Is Drinking Water a Risk Factor for Endemic Cryptosporidiosis in the Immunocompetent Population of the San Francisco Bay Area?

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Acknowledgements

- **School of Public Health, University of California, Berkeley**
- **California Emerging Infections Program**
- **Centers for Disease Control and Prevention**
- **California Department of Health Services**
- **County Public Health Departments** of Alameda, Contra Costa, San Francisco, San Mateo, Santa Clara, Sonoma, Marin, and Tuolumne
- **Participating San Francisco Bay Area Water Systems**: the City of Antioch, Contra Costa Water District, Diablo Water District, East Bay Municipal Utilities District, Marin Municipal Water District, the City of Martinez, San Francisco Public Utilities Commission, Santa Clara Valley Water District, Solano County Water Agency, Sonoma County Water Agency, the Southern California Water Company and the Bay Area Water Users Association

Study overview

RESEARCH QUESTION

- What are the major routes of endemic transmission for cryptosporidiosis among immunocompetent individuals in the San Francisco Bay Area?

METHODOLOGY

- Age- and location-matched, incidence density case-control study design

ANALYSIS

- Conditional logistic regression to determine relative risk of cryptosporidiosis among exposed versus unexposed for major risk factors

Study overview

STUDY POPULATION

- Cases: cryptosporidiosis identified through California Emerging Infections Program (CEIP) population- and laboratory-based active surveillance project in 9 SF Bay Area counties between July 1999 and July 2001
- Controls: age-matched non-cases in the household and the community, using sequential random-digit dialing (RDD) for the latter

Study design features

- Interviewer administered telephone questionnaire
- Stool test offered to controls to rule out potential asymptomatic infection
- Incentives for all study subjects
- Questionnaire developed by CDC's multi-site study
- SIX possible control types for sub-analyses

	Household		Neighborhood		Different Water District	
TYPE OF CONTROL	Sexual contact	Non-Sexual contact	Sexual contact	Non-Sexual contact	Sexual contact	Non-Sexual contact
	2	2	0	45	0	13
TRANS-MISSION	Household or sexual	Household only	Sexual	Non-sexual	Sexual and water	Non-sexual and water
SAMPLING SCHEME	Non-random	Non-random	Non-random	RDD	Non-random	RDD

Exposures studied

- Drinking water
  - Quality, i.e. what kind, whether and how treated
  - Quantity, i.e. glasses per day
- Recreational water
  - Swimming practices and location
- Food sources
  - Food types consumed
  - Unsafe food items (unpasteurized, raw)
- Travel
- Person-to-person (fecal)
  - Child-care and other diaper contact
  - Exposure to with people with diarrhea
- Animal contact
- Sexual practices

Final study statistics

- Cases enrolled: **26**
  - Unable to enroll any controls for one case
- Cases excluded: **145**
- Controls enrolled: **62**
- Stool tested for controls: **13** (all tested negative)
- Ratio of controls to cases: **2.38**

Top 5 Reasons for Exclusion

- Immunocompromised: **46%** (67/145)
- Not reachable after 15 attempts: **15%** (21/145)
- Refused interview: **11%** (16/145)
- No telephone: **10%** (14/145)
- 31 days after specimen date: **10%** (14/145)

Results—Table 1

Characteristic	*Cases*		*Controls*	
	N	*%*	*N*	*%*
Gender				
Male	13	50.0	33	53.2
Female	13	50.0	29	46.8
Age group				
1-5 years	5	19.2	10	16.1
6-11 years	0	0.0	0	0.0
12-17 years	3	11.5	8	12.9
18-25 years	3	11.5	8	12.9
26-44 years	12	46.2	29	46.8
45-64 years	2	7.7	5	8.1
65+ years	1	3.9	2	3.2
Chronic medical condition				
Yes	9	34.6	16	24.2
No	15	61.5	46	74.2
Missing	1	3.9	1	1.6
TOTAL	26		62	

Results—Table 1 (contd.)

Characteristic	*Cases*		*Controls*	
	N	*%*	*N*	*%*
Race				
White	17	65.4	43	69.3
Black	3	11.5	4	6.5
Native American	0	0.0	1	1.6
Asian/Pacific Islander	1	3.9	6	9.7
Other	4	15.4	8	12.9
Unknown*	1	3.9	0	0.0
Ethnicity				
Hispanic	7	26.9	14	22.6
Non-Hispanic	18	69.2	48	77.4
Unknown*	1	3.9	0	0.0

*One case refused to provide race/ethnicity information

Table 2—Composite variables

EXPOSURE	*Cases* *N (%)*	*Controls* *N (%)*	*Univariate OR*	*95% CI*	*P-value*
Drinking water†					
Boil water	2 (*7.7*)	4 (*6.5*)	1.00		
Filter or bottle water	10 (*38.5*)	27 (*43.6*)	0.74	0.11, 5.02	0.754
Tap without further treatment	14 (*53.9*)	31 (*50.0*)	0.92	0.16, 5.30	0.929
Recreational water					
Swimming, hot tub/spring	8 (*30.8*)	18 (*29.0*)	1.02	0.28, 3.75	0.973
Food sources					
Unsafe foods consumed	22 (*84.6*)	59 (*95.2*)	0.38	0.08, 1.79	0.223
Handle raw foods	**5 (*19.2*)**	**28 (*45.2*)**	**0.23**	**0.06, 0.85**	**0.028**
All combined	22 (*84.6*)	60 (*96.8*)	0.03	0.05, 1.88	0.198

†Tests for trend: linear *P*-value=0.674; non-parametric extension of Wilcoxon rank sum *P*-value=0.660

Table 2—Composite variables (contd.)

EXPOSURE	*Cases* *N (%)*	*Controls* *N (%)*	*Univariate OR*	*95% CI*	*P-value*
Travel					
>100 miles from home	**17 (*65.4*)**	**18 (*29.0*)**	**4.44**	**1.53, 12.84**	**0.006**
To another country	**13 (*50.0*)**	**3 (*4.84*)**	**25.67**	**3.28, 201.02**	**0.002**
Person-to-person (fecal)					
Daycare/camp contact	6 (*23.1*)	19 (*30.7*)	0.76	0.27, 2.14	0.604
Contact with diapers	12 (*46.2*)	31 (*50.0*)	1.03	0.38, 2.78	0.959
Contact with people with diarrhea	6 (*23.1*)	13 (*21.0*)	1.07	0.28, 4.09	0.927
All combined	15 (*57.7*)	39 (*62.9*)	0.76	0.28, 2.09	0.599
Animal contact	14 (*53.9*)	45 (*72.6*)	0.48	0.16,1.45	0.194
*Sexual activity**	9(*52.9*)	20 (*45.5*)	1.59	0.44, 5.74	0.476

*Any sexual relations in 2-week risk period or >1 sexual partner in last 6 months (adults only)

Table 3—Multivariate analyses (Part 1)

EXPOSURE	ALL CONTROLS (n=62)			NEIGHBORHOOD CONTROLS (n=45)		
	Odds Ratio	***95% CI***	***P-value***	***Odds Ratio***	***95% CI***	***P-value***
Drinking water						
Boil water	1.00			1.00		
Filter or bottled	2.00	0.09, 46.81	0.666	1.58	0.05, 51.75	0.796
Tap water[a]	3.87	0.20, 73.99	0.369	2.62	0.11, 57.49	0.541
Handle raw foods[a]	0.60	0 .13, 2.85	0.526	0.44	0 .07, 2.88	0.392
Travel 100 miles from home	1.48	0.35, 6.29	0.599	1.33	0.28, 6.29	0.716
Travel to another country	**20.86**	**1.55, 279.93**	**0.022**	12.30	0.93, 162.84	0.057

[a]without further treatment or processing
[b]Includes handling raw meat, fruit, vegetables

Table 4—Multivariate analyses (Part 2)

EXPOSURE	ALL CONTROLS			NEIGHBORHOOD CONTROLS		
	Odds Ratio	*95% CI*	*P-value*	*Odds Ratio*	*95% CI*	*P-value*
Drinking water						
Boil water	1.00			1.00		
Filter or bottled	2.29	0.21, 60.65	0.589	2.11	0.08, 54.71	0.652
Tap water[a]	3.56	0.11, 46.52	0.381	2.91	0.15, 54.91	0.477
Travel to another country	**34.66**	**3.58, 327.96**	**0.002**	**24.12**	**2.64, 220.62**	**0.005**

[a]Without further treatment or processing

Discussion

- A complex relationship exists between drinking water and travel
  - Exploration of this relationship will most likely require a larger or possibly a different type of study design
  - Perhaps the larger multi-site CDC study will be able to address this question
  - Water exposure must be quantified in terms of:
    - Domestic vs. foreign
    - In-home vs. out-of-home
- Protection may be afforded by repeated low-level exposures to oocysts by boosting immunity

Conclusions

- In this study, the only factor significantly associated with cryptosporidiosis among immunocompetent persons in the SF Bay Area was travel to another country:
  - **Adjusted OR: 24.12, 95% CI: 2.64, 220.62**
- These data do not support the hypothesis that drinking water is a significant risk factor for endemic cryptosporidiosis among immunocompetent persons in the SF Bay Area