% sample (50 023 people) of the general adult population of Wales [11]. It comprised a self-completed postal questionnaire that covered people's views of the National Health Service, their use of health services in the previous 12 months (visit to dentist, attendance at accident and emergency, outpatient visit, hospital admission), health status (self-reported health, long-term illness, use of prescribed regular medication), illnesses (heart disease, cancer, diabetes, mental or nervous illness), lifestyle (smoking, alcohol consumption, frequency of exercise, fruit and vegetable consumption), personal characteristics (sex, age, marital status, ethnicity, height, weight), and socio-economic circumstances (employment status, social class). Self-reported height and weight were used to calculate a body mass index (BMI) score. At the request of the Communicable Disease Surveillance Centre, it also included a question about FGI and whether this was associated with travel abroad or had resulted in a consultation with a doctor. The questionnaire was piloted on 605 people, and the definitive survey carried out from May to the end of June 1998 on a random sample drawn from electoral registers, stratified for area of residence. Brief interviews were conducted on a sample of 1003 non-responders.

Case definitions

Respondents were classified according to their responses to the following question, 'Have you had stomach upset with diarrhoea in the past 3 months, which you think was due to something you ate?' People who responded 'Yes' were asked whether it was in the United Kingdom or when abroad, and whether they saw a doctor about it. People who responded 'Yes' to the stem question were defined as cases of FGI. Those who replied 'Yes, and it was in this country' were defined as having domestic FGI and those who replied 'Yes, and it was when I was abroad' were defined as having travel-related FGI. There were no additional questions to define the illness or describe its severity, and no laboratory confirmation was sought. No information was available on travel history in people without FGI.

Statistical analysis

Data were analysed using Epi-Info (version 6.04b, Centers for Disease Control and Prevention, Atlanta, GA, USA) and STATA (version 7, Stata Corporation, College Station, TX, USA) software. The characteristics of people with any FGI were first compared with those without FGI using the χ^2 or Fisher's exact test, as appropriate. People with domestic FGI were then compared to those with travel-related FGI, and the characteristics of consulters compared with non-consulters. Finally, multiple logistic regression models were constructed to clarify the associations with FGI of each of three categories (comprising variables listed in parentheses above): personal characteristics including socio-economic circumstances (six variables), health characteristics (seven variables), and lifestyle factors including BMI (five variables). The model for consulting behaviour also included a fourth category of variables on health service use (four variables) that were initially analysed separately but, since all were strongly associated with consulting behaviour, these were subsequently combined as one variable on health service use. The interrelationships between variables within each category were first explored, using the likelihood-ratio test to identify significant interactions between variables, as well as adjusting for the effect of sex and age group. We then fitted a logistic regression model that combined all the independent variables [for which the Wald test P value for the adjusted odds ratio (OR) was $<0{\cdot}05$] from each category. Crude and adjusted ORs with 95% confidence intervals (CI) and P values were calculated for all relevant variables.

RESULTS

Prevalence and risk factors for FGI

There were 29 874 completed questionnaires returned, a response rate of 61·4% (after adjusting for 244 deaths and 1091 who had moved away). Contact was made with 601/1003 (59·9%) non-responders who

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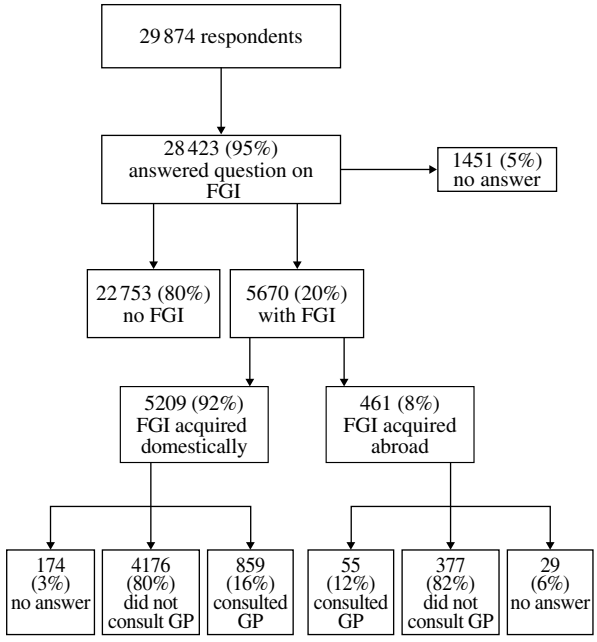

Fig. Flow chart of respondents to the 1998 Welsh Health Survey showing individuals reporting domestic and travel-related foodborne gastrointestinal illness (FGI). GP, General practitioner.

had a lower prevalence of chronic disease than respondents. After excluding 1451 people who did not answer the question on diarrhoea, there were 28 423 responses available for analysis (Fig.). The frequency of FGI in the 3 months before interview was 20·0% (95% CI 19·5–20·4), including 5209 people (18·3%, 95% CI 17·9–18·8) who reported domestic FGI and 461 people (1·6%, 95% CI 1·5–1·8) who reported travel-related FGI. Of those with domestic illness, 859 (16·5%) reported consulting a doctor compared with 55 (11·9%) of those with travel-related illness (OR 0·71, 95% CI 0·53–0·95).

The age group with the highest prevalence of FGI was young adults aged 18–24 years (28·5%) whilst persons aged ⩾65 years had the lowest rate (14·4%) (Table 1). The prevalence was similar among men (21·1%) and women (19·0%) and was highest in married people (24·5%). People reporting their health to be fair or poor (23·9%) had high prevalence compared to those in excellent or very good health (17·5%).

People reporting travel-related FGI had similar age- and sex-specific prevalence. However, prevalence was higher in those who were employed (2·1%) and in those reporting excellent or very good health (2·1%) rather than those reporting fair or poor health (0·9%).

In the multivariate analysis, the association with non-employment (crude OR 1·09, 95% CI 1·03–1·06; adjusted OR 0·97, 95% CI 0·90–1·05) was explained by a combination of age group and self-reported health, and that with poor diet (crude OR 1·50, 95% CI 1·34–1·68; adjusted OR 1·12, 95% CI 1·00–1·26) by age group, health status and smoking. In the final model, sex, age group, marital status, self-reported health, long-term illness, mental or nervous illness, smoking, alcohol consumption and BMI all remained independent predictors of FGI (Table 2).

FGI and consultation behaviour

Consulting rates were higher in older people (⩾45 years), people in employment or lower social class groups (skilled manual, partly skilled, or unskilled). Consulters were between two and three times more likely than non-consulters to have long-term illness, to be taking regular prescribed medication or to suffer from heart disease, cancer, diabetes or mental illness, and more than five times more likely to describe their health as fair or poor. They were also more likely to have visited a dentist, attended an accident and emergency or outpatient department, or been admitted to hospital in the previous 12 months. People who had experienced FGI abroad were no more likely to consult than those with domestically acquired illness. Several variables contributed independently to the final model: older age, poorer health status, taking regular prescribed medication, mental illness, and recent use of health services (Table 3).

DISCUSSION

This study gives an insight into the epidemiology of FGI based on an analysis of data collected by a cross-sectional population survey of health and lifestyle [11]. We found that nearly 1 in 5 adults reported foodborne FGI in the previous 3 months and around 1 in 60 adults reported illness that occurred whilst abroad. This is equivalent to an annual incidence (assuming no seasonal variation) of 798/1000 population (0·8 per person-year), 733/1000 population for domestic and 65/1000 population for travel-related illness. Around 1 in 6 people with domestic illness consulted a doctor compared to 1 in 8 of those that were ill whilst abroad. Our study also shows that prevalence of FGI was higher among young people and also in people reporting poorer health status. In contrast, prevalence of travel-related illness was

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Table 1. *Personal characteristics and health status of people with self-reported FGI, Welsh Health Survey, 1998*

	All respondents ($n=28\,423$)	Any FGI ($n=5670$)		Travel-related FGI ($n=461$)	
		No.	Prevalence (%)	No.	Prevalence (%)
Sex					
Male	12 780	2702	21·1	218	1·7
Female	15 643	2968	19·0	243	1·6
Age group (yr)					
18–24	2713	774	28·5	76	2·8
25–34	4120	1044	25·3	88	2·1
35–44	4688	1064	22·7	92	2·0
45–54	5316	982	18·5	77	1·4
55–64	4462	750	16·8	66	1·5
65–74	3924	565	14·4	38	1·0
⩾75	2616	375	14·3	19	0·7
Ethnic group					
White	27 424	5459	19·9	446	1·6
Other	321	74	23·1	8	2·5
Marital status					
Married/living as couple	4769	3549	24·5	93	2·0
Single	1818	1168	23·5	21	1·2
Divorced/separated	2525	428	16·4	22	0·9
Widowed	18 750	414	18·9	320	1·7
Employment status					
Employed	14 254	2601	18·2	300	2·1
Not employed	13 527	2936	21·7	156	1·2
Self-reported health					
Excellent	3899	588	15·1	92	2·4
Very good	9496	1755	18·5	184	1·9
Good	8200	1710	20·9	124	1·5
Fair	4966	1126	22·7	50	1·0
Poor	1697	469	27·6	8	0·5

FGI, Foodborne gastrointestinal illness.

highest in people who rated their health as excellent or very good.

Most of the limitations of our study are inherent in the design of the original Welsh Health Survey. First, there is sampling frame. The survey only sampled adults, however, young children are generally thought to have higher rates of FGI than adults [12]. Second, there is the timing of the survey which was carried out in May and June. The peak season for travellers' diarrhoea in the United Kingdom is late summer and early autumn, although campylobacter infection rates peak in May and June. The survey, therefore, probably underestimates rates of FGI generally and travel-related illness in particular. However, it is also possible that the winter viral peak may balance out the summer bacterial peak [12]. Third, there is likely to be some non-response bias. The response rate was reasonable for a postal questionnaire survey, but the analysis of non-respondents indicated that they were generally healthier than respondents, a recognized feature of postal surveys [13]. Since good health is associated with travel-related illness, this may result in an underestimate of its true prevalence. A fourth potential problem is recall bias. Respondents may have telescoped the timing of the acute episode of FGI into the 3-month period asked about in the questionnaire and so exaggerated the true rate [3, 14, 15]. Finally, there is the reliability of the case definition. Studies that try to estimate the incidence of FGI often encounter difficulties in relation to case definition, and public perceptions of diarrhoea [16]. The question used in the Welsh Health Survey was very subjective in that it asked people only to report symptoms that they thought were 'due to something you ate'. In practice, people seldom actually know the cause of their gastrointestinal (GI) illness, although

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Table 2. *Multiple logistic regression analysis showing independently associated risk variables for people who reported FGI, Welsh Health Survey, 1998*

Characteristic	Any FGI (%) ($n=5670$)		No FGI (%) ($n=22\,753$)		Adjusted OR* (95% CI)
Sex					
Male	2702	(47·7)	10 078	(44·3)	1
Female	2968	(52·3)	12 675	(55·7)	0·88 (0·82–0·94)
Age group (yr)					
18–24	774	(13·9)	1939	(8·7)	1
25–34	1044	(18·8)	3076	(13·8)	0·79 (0·69–0·90)
35–44	1064	(19·2)	3624	(16·3)	0·63 (0·54–0·72)
45–54	982	(17·7)	4334	(19·4)	0·42 (0·36–0·49)
55–64	750	(13·5)	3712	(16·7)	0·34 (0·29–0·40)
65–74	565	(10·2)	3359	(15·1)	0·26 (0·21–0·31)
⩾75	375	(6·8)	2241	(10·1)	0·26 (0·21–0·33)
Marital status					
Married/living as couple	3549	(63·8)	15 201	(68·2)	1
Single	1168	(21·0)	3601	(16·1)	1·25 (1·06–1·49)
Divorced/separated	428	(7·7)	1390	(6·2)	1·16 (1·01–1·32)
Widowed	414	(7·4)	2111	(9·5)	0·95 (0·85–1·06)
Self-reported health					
Excellent	588	(10·4)	3311	(14·6)	1
Very good	1755	(31·0)	7741	(34·2)	1·35 (1·21–1·52)
Good	1710	(30·3)	6490	(28·7)	1·62 (1·44–1·83)
Fair	1126	(19·9)	3840	(17·0)	1·84 (1·58–2·14)
Poor	469	(8·3)	1228	(5·4)	2·36 (1·932·90)
Long-term illness					
No	3396	(61·5)	14 504	(65·7)	1
Yes	2122	(38·5)	7578	(34·3)	1·26 (1·15–1·39)
Mental or nervous illness					
No	4432	(80·7)	19 328	(87·6)	1
Yes	1061	(19·3)	2742	(12·4)	1·36 (1·23–1·51)
Smoking					
Non-smoker	1703	(31·1)	7952	(36·2)	1
Ex-smoker	1699	(31·0)	7094	(32·3)	1·10 (1·01–1·20)
Current smoker	2080	(37·9)	6908	(31·5)	1·19 (1·09–1·30)
Alcohol†					
Non-drinker	481	(19·9)	2343	(23·5)	1
Moderate drinker	1593	(65·9)	6664	(67·0)	1·21 (1·09–1·34)
Heavy drinker	342	(14·1)	945	(9·5)	1·49 (1·31–1·69)
BMI score					
<20	262	(4·9)	1024	(4·8)	1
20–24	2037	(38·1)	8532	(39·9)	1·04 (0·88–1·24)
25–29	2037	(38·1)	8473	(39·7)	1·13(0·95–1·34)
30–34	717	(13·4)	2549	(11·9)	1·25 (1·03–1·51)
⩾35	288	(5·4)	791	(3·7)	1·43 (1·13–1·80)

FGI, Foodborne gastrointestinal illness; OR, odds ratio; CI, confidence interval; BMI, body mass index.

* Adjusted for all other variables in the table.

† For women, moderate is 1–14 units per week, heavy is >14 units per week; for men moderate is 1–21 units per week, heavy is >21 units per week.

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Table 3. *Multiple logistic regression analysis showing independently associated risk variables for people with FGI who consulted or did not consult a doctor, Welsh Health Survey, 1998*

Characteristic	Consulter (%) ($n=914$)		Non-consulter (%) ($n=4553$)		Adjusted OR* (95% CI)
Sex					
Male	412	(45·1)	2189	(48·1)	1
Female	502	(54·9)	825	(51·9)	1·00 (0·85–1·18)
Age group (yr)					
18–24	83	(9·3)	673	(15·1)	1
25–34	132	(14·8)	891	(20·0)	1·16 (0·85–1·57)
35–44	90	(10·1)	941	(21·1)	0·65 (0·47–0·91)
45–54	151	(17·0)	797	(17·8)	1·03 (0·75–1·40)
55–64	147	(16·5)	569	(12·7)	1·28 (0·93–1·77)
65–74	151	(17·0)	381	(8·5)	1·86 (1·33–2·60)
⩾75	136	(15·3)	214	(4·8)	2·65 (1·86–3·80)
Self-reported health					
Excellent	44	(4·8)	521	(11·5)	1
Very good	166	(18·2)	1534	(33·8)	1·09 (0·76–1·58)
Good	240	(26·4)	1423	(31·4)	1·40 (0·98–2·02)
Fair	287	(31·5)	786	(17·3)	2·03 (1·38–2·99)
Poor	173	(19·0)	273	(6·0)	2·98 (1·95–4·55)
Regular prescribed medication					
No	259	(28·9)	2567	(57·5)	1
Yes	636	(71·1)	1897	(42·5)	1·69 (1·39–2·06)
Mental or nervous illness					
No	590	(68·3)	3701	(83·4)	1
Yes	274	(31·7)	737	(16·6)	1·57 (1·30–1·89)
Most recent health service use					
>12 months	139	(15·2)	931	(20·4)	1
⩽12 months	775	(84·8)	3622	(79·6)	1·70 (1·37–2·13)
Travel history					
FGI in UK	859	(94·0)	4176	(91·7)	1
FGI whilst abroad	55	(6·0)	377	(8·3)	1·05 (0·76–1·44)

FGI, Foodborne gastrointestinal illness; OR, odds ratio; CI, confidence interval.
* Adjusted for all other variables in the table.

they often ascribe it to food. For this reason it is likely that our case definition incorporates general GI illness and not just FGI. Furthermore, the question did not qualify what was meant by diarrhoea and may, therefore, have captured mild episodes of illness.

If we take our estimate to represent the population incidence of general GI illness, then it is broadly similar to previous estimates. It is almost identical to that from a retrospective general practice-based study in Wales in 1992 (7% per month, 0·8 per person-year) [17] and a British community survey of adults by face-to-face interview in 1992 (8% per month, 0·9 per person-year) [18], both carried out in autumn and winter. It is slightly higher than that found in a telephone survey in Ireland in 2001 (0·6 per person-year) [19] and a telephone survey conducted in FoodNet sites in the United States (0·7 per person-year) [12], but considerably lower than rates from a postal survey in Norway (1·2 per person-year; 1·1 per person-year for adults only) [20]. All these studies included children and were conducted over 12 months. Prospective surveys of GI illness in the community, particularly the Study of Infectious Intestinal Disease in England, suggest that true rates of GI illness in the community are somewhat lower [3]. In this study, data were collected prospectively by post cards sent weekly to a population cohort, and GI illness incidence was estimated to be 0·19 per person-year, compared to an incidence of 0·55 per person-year in a retrospective component of the same study. A prospective study in

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The Netherlands also found a lower GI illness incidence of 0·28 per person-year [21].

Interpreting our findings also poses some difficulties in relation to travel-related illness. The survey only collected information about travel history from people who reported FGI, so it is not possible to calculate attack rates or relative risks associated with travel. There was no information on destination of travel in the Welsh Health Survey, but our findings of associations with younger, healthier people are consistent with previous studies of travellers' diarrhoea that generally show highest illness rates in young people, during the summer season, and in travellers to developing countries [5–7].

Consulting rates for FGI (17%, 0·14 per person-year) in our study are similar to those reported from Norway (19%) [20], and The Netherlands (20%) [22]. However, recall bias may exaggerate reporting of consultation. In prospective studies in England [3] and The Netherlands [23], consultation rates were 5·5% (0·03 per person-year; 1 in 18) and 5% respectively. In the English study, illness severity, recent foreign travel, and lower socio-economic status all affected the likelihood of a person with GI illness consulting their GP [24]. Similarly, in the Dutch study patients who consulted a GP had severer symptoms than non-consulters [23]. The Welsh Health Survey did not ask about symptom severity, however, our analysis does indicate some interesting associations with consultation behaviour including a strong relationship with increasing age. There was also a relationship with poor health, taking regular medication and recent use of health services indicating that some of these cases may have a non-infectious aetiology or are more vulnerable to severe infection. Illness associated with a history of travel abroad was not an independent risk factor for consulting a doctor.

This study provides estimates of the population incidence of both domestic and travel-related FGI. Such data are important because routine surveillance underestimates the true incidence of disease [3], and there is no established surveillance for travel-related GI illness. The results are in keeping with estimates from other community-based studies [3, 12, 17–21], suggesting that most adults experience at least one episode of FGI each year, and that there may be as many as 3 million cases of travel-related illness and 375000 consultations annually in the United Kingdom. This means that surveillance data not only underestimate incidence of GI illness, but may also give a biased and distorted impression of the epidemiology of the disease because of variable consulting behaviour [24]. Studies of the aetiology, epidemiology and burden of GI illness need to take this into account.

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DECLARATION OF INTEREST

None.

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