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Strain and host characteristics of *Campylobacter jejuni* infections in Finland

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ABSTRACT

The relative importance of different risk-factors for *Campylobacter* infections and the role of bacterial strain and host characteristics are uncertain. Swimming in natural sources of water was recently described as a novel independent risk-factor for domestically-acquired *Campylobacter* infections. The present study investigated exposure factors and demographical characteristics (collected in a questionnaire), and determined whether *Campylobacter jejuni* serotypes could be linked to each other or to the severity of the disease in domestically-acquired sporadic *C. jejuni* infections during a seasonal peak in Finland. Swimming was associated positively with an age of ≤5 years, and *C. jejuni* serotype Pen 6,7 was found significantly more frequently among patients who reported swimming. The geographical distribution among serotypes differed, in that 54% of the isolates belonging to the Pen 4 complex serotype were identified in the Helsinki area, and 74% of the Pen 21 isolates were from the Kuopio area. Pen 57 was associated with a disease of shorter duration, but no serotype could be linked to hospitalisation or antimicrobial therapy. However, advanced age was associated with hospitalisation and a longer period of hospitalisation. Risk-factors and sources of infection for *C. jejuni* infection may not be identical for all individuals. This study supports the concept that individuals belonging to different age groups and living in different geographical areas may acquire *C. jejuni* infections from different sources.

Keywords *Campylobacter jejuni*, Finland, risk-factors, serotype, severity of disease, swimming

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INTRODUCTION

Campylobacter jejuni and *Campylobacter coli* are the leading causes of human bacterial gastroenteritis in developed countries such as Finland [1–3]. Most human cases of *Campylobacter* infection are sporadic, but a seasonal peak during the summer months has been observed in several countries [1,2,4–6]. Risk-factors for acquiring *Campylobacter* infection may be associated with the human host, with environmental exposure, or with the biology and ecology of the pathogen itself. Case-control studies have identified a variety of risk-factors, including handling and eating poultry meat [1,3,4,7–11], eating raw or undercooked meat (mostly chicken) [1,4,9,12,13], drinking unpasteurised milk [1,3,4,7,13] or untreated water [1,3,4,9,12], contact with domestic animals [1,3,4,8–11], travelling abroad [1,3,4,10,11,13], and previous treatment with omeprazole [11,14]. Furthermore, in a recent study, swimming in natural sources of water was shown to be a novel risk-factor for *Campylobacter* infection [12]. However, there is still considerable uncertainty as to the relative importance of the different risk-factors [4,5,15]. The role of bacterial strain and host characteristics in the acquisition of *Campylobacter* infection is largely unknown.

The factors that may influence the outcome of *Campylobacter* infection, e.g., length of disease, a need for treatment with antimicrobial agents and

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hospitalisation, have not been properly elucidated. Certain *Campylobacter* serotypes have been reported to be associated with complications following gastroenteritis; thus, heat-stable serotype 19 has been associated with Guillan–Barré syndrome [16], and serotype 2 with Miller–Fisher syndrome [16]. However, it has not been possible to link any specific *C. jejuni* serotypes to the severity of acute diarrhoeal disease.

The present study aimed to determine whether a particular *C. jejuni* serotype, exposure factors or demographical characteristics were associated with each other or with the severity of disease in domestically-acquired sporadic *C. jejuni* infections during a seasonal peak in Finland.

MATERIALS AND METHODS

This was a multicentre cross-sectional study of sporadic domestically-acquired *Campylobacter* infections during a seasonal peak (1 July to 30 September 2002) [12]. Three clinical microbiology laboratories, serving both rural and urban areas, participated. Outpatients and hospital patients were included if they had not travelled abroad in the 2-week period before their illness, and if their stool culture was positive for *C. jejuni*. Details of the disease, and information concerning the 2-week period before illness with respect to travel in Finland and abroad, dietary intake (meat, fish, vegetables, fruit and dairy products), source of drinking water, contact with pets and other animals, and swimming in water from natural sources, were collected via a questionnaire sent to the patients, as described in the case-control study published previously [12].

Stool isolates, cultured originally in the participating laboratories, were all collected and stored at −70°C before further analysis. *C. jejuni* isolates were serotyped as described previously [17,18], using commercially available antisera (Campylobacter Antisera Seiken Set; Denka Seiken, Tokyo, Japan) based on heat-stable Penner's antigens.

Originally, 208 cases of *Campylobacter* infection, verified by stool culture, were identified, and 151 (73%) patients completed the questionnaire. The final analysis included 114 patients, most of whom had also participated in the original case-control study [12]. The 37 patients excluded had either travelled abroad (ten cases), had failed to provide information on travel abroad (three cases), had misunderstood the questionnaire (four cases), had a stool culture that yielded *C. coli* (one case), or yielded isolates with unidentifiable serotypes (19 cases). Of the 19 unidentified serotypes, eight isolates were not available for serotyping, ten isolates did not react with the antisera tested, and one isolate had a mixed serotype. All cases were sporadic and were not associated with an outbreak. The Ethics Committee of the Hospital District of Helsinki and Uusimaa approved the study.

For categorical variables, the *z*-test, Pearson's chi-square test, Fisher's exact test and linear-by-linear tests were used, as appropriate. Depending on the distribution, the *t*-test, ANOVA or the Mann–Whitney *U*-test were used for continuous variables. For associations, Pearson's correlation coefficient and linear regression were used. For calculation of OR and 95% CIs, logistic regression was used. All variables that were significant by univariate analysis were included in the multivariate models. All p values reported are two-sided, with $p < 0.05$ considered to be statistically significant. All statistical analyses were carried out using SPSS v.11.5 (SPSS Inc., Chicago, IL, USA).

RESULTS

All but one of 114 patients (99.1%) reported having diarrhoea. There were 39 (34.2%), 53 (46.5%) and 22 (19.3%) patients from the Helsinki, Kuopio and North Karelia areas, respectively. The median age of the patients was 50 (range 1–88) years, and 35 (30.7%) patients were aged ≥60 years; the median ages in the three regions did not differ statistically, but the patients in the study were slightly older than the general population in the three regions ($p < 0.0001$, *t*-test). Males (48.2%) and females (51.8%) were represented equally; this was also true for the general population in all three of the study regions. However, the distribution of males and females among the three centres was uneven (p 0.0020, Pearson's chi-square), in that there was a higher number of females in the Helsinki area (27/39, 69.2%; p 0.0314, *z*-test) and of males in the North Karelia area (17/22, 77.3%; p 0.0098, *z*-test) compared with the general population in these two regions. Stool samples were collected during July (68 cases, 59.6%), August (37 cases, 32.5%) and September (nine cases, 7.9%).

The duration of the illness (mean 8.4 days, range 2–31 days) was 2–5 days, 6–10 days and >10 days in 23 (20.2%), 58 (50.9%) and 26 (22.8%) patients, respectively. Exposure factors, demographical characteristics and the month when the stool sample was collected were not associated with the duration of disease.

In total, 82 exposure factors were analysed. Several exposure factors clearly differed among the age groups. Intake of medication (other than antimicrobial or acid-reducing agents) before becoming ill was less common in the group aged 18–39 years (3/28, 10.7%), and was more common than expected in the group aged ≥60 years (25/35, 71.4%; $p < 0.0001$). Swimming was more common than expected among children aged 0–5 years (4/4, 100%), and was less common than expected in the group aged ≥60 years (10/35, 28.6%; p 0.0480) (Fig. 1). Consumption of chicken (p 0.0380) and eating outside the home (p 0.0001)