

## Epidemiological aspects of *Campylobacter jejuni* enteritis

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### SUMMARY

An epidemiological study on *Campylobacter jejuni* enterocolitis was performed in an urban Swedish community. The study included 55 patients gathered during a six-month period. Forty-one of the 55 patients (75%) were infected outside Sweden. *Campylobacter* enterocolitis was rare among children within the country. Patients infected in Sweden had eaten chicken significantly more often than a corresponding control group. Seven out of nine chicken consuming campylobacter patients also had prepared the fresh chicken alone, and none of their family members became ill. Thus the preparation of food contaminated with *Campylobacter* seems to elevate the risk for contracting the disease. Sick household pets transmitted the campylobacter infection to two patients. Forty-six of the patients had a total of 85 close household members. Three definite secondary cases were found. There was no evidence of transmission of *Campylobacter* by food prepared by two cooks who were working while still being asymptomatic excretors. Clinical reinfection with *Campylobacter* was observed in one patient. No patients became long-term carriers of *Campylobacter*.

### INTRODUCTION

*Campylobacter jejuni* (*Campylobacter*) has recently proved to be one of the most common bacterial agents of enterocolitis in man (Skirrow, 1977; Butzler & Skirrow, 1979; Svedhem & Kaijser, 1980). These bacteria are also frequently found in the faeces of such domestic animals as chickens, pigs, sheep and cattle (Grant, Richardson & Bokkenheuser, 1980; Simmons & Gibbs, 1979; Smith & Muldoon, 1974; Svedhem & Kaijser, 1981). *Campylobacter* seems to belong to the normal intestinal flora of these animals who thus may be potential sources of human campylobacter infection. There are several reports of spread from pet animals (Blaser *et al.* 1978; Ferreira, Ribeiro & Ricciardi, 1979; Hosie, Nicolson & Henderson, 1979; Skirrow *et al.* 1980; Svedhem & Norkrans, 1980). Transmission from person to person occurs (Skirrow, 1977). Epidemic outbreaks are described from drinking-water and raw milk (CDC, Center for Disease Control, 1978; Mentzing, 1981; Robinson *et al.* 1979). However, the mode of transmission may differ. Although transmission is supposed to be mainly alimentary, the epidemiology

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of campylobacter infection is at present not clearly defined, partly because of the lack of established serological tools for diagnosing and an uniform method for serotyping of the bacteria.

The aim of the present prospective investigation on campylobacter enterocolitis in man was to form an opinion of the importance and relative occurrence of different sources and ways of transmission of the infection during a continuous time period in an urban Swedish community.

## MATERIALS AND METHODS

### *Patients*

*Family studies.* All patients at the Department of Infectious Diseases, University of Göteborg, Sweden, from whom *Campylobacter* had been isolated during the six-month period from October 1979 to March 1980 were selected for study. Altogether 70 patients were asked to participate, and 55 actually entered the study. Only two were in-patients. When the bacteriological diagnosis was established each patient was interviewed, and repeated faecal sampling was performed for at least 6 weeks or until three consecutive samples were negative. The interview gathered information on recent travel, food intake during the week before onset of illness, participation in cooking at home, type of water supply, size of family and keeping of pets. Stool samples from all family members and pets were obtained twice with a fortnight's interval.

Patients infected abroad were defined as patients who were healthy when they left Sweden and remained so for at least 2 days after their departure. These patients fell ill abroad or shortly after returning home.

Stool samples and an interview were obtained from an age-matched control group to the patients infected in Sweden. The control group was composed of otherwise unselected out-patients with different kinds of non-enteric acute infections during the six-month period.

*Institutional studies.* Two female patients with campylobacter enterocolitis worked as cooks in a day-care centre and a hospital kitchen, respectively. They were allowed to return to their ordinary work when their diarrhoea had subsided, but they still were asymptomatic faecal excretors of *Campylobacter*. Ten days after the cook's return to work, stool samples were obtained from all children ( $n = 46$ ) and staff ( $n = 17$ ) at the day-care centre, and from 23 out of 28 persons working in the hospital kitchen. The kitchen serves over 1000 meals/day to patients and hospital staff.

### *Bacteriological cultures*

Faecal specimens from all patients with diarrhoea were obtained by a rectal swab. The swab was put into a glass tube containing a slightly modified Stuart medium (Gästrin, Kallings & Martecic, 1968) and transported to the regional bacteriological laboratory. All specimens were plated within 12 h.

The faecal specimens for follow-up and samples for family studies were obtained by a rectal swab at home after the patients had been thoroughly instructed as to

procedures, and transported in the modified Stuart medium by mail to the laboratory. The transport time never exceeded one day and the bacteria are viable for several days in this medium.

*Campylobacter* was cultured as described by Skirrow (Skirrow, 1977). All specimens also cultured for *Salmonella sp.*, *Shigella sp.* and *Yersinia enterocolitica*. Direct plating on selenite – and XLD-agar (XLD – xylose, lysine, desoxycholate, BBL, Baltimore Bacteriological Laboratory) was performed from the transport tubes, but also after 1 day of enrichment in selenite broth. The plates were read after 48 h incubation.

### Serotyping

Some of the *Campylobacter* strains isolated have been 0-serotyped by Dr S. Lauwers in Brussels, based on passive hemagglutination using heat-stable antigens. Antisera are raised in rabbits by immunization of living *Campylobacter* cells (Lauwers, Vlaes & Butzler, 1981). The nomenclature of Dr Lauwers' scheme is used.

### Statistical methods

The chi-square method with Yates's correction was used for statistical calculations.

## RESULTS

*Sex and age distribution* in the 55 patients in the study and the 15 drop outs is shown in Table 1. Only three patients were 15 years old or less.

*Travel.* Forty-one of the 55 patients (75 %) and 11 of the 15 drop outs (73 %) were infected abroad. The shortest time between arrival to a foreign country and onset of illness was four days. In one patient, a *Salmonella* species also was isolated from the stools.

*Foods.* Reliable information on the type of food consumed during the week before onset of illness could only be obtained from the patients infected in Sweden. These patients had eaten chicken significantly more often than the matched control group (Table 2). Seven of the nine campylobacter patients, who had eaten chicken, had done the cooking (Figure 1). None of these patients' family members, who had eaten the prepared bird, were infected by *Campylobacter*. The intake of other kinds of meat, dairy products and vegetables did not differ between the two groups, nor did the restaurant habits. All campylobacter patients and control patients were using the community water supply system.

*Keeping of pets.* Seventeen of the patients had a total of 20 pets (six cats, five dogs, eight birds, one guinea pig). A kitten proved to be the 'index case' to a female with campylobacter enterocolitis as reported elsewhere (Svedhem & Norkrans, 1980), and a puppy with *Campylobacter* and diarrhoea transmitted the disease to another 'index case' female. The two pairs of *Campylobacter* isolates from pet-patient belonged to the serotypes 25/28/48 and 3/47 respectively. The rest of the animals appeared to be healthy and were all negative in stool cultures for *Campylobacter*.

*Family size.* Forty-six of the 55 patients in the study had families with a total

Table 1. Sex and age distribution in the 70 patients with campylobacter enterocolitis

	In the study		Drop outs		Total
	Women	Men	Women	Men	
Number	32	23	9	6	70
Age (years)					
Median	26	34	29	36	29
Range	1-61	2-65	21-53	26-70	1-70

Table 2. Number of patients with *Campylobacter jejuni* enteritis and non-enteric infections (control group) having consumed food prepared from chicken or pig during the week before onset of illness

Type of food	Campylobacter patients (n = 13)	Control patients (n = 14)
Chicken	9*	2
Pig	2	7
Neither of above	2	5

\*  $P < 0.01$ .

of 85 household members (range 1-6 members/household - patients excluded). Nine patients lived alone.

*Intrafamilial spread.* Three secondary cases of symptomatic campylobacter disease were diagnosed in two different households: The illness started in one man 6 days after his wife had returned from abroad with *Campylobacter* enterocolitis, and both isolates were of the serotype 20. A mother and her 3 year-old child fell ill 6 and 13 days, respectively, after the family's one-year-old child had fallen ill. The strains were not serotyped.

*Campylobacter* was isolated from stools from three additional persons without clinical disease in a further three different households: *Campylobacter* was found in a man 7 days after his wife's return from abroad, and in a mother 12 days after her 25-year-old daughter's return to Sweden. The strains were not serotyped. Finally, a woman fell ill one week after coming back to Sweden and her husband had a positive *Campylobacter* culture 13 days after onset of his wife's illness. The latter two isolates were both not typable.

*Institutional studies.* *Campylobacter* could not be isolated from the 63 children or staff in the day-centre, or from the 23 hospital kitchen staff tested. No campylobacter patient in the study had eaten meals from the hospital kitchen during the period following the cook's illness. The cook worked for more than 1 week while still excreting *Campylobacter*.

*Reinfection.* One patient had an attack of campylobacter enterocolitis after a visit abroad in 1978 and recovered clinically at that time, but was not followed up with stool cultures until clearance of *Campylobacter* from faeces. The patient returned again from abroad with enterocolitis and positive campylobacter cultures

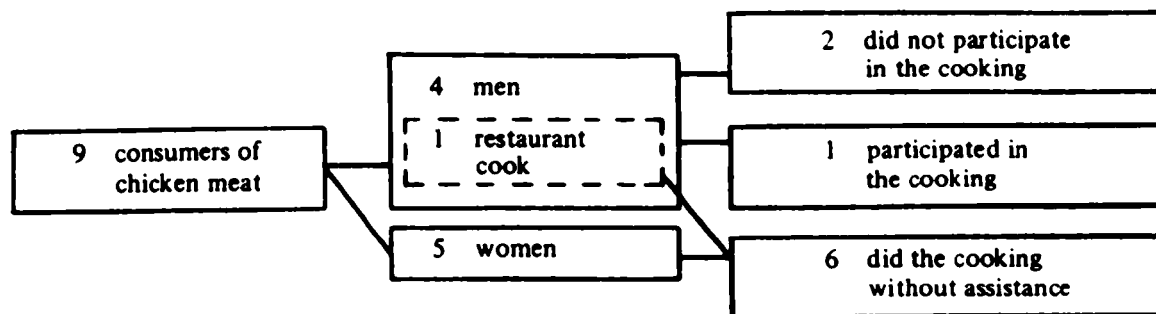


Fig. 1. Nine patients with campylobacter enteritis who consumed chicken the week before onset of disease and their participation in cooking of the birds.

during the 6-month study period. He recovered clinically and was free from *Campylobacter* in faecal samples 4 weeks after onset of illness. The *Campylobacter* isolates from 1978 and 1980 belonged to different serotypes, 13/45/w and 3/47 respectively.

**Duration of excretion.** The excreting period of *Campylobacter* ended within 4 weeks after onset of disease in 30 patients. Twenty-three patients became excretors for 4–10 weeks, and only two reached the maximum of 10 weeks. No longterm carriers were seen.

#### DISCUSSION

It has earlier been reported that a majority of the campylobacter infections diagnosed in Sweden have been acquired outside Sweden (Svedhem & Kaijser, 1980). As is seen in the present study, the infection is primarily a traveller's disease – 75% of the patients had acquired the infection abroad. This pattern is not as prominent in other developed countries and the opposite is found in developing countries (Bokkenheuser, *et al.* 1979). There may be some risk of bias, however, in that patients contracting diarrhoea following a journey abroad may to some extent seek help at the Department of Infectious Diseases more often than patients with enteritis acquired in Sweden. The community is mainly urban and the 70 patients diagnosed at the clinic constituted about half of all the patients diagnosed during the 6 month period at the only bacteriological laboratory in the region.

It is known that *Campylobacter* is a frequent or almost regular finding in the faeces of animals such as chickens and pigs (Smith & Muldoon, 1974; Svedhem & Kaijser, 1981). Increasing evidence also suggests that chickens might be a predominant source of human infection (Skirrow, 1977; Brouwer, Mertens, Siem & Katchaki, 1979). Proper heating eliminates the risk of transmission of *Campylobacter*, but the person preparing a fresh or frozen chicken may carry a risk of acquiring the infection (Brouwer *et al.* 1979; Svedhem, Kaijser & Sjögren, 1981). In the present study, patients infected in Sweden had eaten chicken significantly more often than a control group, and seven of nine patients also participated in cooking.

*Campylobacter* is found among household pets, such as cats and dogs (Svedhem

& Kaijser, 1981; Ferreira *et al.* 1979; Hosie *et al.* 1979; Skirrow *et al.* 1980; Svedhem & Norkrans, 1980). In the present study, one index-woman was seen actually to be a secondary case to a sick kitten. Other kittens from the same cat farm were also infected (Svedhem & Norkrans, 1980). A sick puppy also turned out to be the source of infection to another index-woman. The dog farm from which this newly acquired puppy came was investigated, and *Campylobacter* could be isolated from one of five adult dogs and from four of four other puppies. Pets may thus be a minor but still significant source of campylobacter infection in Sweden.

Six cases of suspect secondary transmission of *Campylobacter*, three with and three without symptoms, were found. Secondary spread from patients giving rise to symptomatic enterocolitis was clearly established from one of the 46 (2.2%) patients with families to one of the 85 family members. Whether the mother and her child described represent real secondary cases to the 'index child' is uncertain. Two asymptomatic cases probably also represent real secondary spread (4.3%), while the third asymptomatic case mentioned may be due to a common intrafamilial source of infection occurring in Sweden. Skirrow reported that secondary cases occurred especially among children (Skirrow, 1977). As a comparison to our 2.2% of secondary symptomatic spread of *Campylobacter* this occurred from 24 of 887 (2.7%) index cases in an epidemic outbreak of *Salmonella enteritidis* in Sweden in 1977 (Böttiger *et al.* 1977). We feel, however, that the risk of secondary transmission of *Campylobacter* is even lower when overt diarrhoea has subsided, and the patient is informed about and aware of the potential contagiousness.

The special growth conditions required for *Campylobacter*, including sensitivity to atmospheric oxygen, is probably one factor accounting for the low risk of secondary transmission of the infection, despite the fact that the infective dose appears to be low (Robinson, 1981). The low risk of secondary spread is illustrated by the absence of secondary cases in the day-care centre and the hospital population, in spite of the fact that the two cooks came back to work after they had clinically recovered but when they still were harbouring *Campylobacter*. Otherwise, in Sweden, a cook who excretes enteric pathogens such as a *Salmonella* or a *Shigella* is legally not allowed to work, in spite of being clinically well, until free from the intestinal pathogen. This kind of legal restriction has not been applied to campylobacter enterocolitis, as the risk of secondary transmission from asymptomatic carriers has been regarded as very low.

Human healthy excretors of *Campylobacter* are not common in the Western world but seem to be more frequent in the developing countries (Bokkenheuser *et al.* 1979; Blaser *et al.* 1980). All patients in the present study cleared the bacteria within 10 weeks after onset of disease. Reinfection was seen in one patient, which recently also was reported by Karmali *et al.* (1981). Very little is known about the development and duration of immunity following campylobacter infection.

In conclusion, we found that campylobacter enterocolitis is predominantly a traveller's disease in Sweden, rarely affecting children in this country. The route of transmission is probably mainly alimentary, and chicken was indicated to be one risk factor. The preparing of fresh food contaminated with *Campylobacter* might be a raised risk for acquiring the infection. Infected pets, especially young animals,

are also sources of campylobacter infection. Secondary transmission from patients do occur but is uncommon, and there seems to be little risk of transmission of the disease from kitchen staff excretors without diarrhoea. Clinical reinfections with *Campylobacter* may occur.

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