

Clustering of campylobacteriosis in rural areas in Norway

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Summary

A trend analysis showed that the increase in the annually reported number of cases of human campylobacteriosis from 1995 to 2001 acquired domestically was statistically valid from 1998. In an ecological analysis of risk factors for human campylobacteriosis acquired domestically, more cases were found in geographical areas with agriculture and some industrial activities and the relative risk of contracting campylobacteriosis was estimated to 1.32 (95%CI; 1.14-1.66) for people living in these areas.

Introduction

In regard to the observed geographical differences, the modelling of human exposure to thermophilic *Campylobacter* should take geographical areas into account. Ecological studies have featured prominently in environmental epidemiology because exposure often is already measured at the group level or limited resources for conducting studies prohibits collection of individual-level data⁸.

Aim:

- Investigate whether the reported increase in incidence of campylobacteriosis from 1995 to 2001 in Norway was statistically significant when accounting for variations between counties (*trend model*).
- Investigate possible pattern of domestically acquired human *Campylobacter* infections in 2000 and 2001 in regard to assumed biological risk factors; consumption of chicken meat, drinking untreated water, the density of grazing animals and dogs, and other explanatory variables representing various levels of spatial clustering (*ecological model*).

Materials and Methods

The incidence of human campylobacteriosis

The incidence data were obtained from the Surveillance of Communicable Diseases in Norway (Norwegian Institute of Public health²). Only the cases that acquired the infection in their home county were included in the trend analysis. In the ecological risk factor analysis both the cases infected within the home county as well as those domestically infected with an unknown place of infection were included.

Human population data

The number of inhabitants in the counties (“Mid Year Number” defined by Statistics Norway) and in the municipalities in Norway from 1995 to 2001 was obtained from Statistics Norway³. Codes for seven different categories related to the main

occupation of people in the municipality were from the “Standard for Municipality Classification” (Municipality code) from Statistics Norway³.

Chicken meat sale statistics

The number of kilos of broiler chicken meat sold in the different counties and municipalities in 2000 and 2001 was obtained from the company that had the 85% market share of the chicken broiler meat in Norway⁴.

Drinking water

The number of people that receive untreated drinking water in the counties and municipalities were based on permanent addresses recorded in the Registry of Norwegian Waterworks per 2001⁵. Treatment was defined to be processes that could inactivate *Campylobacter* efficiently, such as UV light, different regimes in regard to chemical treatment, and some types of filter-methods⁷. Some waterworks were supplied with water from different sources. Sources that were difficult to categorise in regard to whether the water was treated or not were put in the category, “treatment” if water from the other supplying sources were treated.

Software and statistical analysis

The merging of the different datasets and descriptive statistics were conducted in SAS-PC system® version 6.12 for Windows (SAS Institute, Cary, NC USA 1996) and Excel version 2000 (Microsoft). The Poisson models were conducted in Intercooled Stata 7.0 for Windows (Stata Corp. College Station, TX) (trend model) and MLwin (Version 1.0, Multilevel Project, Institute of Education, London, 1998) (ecological model).

Results

The trend model

From 1995 to 2001, a total of 4928 domestically acquired cases of human campylobacteriosis were reported. The increase in the annually reported number of cases acquired domestically and within the home county was statistically valid from 1998 (Table).

Table.

Time trend of *Campylobacter* incidence in Norway; Results from population-averaged random-effect Poisson regression, showing results as incidence relative risks (IRR) with 95% confidence interval (CI)

Year	IRR	95% CI
1995	1.00	-
1996	1.06	0.88-1.28
1997	0.91	0.62-1.34
1998	1.60	1.36-1.89
1999	1.86	1.52-2.84
2000	1.95	1.59-2.40
2001	2.52	1.96-3.25

The ecological model

The final multilevel Poisson model included only the Municipality code. More cases were found in geographical areas with agriculture and some industrial activities and the relative risk of contracting campylobacteriosis was estimated to 1.32 (95% CI; 1.14-1.66) for people situated in these areas.

Discussion

The only variable included in the final ecological model was the Municipality code; agriculture and industrialized areas. Since the variable was based on detailed information on yearly income we assume that it was relatively unbiased. The prevalence of thermophilic *Campylobacter* in chicken meat distributed to the market could have decreased during the study period due to a *Campylobacter* control program in the broiler chicken production implemented in May 2001¹. It is biologically plausible that untreated drinking water could be important since mixed agricultural and industrialized areas ended up in the final model. Thus, the quality of the Registry of Norwegian Waterworks should be improved and exposure to untreated drinking water from other sources should be revealed. Of the included variables, chicken meat and drinking water are factors we are about to control through the surveillance and control program and the drinking water legislation^{1,6}.

Multilevel analysis was applied in order to put the variance in the data on the correct geographical level. Conclusions can however not be drawn for the individual when we have the observations on the municipality and county level.

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