Risk Factors for Endemic Giardiasis

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Abstract: In a mail survey, 171 Hitchcock Clinic patients with giardiasis were compared with an age- and sex-matched control group of 684 clinic patients with respect to potential risk factors. Households with shallow well or surface water sources had an odds ratio (OR) for giardiasis of 2.1 (95% confidence interval (95%CI) 1.3-3.2) compared with households with drilled well or municipal water supply. Other observed risks include family member in day care program (OR 2.2, 95%CI 1.3-3.7) and family member with diagnosed giardiasis (OR 17, 95%CI 7.4-37). Previously reported risks such as travel out of country (OR 3.2, 95%CI 1.5-7.2) and camping (OR 1.7, 95%CI 0.9-3.2) were also observed. Virtually no giardiasis risk was observed associated with report of dog or barnyard animal proximity. Control for confounding and adjustment for recall and non-response bias does not materially alter the risk estimates. We suggest that shallow well or surface household water source is an important and previously unrecognized giardiasis risk factor. (*Am J Public Health* 1987; 77:585–587.)

Introduction

Giardiasis is traditionally considered an epidemic disease, often occurring in waterborne community outbreaks.[1-3] Recently, however, increasing numbers of isolated case reports in New Hampshire and Vermont[4,5] suggest multiple sources of endemic infection.

Relatively little has been written about endemic or sporadic giardiasis. Probable risk factors include mountain camping,[6] day care exposure,[7] person to person contact,[8,9] and travel abroad.[10,11] We evaluated these and other potential endemic risk factors such as shallow well household water sources and animal exposure.

Shallow or dug well household water sources were of particular interest to us. Often old and deteriorating, these shallow water sources are frequently open to surface contamination, and are common in northern New England (20 per cent among our controls overall). Several animal species have been implicated as potential giardiasis reservoirs.[12-14] We were interested in the giardia risk conferred by household animal contact and whether such contact interacted with the risk conferred by shallow household water sources.

Methods

We used the Dartmouth-Hitchcock Medical Center laboratory log to identify 190 giardiasis cases seen between January 1, 1977 and June 1, 1984. Nineteen were Dartmouth College students, a highly mobile population, and were not considered in the analysis. The endemic nature of the remaining 171 cases was demonstrated by their failure to cluster by date of diagnosis or zip code; contact with the New Hampshire and Vermont Health Departments confirmed our impression that there had been no epidemic outbreaks of giardiasis in our region during the study period.

Control patients were selected from among the 500,000 Hitchcock Clinic patients in the clinic computer registry (a cumulative data base maintained since 1969). Four age- and sex-matched controls for each case, excluding Dartmouth College students, were randomly drawn from the computer registry. We did not have access to patient medical records, precluding knoweldge of medical diagnosis or vital status.

We mailed a one-page questionnaire to cases and controls asking about place of residence and work, domestic water supply, child day care utilization, animal contacts, foreign travel, household exposure to giardiasis, diarrhea history, and outdoor activities. The questionnaire specified that answers should refer to the year and month of diagnosis for the cases, or the year and month of the case for which a given control was matched. A second mailing was sent to all nonresponders. Finally, we attempted to interview by telephone all the cases and one-third of the controls who did not respond to both mailings (see Table 1).

Standard contingency tables and unconditional logistic regression[15,16] were used to analyze the data. The matching variables (age, sex, year of diagnosis) were included in the logistic models. Recall bias was minimized by also including the year of diagnosis. Response bias was evaluated by weighting the telephone subset to simulate the entire group of non-responding cases and controls in a regression model, and comparing the weighted and unweighted risk estimates. We report exposure frequencies, etiologic fractions,[17] and crude and adjusted odds ratios.[15]

Results

Table 1 summarizes the response patterns for both mailings and the telephone follow-up. The matching criteria are distributed similarly for responding cases and controls (Table 2), while crude exposure rates differ (Table 3).

Table 3 outlines crude and adjusted giardiasis odds ratio (OR) estimates with their 95 per cent confidence intervals (95%CI) and etiologic fractions. Adjustment for matching factors does not materially alter the point estimates. We confirm the influence in our area of previously established risk factors, although the camping risk estimate is imprecise. Shallow well or surface water sources, compared with all other water sources (drilled well or municipal) confers the hypothesized risk for giardiasis (OR 2.1, 95%CI 1.3-3.2).

TABLE 1—Response Rates

	Cases		Controls	
Source	N	%	N	%
Identified	171		684	
1st Mailing	101	59	246	36
2nd Mailing	14	8	75	11
Phone subset	15	9	50	7
TOTAL	130	76	371	54

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TABLE 2—Characteristics of Respondents

Characteristic	Case (130)	Control (371)
Mean Age (years)	31	29
Oldest	76	76
Youngest	2	1
Male	54%	51%
Female	46%	49%
Year of Diagnosis		
1977	14%	14%
1978	8%	10%
1979	9%	14%
1980	13%	12%
1981	15%	15%
1982	15%	15%
1983	21%	16%
1984	5%	4%

"Year of Diagnosis" for Controls refers to that of the matched case.

Compared with municipal water sources, the OR estimate is even larger (OR 2.6, 95%CI 1.6-4.3). Adjustment for matching factors, travel history, age of well, or animal exposure does not substantially change the estimate. Animal exposure is not clearly associated with disease, with the possible exception of cats. Similar results are found when the analysis is limited to households with shallow wells.

Discussion

This case-control study of non-epidemic giardiasis identifies several risk factors of importance in rural northern New England. We confirm the importance of some established risk factors (foreign travel, day care center exposure, and household case contact) and calculate a positive but unstable risk estimate for camping (Table 3). We also find a previously unrecognized giardiasis risk for the household use of shallow water sources, while domestic and barnyard animal contact does not seem to be important.

Shallow wells are a common household water source in northern New England, and their association with giardiasis may be an important public health consideration. Inadequate construction or maintenance may be responsible for surface or septic contamination. Among households with shallow wells, those with pets or livestock did not have an increased giardiasis risk, perhaps reflecting a lack of importance of domestic animal reservoirs.[13,14] We believe our questionnaire did not reliably ascertain exposure to wild animals since the reported prevalence was unexpectedly low for this region. Risk estimates for wild animal proximity are extremely imprecise and are excluded from this report.

The risk associated with household contact may operate through contaminated water, but this may simply represent person to person contact or common exposure to a different risk factor. Large urban day care centers are recognized as an important source of giardiasis[7]; we observed increased risk among those exposed to children attending small rural day care centers. Camping and domestic animal exposure in northern New England appear to be less important giardiasis risk factors than in other parts of the United States.[6,12] The etiologic fraction (14 per cent) for cat exposure incorporates an unstable odds ratio estimate and should be interpreted with caution.

Several potential biases are possible in this retrospective case-control study. Recall bias was evaluated using logistic models that included year of diagnosis as a covariate. This adjustment did not materially affect the risk estimates. The Hitchcock Clinic records from which the controls were selected included patients seen since 1969, although cases occurred only since 1977. To evaluate the potential impact of this difference in time frames, the analysis was repeated using the subset of controls with patient billing activity since 1980 (a list through 1977 was unavailable). This subset analysis generated risk estimates similar to those reported for the entire sample.

Response bias was controlled by weighted logistic regression in which the cases and controls interviewed by telephone were weighted to represent all non-respondents to the mailings. Crude and weighted odds ratios appear in Table 4. The point estimates differ substantially only for "travel abroad" and "household contact", but these are based on small numbers of exposed cases and are therefore unstable. Overall, we do not think nonresponse greatly distorted our findings. Detection bias was possible if physicians tested for giardiasis more commonly among returning travelers or household contacts of known cases. We believe this may have inflated our risk estimates for these exposures.

Information bias may misclassify water source information. We did not ask if municipal water sources were filtered—a water treatment known to reduce water supply giardiasis risk. However, in 1981 fewer than 20 per cent of the community water sources in our region were filtered. Since we do not know the addresses of controls at the time of case diagnosis, we are unable to establish the filtering status of municipal water sources in our data. However, failure to control for this would tend to bias conservatively our estimate of the giardiasis risk associated with shallow wells. Our information regarding onsite water sources is probably ac-

TABLE 3—Risk Measures for Giardiasis

Risk Factor	% Exposure		% Etiologic Fraction	Crude OR		Adjusted OR*	
	Case	Control		OR	95% CI	OR	95% CI
Foreign Travel	11	4	8	3.3	(1.5–7.2)	4.2	(1.8–9.5)
Camping	14	8	5	1.7	(0.9–3.2)	1.6	(0.6–3.1)
Day Care	23	12	12	2.2	(1.3–3.7)	2.2	(1.2–4.0)
Household Case	31	12	29	16.5	(7.4–37)	21.0	(8.8–50)
Shallow Well	34	20	18	2.1	(1.3–3.2)	2.1	(1.3–3.2)
Household Dog	56	57	0	1.0	(0.7–1.5)	0.9	(0.6–1.4)
Household Cat	48	41	14	1.4	(0.9–2.0)	1.3	(0.9–2.0)
Farm Animals	14	12	2	1.2	(0.7–2.2)	1.1	(0.6–2.1)

*Adjusted for matching factors: age, sex, year of diagnosis.

TABLE 4—Impact of Potential Response Bias

Factor	Mailing OR	Weighted OR
Shallow Well	2.2	1.9
Day Care	2.2	2.1
Travel	3.0	5.4
Household Contact	15	27

curate: rural homeowners are aware of household water source, since municipal or drilled water sources can substantially improve the market value of a home.

It is possible that some of our controls may have had giardiasis. Among controls, 3 per cent indicated a past diagnosis of the condition, while 7 per cent reported a prolonged episode of diarrhea. Because we could not verify the giardiasis status of controls, we did not exclude respondents on the basis of self-reported disease. This misclassification would tend to bias observed risks toward the null; we believe this conservative approach justifiable in the absence of systematic disease ascertainment on all controls.

We found no evidence of important confounding by the matching variables (age, sex, and year of diagnosis) using unconditional logistic regression (Table 3). Adjustment for camping and foreign travel did not alter the risk estimates for shallow well household water source. We cannot exclude the possibility of residual confounding by unknown factors. In particular, socioeconomic factors that may influence the type of water source might also influence other giardiasis risks.

In summary, our study confirms the previously reported endemic or sporadic giardiasis risks of foreign travel, day care exposure, and household case contacts. We suggest that shallow well household water sources are an important and previously unreported risk for endemic giardiasis in northern New England. The 18 per cent etiologic fraction attributable to this exposure suggests that it has a significant impact on endemic giardiasis.

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