Giardia infection in Auckland and New Zealand: trends and international comparison

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Abstract

Aims. To describe the epidemiological pattern of *Giardia* infection in the Auckland region and compare it with national and international patterns of *Giardia* infection.
Methods. Anonymised giardiasis notification data from the Auckland District Health Board for the period July 1996 to June 2000 were analysed by person, place and time. Infection rates and relative risks were calculated and compared with national and international information.
Results. Auckland had a significantly higher rate of *Giardia* infection than New Zealand as a whole. Infection rates, which peaked during February-May, were significantly higher in Pakeha/Europeans and Asian/others, compared with Maori/Pacificans. Adjusted notification rates were higher for residents of North Shore and Auckland cities than for other areas of Auckland. The crude regional and national notification rates were almost six times the rate of laboratory identification of positive isolates in the UK and four times US reported rates.
Conclusions. The higher rates of giardiasis observed in Auckland and New Zealand, in comparison with other developed countries, may be related to environmental or social factors. Missing ethnicity information precludes clear interpretation of variations in notification rate by ethnic group and suggests a need for improvement in data collection. There are opportunities to investigate the influence of risk factors on seasonal changes in notification rates both locally and nationally.

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Giardia is one of the leading protozoal causes of human gastrointestinal illness. The transmission of *Giardia* is very common in specific groups and settings and varies seasonally.[1-6] Giardiasis is the third most commonly notified communicable disease in New Zealand and the most commonly notified potentially waterborne disease with an incidence rate of 46.6/100 000 population,[7] which is thought to be one of the highest among developed countries.[8] Nearly 2000 *Giardia* positive cases are reported in New Zealand annually, a third of which are from the Auckland region. Despite its high incidence and cost, few reports have evaluated the epidemiological pattern of giardiasis in New Zealand. Most were published before notification was required (1 July 1996) and used sporadic data collected through local health service providers or personal effort.[1,9-11] A review of its occurrence is well overdue.

This paper outlines the results of a review of four years of notifications from the Auckland region aimed at identifying local epidemiological trends in giardiasis notification rates in national and international contexts. The study aims to identify high risk groups and geographic patterns of infection.

Methods

Data sources. We obtained anonymised raw giardiasis data notified between July 1996 and June 2000 for the Auckland region from the Auckland District Health Board (ADHB). The DHB receives notifications of giardiasis for all three Health Districts, comprising seven local authorities (LAs) in the Auckland region of which four are city councils and three are district councils. The data include general demographic information on notified cases. National information on incident cases for the same period was collected from published reports (NZ Public Health Report). International data on the incidence of giardiasis were downloaded from overseas websites (Centers for Disease Control and Prevention, USA and Public Health Laboratory Service, UK).

Data analysis. Data for the Auckland region were analysed by age, gender, area of residence (LA), ethnicity and date of notification. Regional data were compared with national and international data. Results are expressed in frequencies, rates, relative risks with their confidence intervals and levels of significance. EPI-Info 6.04d & 2000, PEPI 3.01, SAS v8.0 and MS Excel 2000 computer packages were used for statistical analysis and data presentation.

Results

Auckland District Health Board received 2510 *Giardia* positive case notifications between July 1996 and June 2000, an average annual infection rate of 58/100 000 population. Gender was not available for eighteen cases (<1%) who were excluded from gender analysis. The mean age (±SEM, years) for all cases was 27.8±0.40 with females (29.7±0.57) being slightly older than males (26.0±0.56). Medians for females and males were similar (31 versus 29) and cases were distributed equally between the genders (50.9% versus 49.1%). A bimodal pattern of infection was observed, peaking in children under five years and in 25-44 year olds (Figure 1), who represented over 20% and 40% of cases, respectively. Children aged under five years had thrice the infection rate of the 25-44 year age group and a twelve fold higher rate than those 10-19 years after adjusting for gender, ethnicity and LA. The gender ratio was reversed among 1-4 and 25-34 year olds. Males had a significantly higher risk of infection in the 1-4 year age group (RR=1.22,95%CI 1.02-1.46;p<0.05) than their female counterparts but a lower risk in the 25-34 year group (RR=0.84,0.71-1.00;p<0.05).

Ethnicity was classified as Pakeha/European, Maori/Pacificans or Asian/others. Ethnicity was not available for a quarter of cases (24.2%). The risk of infection was significantly higher for Pakeha/Europeans (RR=5.91) and Asian/others (RR=3.10) compared to Maori/Pacificans after adjusting for age and gender (Table.1).

The risk of *Giardia* infection for the Auckland region as a whole was significantly higher (RR=1.11,1.06-1.16;p<0.0001) than for New Zealand (Figure 2). Average annual *Giardia* infection rates (standardised and adjusted) for all LAs within Auckland were higher than the current national incidence (notifications) rate[7] except for Manukau City (Table 2). When biennial average rates were compared, a reduction in rates from July 1996-June 1998 to July 1998-June 2000 was observed for Papakura (-51.6%), Rodney (-27.9%), Franklin (-18.3%) and Waitakere (-4.3%), whereas increased rates were observed for North Shore (+9.6%) and Auckland (+20.7%) when adjusted for age, gender and ethnicity.

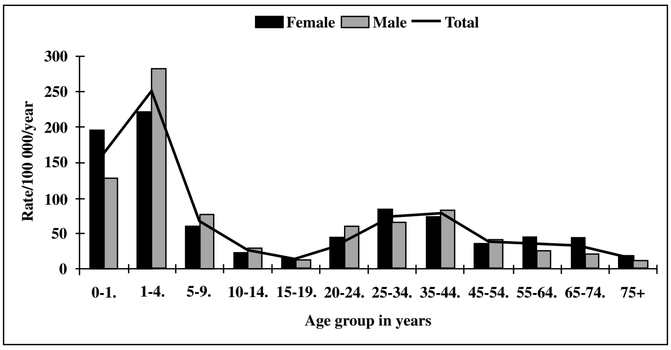

Figure 1. Rates of notified giardiasis in Auckland adjusted for gender, ethnicity and Local Authorities (July 1996-June 2000).

Seasonal patterns of giardiasis in the Auckland region and in New Zealand were almost identical, although the Auckland region had a slightly higher rate throughout (Figure 2). A similar seasonal pattern was observed in the UK. Infection/notification rates peaked in late summer and early autumn and dropped in winter. This seasonal variation was significant (Edward's test: χ^2=15.0,df=2;p<0.001) in the region. A comparison of two year's average annual rates of giardiasis notifications in New Zealand (July 1996-June 1997), positive laboratory tests for giardiasis in the UK (Jan 1996-Dec 1997), and reported giardiasis cases from 41 states in the US (Jan 1996-Dec 1997) showed that the New Zealand rate (55.68/100 000) was much higher than the UK (10.22/100 000) and the US (15.39/100 000) rates. The Auckland rate (57.59/100 000) was significantly higher (RR=2.07,1.94-2.21;p<0.0001) than that of New York (27.80/100 000) which was double that for the US as a whole.

Discussion

Communicable disease surveillance is an essential pre-requisite for health service delivery in the community. An organised surveillance system based on disease reporting by general practitioners (GPs) is in place in many countries.[7,12] Regular interpretation and appropriate dissemination of surveillance data and evaluation of surveillance performance are important in disease containment and prevention.[13] The underreporting of disease notifications has been highlighted previously[14,15] and this is often influenced by social and regional factors.[12]

This study found that more than one-third of giardiasis cases in New Zealand were reported from the Auckland region. A bimodal infection pattern peaking in the 1-4 year and 25-44 year age groups has been documented elsewhere.[4,6,10,11,16] Higher rates in 1-4 year old males and in 25-44 year old females requires further investigation. These findings support a major role for person-to-person transmission of the disease and indicate a possible route of transmission between children and their parents and/or caregivers which may be facilitated by environmental exposures eg, childhood centre attendance, household contact,[10,17,18] or nappy handling.[19] The low incidence rates among teenagers are not unexpected.[1,5] The relatively low incidence in infants and a declining rate after 45 years are consistent with overseas observations.[20,21] The limited activities of older people and infants may reduce transmission of the disease.[22]

The deprivation profiles (NZDep96) for Maori and non-Maori in New Zealand suggest Maori are disadvantaged.[23] In this study, the group without ethnicity was evenly distributed across the LAs. However, the absence of ethnicity in 25% of cases suggests that the ethnic data should be treated with caution. In comparison with ethnic representation in the Auckland population and excluding those of unknown ethnicity, Pakeha/European were over-represented by 20%, and Maori/Pacificans and Asian/others were under-represented by 19% and 3% respectively. This is consistent with other New Zealand studies[1,24] but is inconsistent with the reported inverse relationship of the disease with socio-economic status,[25] suggesting under-diagnosis in some ethnic groups. This is supported by a substantial difference between crude (5.60) and age adjusted (12.60) relative risks for Pakeha/Europeans analysed separately. The under-representation of Maori/Pacificans and possibly of Asian/others appears to exaggerate the risk in Pakeha/Europeans.

The sustained increase in infection rates for Auckland and North Shore could be real or artifactual.[9] Auckland City has a high number of visitors, possibly contributing to incidence rates. The lowest infection rate, reported in Manukau City, again suggests under-reporting or effect modifications influenced by ethnicity and/or socio-economic factors. Lower infection rates in Waitakere and in Franklin are possibly due to under-diagnosis or the absence of environmental risk factors. A dramatic decrease in giardiasis in Papakura District coincides with a number of changes made by the local water supplier in the last 2-3 years which include expansion and improvement in reticulated supply (personal communication: Michael Morgan, United Water International Pty Ltd, Papakura, Auckland). Each Council in Auckland, which is primarily urban, either operates or sub-contracts its own local water network operation after it receives bulk water from Watercare Services Ltd. In contrast, Districts, which are mostly rural, are more likely to have a smaller proportion of their population on a reticulated water supply. Reticulated supplies have previously been associated with reduced risk.[26] However, the main factors that contributed to these changes in infection rates among LAs are yet to be determined.

The seasonal pattern of *Giardia* infection in Auckland and New Zealand is similar to that in England and Wales with a

Table 1. Relative risk of *Giardia* infection by ethnic group in the Auckland region.

Ethnicity	Female n(%)	Male n(%)	Total n†(%)	Adjusted for Age & gender RR (95% CI)
Maori/Pacificans*	62 (4.9)	57 (4.7)	121 (4.8)	1.0
Pakeha/European	855 (67.4)	776 (63.4)	1637 (65.2)	5.91 (4.93-7.09)‡
Asian/Others	59 (4.7)	85 (6.9)	144 (5.8)	3.10 (2.44-3.94)‡
Unknown	292 (23.0)	306 (25.0)	608 (24.2)	–
All	1268 (100.0)	1224 (100.0)	2510 (100.0)	5.07 (4.24-6.07)‡

*Reference group: †include cases gender not specified; ‡p<0.0001.

late summer and early autumn peak. This is consistent with other reports of seasonality,[1,2,4-6] although, giardiasis is more prevalent in the cooler months in tropical and subtropical countries.[27-29] A peak incidence in Auckland during February and March, continuing throughout April and May, suggests outdoor activity in these months may occur at temperatures similar to those in cooler months elsewhere.

Table 2. Rate of giardiasis/100 000 population in Auckland region by Local Authorities (LAs)

LAs	Maori*	European*	Asian & others*	§All ethnicity‡
Manukau City	10.52	51.27	31.86	45.05
Waitakere City	7.54	47.55	45.52	48.69
Franklin District	7.72	49.20	29.12	56.52
North Shore City	11.08	59.75	30.40	60.99
Auckland City	14.89	70.62	36.63	65.08
Papakura District	20.60	78.75	20.73	75.73
Rodney District	27.18	71.22	53.06	87.64
Auckland Region†	11.77	63.73	34.12	57.59

*Adjusted for age and gender; †adjusted for age, gender and LAs; ‡adjusted for age, gender and ethnicity; §include cases ethnicity not specified; currently giardiasis incidence rate in New Zealand is 46.6/100 000.

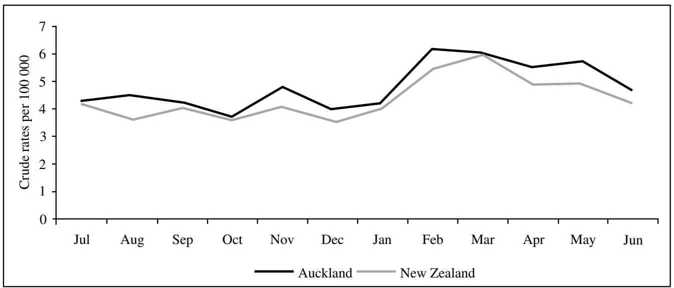

Figure 2. Average monthly giardiasis notifications in Auckland and New Zealand (July 1996-June 2000).

A four fold increased rate in Auckland, and in New Zealand, compared to the UK is surprising. If under-reporting is assumed to be at a similar level to that previously found in New Zealand, (37-50%, Hill P et al, ADHB and Hoque ME et al, NEOH – unpublished data), this difference would be only slightly reduced. A similar rate difference was also observed in comparison with the US notification records; although rates were not consistent between the states and notification is voluntary in the US where substantial under-reporting is suspected.[12]

This study highlights a need for improvement in reporting and in data completeness. Factors which possibly influence the higher incidence in New Zealand could be behavioural, climatic, environmental or related to the virulence or genotype of the parasites. Further study of the seasonality and situational characteristics of the infection could aid understanding of giardiasis. Analysis of national surveillance data will provide further insight into *Giardia* epidemiology in New Zealand which may contribute to enteric infectious disease policy at a national level.[30]

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