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Irritable Bowel Syndrome and Chronic Fatigue 6 Years After *Giardia* Infection: A Controlled Prospective Cohort Study

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Background. Functional gastrointestinal disorders and fatigue may follow acute infections. This study aimed to estimate the persistence, prevalence, and risk of irritable bowel syndrome and chronic fatigue 6 years after *Giardia* infection.

Methods. We performed a controlled prospective study of a cohort of 1252 individuals who had laboratory-confirmed *Giardia* infection during a waterborne outbreak in 2004. In total, 748 cohort cases (exposed) and 878 matched controls responded to a postal questionnaire 6 years later (in 2010). Responses were compared to data from the same cohort 3 years before (in 2007).

Results. The prevalences of irritable bowel syndrome (39.4%) by Rome III criteria and chronic fatigue (30.8%) in the exposed group 6 years after giardiasis were significantly elevated compared with controls, with adjusted relative risks (RRs) of 3.4 (95% confidence interval [CI], 2.9–3.9) and 2.9 (95% CI, 2.3–3.4), respectively. In the exposed group, the prevalence of irritable bowel syndrome decreased by 6.7% (RR, 0.85 [95% CI, .77–.93]), whereas the prevalence of chronic fatigue decreased by 15.3% from 3 to 6 years after *Giardia* infection (RR, 0.69 [95% CI, .62–.77]). *Giardia* exposure was a significant risk factor for persistence of both conditions, and increasing age was a risk factor for persisting chronic fatigue.

Conclusions. *Giardia* infection in a nonendemic setting is associated with an increased risk for irritable bowel syndrome and chronic fatigue 6 years later. The prevalences of both conditions decrease over time, indicating that this intestinal protozoan parasite may elicit very long-term, but slowly self-limiting, complications.

Keywords. *Giardia*; irritable bowel syndrome; chronic fatigue; postinfectious.

Fatigue and gastrointestinal symptoms are common manifestations of several infections and other diseases [1, 2], In some cases, these symptoms may persist after the infection has resolved [3–5]. Irritable bowel syndrome (IBS) is characterized by prolonged abdominal pain or discomfort combined with diarrhea and/or constipation of variable intensity, and may occur after gastroenteritis, including travelers' diarrhea [3, 4]. Between 6% and 17% of IBS cases have been reported to be preceded by gastroenteritis [6]. Some longitudinal follow-up studies have been performed and support gradual recovery of abdominal complaints after infectious gastroenteritis. However, after 6 years of follow-up, postinfectious IBS (PI-IBS) may persist in >50% of cases [7, 8]. Similarly, fatigue has also been reported to persist after acute infection, but long-term studies are scarce [5, 9–11]. Long-term follow-up data of chronic fatigue (CF) following enteric infections and its association with PI-IBS has not been reported.

The ubiquitous protozoan intestinal parasite *Giardia lamblia* is a frequent cause of waterborne gastroenteritis

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outbreaks in many countries, and it is commonly seen in returning travelers with diarrheal disease [12]. During a waterborne outbreak of *G. lamblia* gastroenteritis in Bergen, Norway, in autumn 2004, approximately 2500 individuals were treated for giardiasis [13]. Patients with persistent, metronidazole-refractory giardiasis were successfully treated during the initial follow-up [14]. Since the outbreak, all individuals with laboratory-confirmed giardiasis during the outbreak (n = 1252) have been followed up, with special attention to prolonged postinfectious abdominal symptoms and fatigue [15–19]. The main objective was to evaluate the prevalences and relative risks of IBS and CF 6 years after *Giardia* infection; secondary objectives were to evaluate changes in prevalence from 3 to 6 years after infection and to evaluate risk factors for persistence of these conditions.

METHODS

Participants

This study presents data from a prospective follow-up in 2010 of a cohort of 1252 individuals 6 years after verified *Giardia* infection during a waterborne outbreak (exposed group). A randomly sampled 2:1 age- and sex-matched control group of 2504 individuals was established with the aid of Statistics Norway during 2007, and made it possible to compare developments over time in both groups. Table 1 shows details of the exposed and control groups approached in October 2007 and October 2010. The study was approved by the Regional Committee for Ethics in Medical Research (2010/721).

Table 1. Description of the Cohorts Available for Analyses of Irritable Bowel Syndrome and Chronic Fatigue 3 and 6 Years After the 2004 *Giardia* Outbreak in Norway

Cohort	Exposed[a]	Controls[b]	Total No.
Target population 2007 [19]	1252 (100.0)	2504 (100.0)	3756
Study population 2007	817 (65.3)	859 (34.3)	1676
Lost to follow-up[c]	13 (1.0)	60 (2.4)	73
Target population 2010	1239 (100.0)	2444 (100.0)	3683
Questionnaires returned 2010	748 (60.4)	888 (36.3)	1638
Giardia during outbreak		7 (0.3)	
Incomplete/ambiguous response		3 (0.1)	
Study population in 2010	748 (60.4)	878 (35.9)	1626
Responded in 2007 and in 2010	601 (48.5)	559 (22.9)	1160

Data are presented as No. (%).

[a] *Giardia* exposed.

[b] Age- and sex-matched individuals from the general population in Bergen, Norway.

[c] Emigrated or died between 2007 and 2010, or address not found in 2010.

Variables

The primary outcome of this study was the presence of CF and IBS 6 years after giardiasis in the *Giardia*-exposed and control groups. Secondary outcomes were the changes in the prevalence of CF and IBS and mean fatigue scores [20] in the exposed group and the control group between 3 and 6 years after *Giardia* infection, where those who had a condition at both time-points were defined as having a persistent condition. We also evaluated factors potentially influencing persistence of CF and IBS from 2007 to 2010.

IBS was defined using the Rome III criteria [21]. IBS limiting or restricting daily activities at least "often" was termed "severe IBS."

Fatigue was measured using the validated 11-item Fatigue Questionnaire [20]. To each of the 11 questions, there are 4 possible answers ("less than normal," "as normal," "more than normal," "much more than normal"). These are scored (0, 1, 2, 3) and added, giving a score range from 0 to 33. Responses are also dichotomized (0 and 1 into 0, 2 and 3 into 1), and a total dichotomized score of ≥4 defined CF, if symptoms lasted >6 months.

The combination of CF and a total fatigue score of ≥23 was defined as severe fatigue. The Fatigue Questionnaire was accepted if ≥8 of the 11 questions were answered. Unanswered questions were assigned the same value as the mean of all responses to that particular question. To describe the substantial overlap of IBS and CF, we also analyzed prevalences of having only 1 of the conditions or a combination of both.

Questions on the demographic variables sex, age (categorized in 20-year groups), marital status, education level (3 categories), and main occupation (4 categories) were also included in the questionnaire. These variables were considered potential confounders. Sex was also considered a potential effect modifier.

Analyses and Statistical Methods

Descriptive statistics are given as percentage, mean, and standard deviation (SD). Nonresponders were only included in nonresponder analyses and compared with responders. Participants with missing data were excluded from analyses pertaining to that specific variable. For associations in $2 \times k$ tables, we used Pearson exact χ^2 test. Continuous variable means were compared between groups using Gosset paired and unpaired *t* test [22].

Prevalences at 6 years are compared using relative risks (RRs) with 95% confidence intervals (CIs). IBS and CF were analyzed separately with respect to the risk factors and possible interactions using multiple logistic regression, producing adjusted odds ratios (ORs) with 95% CIs. In this model, backward stepwise selection was applied removing variables with a *P* value >.05; thus, variables that did not influence the results were excluded. Also, it was checked that removing a variable did not change the estimated effects of the remaining variables in a

Table 2. Characteristics of Individuals Responding to a Questionnaire 6 Years After Acute Giardiasis, and of Those Responding to Questionnaires at Both 3 and 6 Years After the 2004 *Giardia* Outbreak in Norway

	All Responders in 2010 (n = 1626)			Responders in 2007 and 2010 (n = 1160)		
Characteristics	Exposed, No. (%)	Controls, No. (%)	*P* Value[a]	Exposed, No. (%)	Controls, No. (%)	*P* Value[a]
Female sex	502 (67.1)	578 (65.8)	.599	410 (68.2)	380 (68.0)	.950
Age, y						
Mean (range)	38.1 (7–97)	38.9 (6–85)	.283	39.2 (8–97)	40.0 (7–83)	.313
0–19	29 (3.9)	37 (4.2)	.288	18 (3.0)	12 (2.1)	.187
20–39	451 (60.3)	516 (58.8)		347 (57.7)	325 (58.1)	
40–59	207 (27.7)	238 (27.1)		180 (30.0)	164 (29.3)	
60–79	48 (6.4)	78 (8.9)		44 (7.3)	54 (9.7)	
80–99	13 (1.7)	9 (1.0)		12 (2.0)	4 (0.7)	
Marital status						
Single	202 (27.3)	184 (21.1)	.017	157 (26.3)	98 (17.7)	.002
Married	499 (67.5)	631 (72.3)		405 (67.7)	428 (77.3)	
Divorced	28 (3.8)	47 (5.4)		27 (4.5)	23 (4.2)	
Widowed	10 (1.4)	11 (1.3)		9 (1.5)	5 (0.9)	
Education						
Primary school	35 (4.7)	72 (8.3)	<.001	29 (4.9)	32 (5.8)	.056
Secondary school	136 (18.4)	225 (26.0)		112 (18.8)	133 (24.1)	
University	567 (76.8)	567 (65.6)		455 (76.3)	387 (70.1)	
Main occupation						
Worker	561 (76.2)	688 (78.8)	.121	450 (75.5)	458 (82.2)	.005
Student	63 (8.6)	78 (8.9)		50 (8.4)	37 (6.6)	
Unemployed/retired	89 (12.1)	94 (10.8)		78 (13.3)	58 (10.4)	
Other	23 (3.1)	13 (1.5)		18 (3.0)	4 (0.7)	

[a] *P* values derived from the exact χ^2 test from 2 × k table for categorical data, and from *t* test for independent samples for the mean age.

substantial way. Because ORs and RRs correspond poorly when outcome prevalence is high, we converted adjusted ORs from logistic regression analyses to RRs and corresponding CIs by the method of Zhang and Yu [23]. The ratio of RRs was calculated using the formula of Altman and Bland [24], using the RR from 3 to 6 years in the exposed group as a reference.

The attributable fraction among the exposed (AFE)—that is, the proportion of the outcome conditions in the exposed group that can be attributed to the *Giardia* infection—was calculated as a percentage given by the formula AFE% = (1–1/RR) × 100 [25].

A binary logistic regression analysis using generalized estimating equations (GEEs) was used to evaluate changes in IBS and CF prevalence from 3 to 6 years, making it possible to include data from all respondents at both time-points and accounting for correlation between repeated measures and the matched design.

Comparisons of new and recovered cases from 2007 to 2010 were done using McNemar test for symmetry. Evaluation of risk factors for persistence of CF or IBS from 2007 to 2010 was done among individuals who had responded at both time points using multiple logistic regression analysis with respect to age, sex, and exposure.

The level of statistical significance was set at .05, and all tests were 2-sided. All analyses were done using IBM SPSS Statistics version 19.

RESULTS

In total, 748 (60.4%) exposed individuals and 878 (35.9%) controls responded to the 6-year questionnaire (Table 1). More nonresponders to the 6-year questionnaire were male (43.1%) compared with responders (33.7%; $P < .001$) and they were younger (mean age, 36.9 years) than responders (mean age, 38.2 years; $P < .001$). Table 2 shows the characteristics of responders in the exposed and control groups.

Six years after the outbreak, the prevalence of CF was 30.8% (226/733) in the exposed group and 11.0% (96/874) in controls, giving an adjusted RR of 2.9 after *Giardia* exposure. The fraction of CF (AFE) attributable to previous giardiasis was 65% (95% CI, 57.3%–70.8%) in the exposed group.

The prevalence of IBS was 39.4% (291/739) in the exposed group and 11.6% (101/870) in controls. This gave an adjusted RR of 3.4 in the *Giardia*-exposed group (Table 3). For IBS,

Table 3. Prevalence of Irritable Bowel Syndrome and Chronic Fatigue 6 Years After the 2004 *Giardia* Outbreak in Norway

Condition	All No.	Exposed, No. (%)	Controls, No. (%)	Unadjusted RR (95% CI)	Adjusted[a] RR (95% CI)
IBS	1609	291 (39.4)	101 (11.6)	3.4 (2.8–4.2)	3.4 (2.9–3.9)
Severe IBS	1595	53 (7.2)	18 (2.1)	3.5 (2.0–5.9)	3.1 (1.9–5.1)
CF	1607	226 (30.8)	96 (11.0)	2.8 (2.3–3.5)	2.9 (2.3–3.4)
Severe CF	1607	66 (9.0)	23 (2.6)	3.4 (2.1–5.4)	3.1 (1.9–4.8)
Both IBS and CF	1586	135 (18.6)	29 (3.3)	5.6 (3.8–8.2)	5.5 (3.8–7.7)
Only IBS	1586	150 (20.7)	71 (8.2)	2.5 (1.9–3.3)	2.5 (2.0–3.2)
Only CF	1586	87 (12.0)	64 (7.4)	1.6 (1.2–2.2)	1.7 (1.2–2.3)

Abbreviations: CF, chronic fatigue; CI, confidence interval; IBS, irritable bowel syndrome; RR, relative risk.

[a] Adjusted for sex, age, level of education, marital status, and main occupation.

the AFE due to giardiasis was 70.5% (95% CI, 65.1%–74.6%). Relative risks for the subgroups of severe IBS and severe CF were also elevated in the exposed group (Table 3).

The mean total fatigue score was 14.8 (SD, 5.5) in the exposed group and 12.2 (SD, 4.2) in controls ($P < .001$). The mean total fatigue scores in 2007 and in 2010 showed a reduction from 16.0 to 14.8 in the exposed group ($P < .001$) and no change in the control group, from 12.0 to 11.9 ($P = .731$).

In both groups, CF and IBS were associated with each other. In the exposed group, 47.4% of those with IBS also had CF, whereas 19.8% of those without IBS had CF ($P < .001$). A similar pattern was seen in the controls, with corresponding figures of 29.0% and 8.4% ($P < .001$).

Female sex was found to be a risk factor for IBS in the control group (females, 13.8% and males, 7.4%; $P = .007$), but not in the *Giardia*-exposed cohort (females, 41.0% and males, 36.1%; $P = .228$). There was no significant sex difference in CF prevalence in the 2 groups; CF in exposed females was 31.6%, and in males 29.3% ($P = .55$), whereas it was 11.8% in female controls and 9.4% in male controls ($P = .31$).

We found a significant decrease in prevalence of both IBS (46.1%–39.4%) and CF (46.1%–30.8%) from 3 to 6 years in the exposed group, but not among the controls (Table 4). When comparing the changes in prevalence between the exposed group and the controls with logistic regression analysis, we found that the decrease in CF and severe CF from 3 to 6 years was significantly different between the 2 groups, whereas the change in IBS was not (Table 4).

Some of the participants fulfilled criteria for a condition in 2007 but not in 2010, indicating that they had "recovered." Likewise, there were also "incident" cases of both conditions that fulfilled the criteria in 2010 but not in 2007.

In the exposed group, recovery from IBS was significantly more common with 96 individuals (16.9%) no longer fulfilling the criteria, whereas there were 53 (9.3%) incident cases ($P = .001$). In the control group, 39 (7.1%) had recovered, whereas 31 (5.7%) individuals had incident IBS ($P = .403$).

In the exposed group, 105 (18.3%) individuals had recovered from CF, whereas 32 (5.6%) cases were incident ($P < .001$). In controls, 42 (7.6%) individuals had recovered from CF and there were 31 (5.6%) "incident" cases ($P = .24$).

Table 4. Changes in Prevalences of Irritable Bowel Syndrome and Chronic Fatigue Including Subgroups and Combinations of These Conditions at 3 Years and 6 Years After the 2004 *Giardia* Outbreak in Norway

	Giardia Exposed				Controls				Between Groups Ratio of RR[c] (95% CI)
Condition	3 y[a] No. (%)	6 y No. (%)	% Change	RR[b] (95% CI)	3 y[a] No. (%)	6 y No. (%)	% Change	RR[b] (95% CI)	
IBS	355 (46.1)	291 (39.4)	−6.7	0.85 (.77–.93)	155 (14.0)	101 (11.6)	−2.4	0.84 (.69–1.11)	1.01 (.78–1.32)
Severe IBS	106 (13.8)	53 (7.2)	−6.6	0.52 (.40–.60)	30 (2.7)	18 (2.1)	−0.6	0.77 (.44–1.34)	0.68 (.37–1.23)
CF	366 (46.1)	226 (30.8)	−15.3	0.69 (.62–.77)	134 (12.0)	96 (11.0)	−1.0	0.91 (.72–1.13)	0.76 (.59–.98)
Severe CF	120 (15.1)	66 (9.0)	−6.1	0.60 (.47–.75)	24 (2.1)	23 (2.6)	0.5	1.21 (.73–1.99)	0.49 (.28–.86)
Both IBS and CF	216 (28.6)	135 (18.6)	−10.0	0.66 (.57–.77)	49 (4.5)	29 (3.3)	−0.8	0.75 (.48–1.15)	0.88 (.56–1.41)
Only IBS	129 (17.1)	150 (20.7)	3.7	1.19 (.98–1.42)	104 (9.5)	71 (8.2)	−1.0	0.89 (.68–1.15)	1.34 (.97–1.86)
Only CF	125 (16.6)	87 (12.0)	−4.7	0.73 (.58–.92)	85 (7.7)	64 (7.4)	−0.3	0.95 (.72–1.26)	0.77 (.54–1.10)

Abbreviations: CF, chronic fatigue; CI, confidence interval; IBS, irritable bowel syndrome; RR, relative risk.

[a] Data taken from Wensaas et al [19].

[b] RR with 95% CI for having the condition 6 years after *Giardia* infection compared to 3 years after. The RR was calculated from the odds ratio (OR) derived from binary logistic regression analysis using generalized estimating equations (GEEs) for IBS and chronic fatigue with only time as factors, and separately for exposed and controls.

[c] Evaluation of the statistical significance of the difference between changes in exposed and controls by testing model effects in GEE for interaction between exposure and time. The OR returned in this model was used to calculate the RR using the method of Zhang and Yu [23], and the ratio of RR was calculated by the method of Altman and Bland [24].

Prevalences of persisting IBS and CF were estimated among the individuals who fulfilled the criteria for IBS or CF in 2007, and who also responded in 2010 (Supplementary Table 1). Among 251 exposed individuals with CF in 2007, 146 (58.2%) still had CF in 2010, whereas the corresponding figures in controls were 16 of 58 (27.6%). In a logistic regression model including sex, age, and *Giardia* exposure, we found that *Giardia* exposure was significantly associated with persisting CF (RR, 2.13 [95% CI, 1.55–2.64]). Increasing age was associated with increased risk for CF, with an RR of 1.43 (95% CI, 1.14–1.69) in those 40–59 years of age, and an RR of 1.57 (95% CI, 1.12–1.91) in those 60–97 years of age, compared with the younger (20–39 years) age group.

Among the 262 exposed individuals with IBS in 2007, 164 (63.1%) still reported IBS in 2010. Among the 64 controls with IBS in 2007, 25 (39.1%) reported IBS again in 2010. *Giardia* exposure was significantly associated with persisting IBS in 2010 (RR, 1.64 [95% CI, 1.29–1.95]), whereas age and sex were not.

DISCUSSION

The main finding in this study was that there was a high prevalence of CF (30.8%) and IBS (39.4%) 6 years after laboratory-confirmed giardiasis and that these 2 conditions were strongly associated. We also show that during the period from 3 to 6 years after the infection, the prevalence of both conditions decreased, and that recovery from chronic fatigue (15.3%) was more pronounced than recovery from IBS (6.7%). In the exposed group, both conditions were more persistent over time than in controls. Persisting chronic fatigue was associated with higher age.

The strengths of this study are that it includes a high number of participants, who all had laboratory-confirmed infection with the same pathogen during a short time period, and that questionnaires with identical questions were mailed to the same groups of exposed and control individuals at the same time of the year with a 3-year interval.

We judged that questions regarding preoutbreak fatigue and IBS would be too prone to recall bias in the present study, but from a previous study of 124 patients referred with severe abdominal symptoms 2–18 months after the outbreak, we know that approximately 15% reported preoutbreak IBS-like symptoms [15]. Also, we found it questionable whether it would be correct to exclude persons with preoutbreak fatigue and/or IBS. Treating the whole *Giardia*-exposed cohort as a group has its merits, as the *Giardia* infection may have modulated preexisting fatigue or IBS.

The higher percentage of women among the exposed can partly be explained by women drinking more tap water [13]. There is a possibility that those in the exposed group had a stronger tendency to consult the health services, given that they were selected based on consultation and sampling during the outbreak, compared with the controls that were randomly chosen among the population. This might again influence the way they evaluated their health and how they answered the questionnaire, and to some extent account for the high prevalences of CF and IBS. However, from follow-up data, we know that the response rate of the initially hospital-referred individuals, presumably experiencing more severe symptoms, was similar to that of nonreferred individuals within the exposed group.

Sampling bias is possible, as the response rate differs between the 2 groups. Although the response rate ideally should be higher in the control group, the prevalences of CF and IBS at 3 and 6 years are comparable to previous Norwegian population-based studies [26, 27]. The response rate of 60.4% in the exposed group 6 years after the outbreak is acceptable, but there still could be a bias toward responders having and reporting more symptoms than nonresponders, and this relationship may be different in the control group. However, we do not find it plausible that this could account for the high RR among the exposed group.

Chronic giardiasis may give an IBS-like clinical picture. During the 2 years after the outbreak, patients with persisting symptoms in this cohort were thoroughly investigated in this respect at the hospital or by their general practitioners. All positive cases identified were successfully treated [14], and the carrier status in the exposed general population was very low [28]. Five years after the outbreak, chronic giardiasis was assessed in this cohort by polymerase chain reaction of stool samples from 53 exposed persons with long-term CF and/or IBS and 20 exposed persons without sequelae, and none were found to be positive [29, 30]. We therefore are convinced that the prevalence of chronic giardiasis in the exposed group is very low.

Interpretation

PI-IBS may follow bacterial [7, 31] and parasite-induced gastroenteritis [19, 32, 33], as well as viral disease [34]. Studies after an outbreak of bacterial gastroenteritis in Walkerton, Canada, showed the prevalence of PI-IBS to be 36% by Rome I criteria 2–3 years after infection [35]. Six years after, the prevalence had decreased to 22% [7]. Our data show a somewhat higher prevalence at both 3 and 6 years even when correcting for the background IBS prevalence present in our data. The difference in PI-IBS prevalence may be influenced by different IBS criteria used (Rome I vs Rome III), selection bias in the examined populations, or real differences due to the eliciting pathogens or host responses.

Following an outbreak of Q fever in the United Kingdom in 1989, controlled studies showed a high and significantly elevated level of fatigue both 5 and 10 years after the outbreak [36]. No long term follow-up studies of CF elicited by gastroenteritis have so far been performed. In the present study, the prevalence of both CF and IBS in the exposed group decreased from 3 to 6 years postexposure. The decrease in prevalence of CF was also statistically significant when compared with the change in the

control group, whereas the corresponding decrease in IBS prevalence did not reach statistical significance (Table 4). PI-IBS thus seems to be more protracted than PI-CF after *Giardia* infection.

A large part of the *Giardia*-exposed individuals who reported IBS and/or CF in 2007 had persisting complaints also in 2010. This must be seen in conjunction with the large turnover found in both examined conditions over the 3-year period, especially in the control group. *Giardia*-exposed individuals were more likely to have had this complication for 3 years already in the 2007 questionnaire study and therefore to have a more established condition than controls. So whereas *Giardia* exposure is associated with persistence of IBS and CF, the risk may be overestimated due to initial differences in the exposed and control groups. Still, we conclude that the individuals with *Giardia*-associated IBS and/or CF reported a more persisting phenotype than controls.

The mechanisms by which a ubiquitous noninvasive intestinal parasite such as *G. lamblia* may elicit both CF and IBS remain elusive, but are probably multifactorial. Fatigue syndromes and IBS in general share some predisposing risk markers such as frequent physician consultations, sickness certificates, atopy, mood, and other symptom-based disorders [10]. Most of these predisposing factors are difficult to assess retrospectively. Atopy was assessed in a previous study in this cohort, and was found not to be associated with IBS in the *Giardia*-exposed group [37]. Genetic vulnerability with polymorphisms in genes related to epithelial cell barrier function and the innate immune response could be at play, and have been found in individuals with IBS after the Walkerton outbreak [38]. The severity of the eliciting gastroenteritis has been shown to be a risk factor for development of PI-IBS [39] and has also been found in this cohort [40]. Protracted *Giardia* infection and associated duodenal inflammation described by us previously [15] indicate a strong immune activation in a large proportion of the affected population that may precipitate long-term sequelae.

Our data are based on a waterborne *Giardia* outbreak, causing gastroenteritis in a large population of individuals presumed not to have been exposed to this parasite previously. This unfortunate event made it possible to study the natural course of IBS and CF after giardiasis, and shows a significantly increased risk for both IBS and CF even 6 years after the infection.

Based on our findings, *Giardia*-induced IBS and/or CF could be considered a differential diagnosis, especially in returning travelers who present with such symptoms and where infectious microorganisms are not detected.

Supplementary Data

Supplementary materials are available at *Clinical Infectious Diseases* online (http://cid.oxfordjournals.org). Supplementary materials consist of data provided by the author that are published to benefit the reader. The posted materials are not copyedited. The contents of all supplementary data are the sole responsibility of the authors. Questions or messages regarding errors should be addressed to the author.

Notes

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Potential conflicts of interest. All authors: No potential conflicts of interest.

All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

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