cats and to reduce the number of people receiving anti-rabies treatment at significant cost savings to the state.

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Giardia Prevalence among 1-to-3-Year-Old Children in Two Washington State Counties

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Abstract: A survey of intestinal parasites was conducted in two Washington counties. *Giardia* prevalence among 518 children surveyed was 7.1 per cent and was unrelated to the source of domestic drinking water (surface or well), day care center attendance, or parental occupation. Identified risk factors for *Giardia* infection include a history of drinking untreated surface water and having two or more siblings between the ages of 3 and 10 years. Of 47 family members of *Giardia* positive children, 10 (21.3 per cent) were *Giardia* positive. (*Am J Public Health* 1982; 72:386–388.)

Outbreaks of giardiasis have been traced to drinking water contaminated by animal[1] or human waste,[2] to person-to-person transmission within day care centers,[3] and to fecal contamination of food.[4] The prevalence of *Giardia* among asymtomatic persons in the United States is unknown, but thought to range from 1.5 to 20 per cent,[5] depending on the age and socioeconomic status of the group considered.

Giardia infections are commonly found among aquatic mammals, residing in mountain areas which supply much of the domestic drinking water for Washington State residents.[6] Outbreaks of giardiasis associated with *Giardia*-contaminated municipal water supplies have recently occurred in Camas[1] and Leavenworth, Washington.* The extent to which domestic drinking water from surface origins contributes to giardiasis in non-outbreak situations is unknown.

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A stool survey of one-to-three-year-old children was conducted to compare the prevalence of *Giardia* infections among people served by surface water supplies to persons served by deep wells or springs, as well as to estimate *Giardia* prevalence for young children.

Methods

Two Washington state counties (Thurston and Skagit) were selected for the survey. Thurston County residents are served by an artesian spring or deep municipal or private wells for their water. Most drinking water in Skagit County is obtained from municipal surface sources or private shallow wells.

Children were selected from birth certificate records. A total of 1,349 certificates were randomly selected from the two counties. To be eligible, the child had to be between the ages of one and three years at the time of the selection. Of the selected certificates, exclusions were made if the child were deceased (17 children), if a serious birth defect or a birthweight less than 1500 grams were reported (25 children), if the mother was less than age 20 and no father were listed (57 children), or if the mother were an immigrant (15 children). Another 545 children were excluded because the family could not be traced through directory assistance, or from county telephone book from the information provided on the birth certificate.

Parents of the remaining 690 cases were sent letters explaining the study and requesting their participation. The letter was followed by a telephone call, at which time the parent was interviewed. Of the parents receiving letters, 90 refused to participate, 50 could not be reached, and 32 failed to send in the required stool specimens.

A total of 518 parents (75 per cent of those sent letters) were surveyed, 295 having children born in Skagit County and 223 in Thurston County. Skagit County was over-

sampled to gain an adequate number of persons on both well water and surface water supplies.

Only the child on the selected birth certificate was included in the survey. Some family members chose to be examined when the index child was positive. Participants were paid $5 for each of two samples taken at least one day apart. Stool samples were submitted by mail to the State Public Health Laboratory in 5 per cent buffered formalin preservative. One gram of stool per sample was examined by formalin-ethyl acetate sedimentation.[7] The results of the stool examination was sent to the parent, and to the family physician when so requested.

Results

Of the 518 children surveyed, 37 (7.1 per cent) were found to carry *Giardia*. Nonpathogenic parasites were found more commonly among *Giardia* positive children ($p = .001$) than among *Giardia* negative children. Forty-seven family members of *Giardia* positive children were tested and 10 (21.3 per cent) were found to be positive for *Giardia* while nine others carried nonpathogenic parasites. None of the *Giardia* positive persons reported recent episodes of diarrhea, and no differences in histories of diarrhea could be found between *Giardia* positive and *Giardia* negative children.

There were no statistically significant differences in *Giardia* prevalence by source of domestic water or size of water utility, although two of five children on private streams or spring water sources were *Giardia* positive and only one of 37 children on surface filtered water were *Giardia* positive (Table 1). Overall there were no statistically significant increases in prevalence for children of working women, children attending day care centers, or for families engaged in outdoor activities (boating, camping, wading or hiking) within the two months prior to the interview (Table 2). Significant increases in prevalence were observed, however, if the child had a history of drinking untreated surface water (from streams or lakes during recreational activities) and, among children with untreated water consumption, if the household included other children between the ages of 3 and 10 (Table 3). No significant increases in prevalence were observed for children with a sibling under age 3 or with older siblings when untreated water consumption was not reported.

TABLE 1—*Giardia* Prevalence According to Type of Water Supply

Type of Water Supply	Number Surveyed	% *Giardia* Positive
Serving over 100 residences		
Surface unfiltered	175	6.9
Surface filtered	37	2.7
Drilled well	63	7.9
Artesian well	66	7.6
Serving 10 to 99 residences		
Drilled well	41	4.9
Serving 2 to 10 residences		
Drilled well	22	9.1
Private systems		
Drilled well	110	7.3
Other (streams or springs)	5	40.0
Total	518	7.1
$p = .87$		

TABLE 2—*Giardia* Prevalence According to Recreational Activity

Type of Activity	Number Surveyed	% *Giardia* Positive
Boating	41	9.8
Camping	101	5.9
Wading pool (home)	221	9.0
Wading in pool, lake or river	204	8.3
Hiking	32	9.3
$p > .1$		

To estimate the effect of the case exclusions and the children not followed, the occupational distribution of survey participant fathers (1978 births) were compared to a random sample of Thurston and Skagit County 1980 births.** The results (Table 4) show that the survey included a higher percentage of professional and administrative occupations and a lower percentage of laborers, clerical, sales and service workers than the random sample ($p = .00$). No difference was observed in *Giardia* prevalence by occupation ($p = .72$).

Discussion

Although no differences in *Giardia* prevalence were found between surface and well drinking water sources, a generally high *Giardia* prevalence was observed. Untreated water consumption and siblings between 3 and 10 years of age for families reporting untreated water consumption were the only identified risk factors. This latter finding, together with the high prevalence of non-pathogenic parasites in *Giardia* positive children and the high prevalence of *Giardia* among household members of *Giardia* positive children, suggests person to person transmission. The failure to find an increased risk among children attending a day care center was unexpected in light of family-associated risk factors. *Giardia* infection was not associated with a recent history of illness, suggesting that many infections in this age group are asymptomatic.

The survey did not constitute a random sample of the population of one-to-three-year-old children in these counties. The differences in the paternal occupation distribution of survey participants and the sample of 1980 birth certificates were expected from the design of the survey. Since no differences in *Giardia* prevalence were observed by paternal occupation, the importance of this bias is unclear.

**The 1980 comparison was necessary since occupation was not previously recorded on the birth certificate.

TABLE 3—*Giardia* Prevalence According to Untreated Water Consumption* and Number of 3–10 Year Old Children in Household

Untreated Water Consumption	Number of 3–10 year old children in household			
	0 (N = 232) %	1 (N = 207) %	2+ (N = 79) %	Total (N = 518) %
Yes	8.5	11.9	40.0	15.1
No	4.9	3.6	9.4	5.1
Total	6.0	5.3	15.0	7.1**

*From streams or lakes during recreational activities.
**P for history of drinking untreated water = .002.
P for number of children 3–10 in household = .01.

The survey findings suggest that intestinal parasites continue to be a common occurrence among young children despite advances in sanitation and personal hygiene. The uniformly high prevalence of *Giardia* in children of all paternal occupation groups suggests that the problem is not restricted to any socioeconomic segment of the population.

TABLE 4—Occupational Distribution of a Random Sample of Fathers of 1980 Births Compared to that of Fathers of Survey Participants and *Giardia* Prevalence According to Father's Occupation

Occupation Group	1980 Birth Certificate Sample N = 1000	Survey* Participants N = 517	*Giardia* Positive
Professional, administrative	6	27	7.6
Crafts, sales (insurance real estate, etc.)	59	57	5.9
Laborers, clerical, sales service	23	7	8.3
Students, unemployed	2	5	8.0
No father listed	9	4	13.6

*Occupation—sample vs survey p = .00
Prevalence by occupation p = .72

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