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Incidence of gastroenteritis in Norway – a population-based survey

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SUMMARY

In 1999–2000 we conducted a one-year, retrospective population-based survey in Norway to estimate the incidence of gastroenteritis and study the association with selected exposures. A self-administered questionnaire was mailed to 3000 persons selected at random from the population registry, with 250 persons being contacted each month. The response rate was 61%. The incidence of acute gastroenteritis was 1·2 per person-year. The incidence was higher for women than for men. Of the total of 171 cases, 29 (17%) consulted a physician, 13 (8%) reported that a stool sample was taken, and 7 (4%) were admitted to hospital. Among children aged less than 15 years, drinking water from a private water supply was associated with illness, while using chlorinated water was protective. Among adults aged 20–40 years, travelling abroad was associated with illness. The incidence in our survey is similar to rates found by FoodNet in United States.

INTRODUCTION

Gastrointestinal infections are common diseases all over the world. In developing countries, gastrointestinal infections are an important cause of childhood mortality; about 1·5 million child deaths per year are attributable to them [1]. In developed countries these diseases are rarely fatal, but they cause considerable morbidity, and high costs due to consultations, medications, hospitalizations and absence from work.

Studies conducted during the last years in developed countries have shown considerable variation of the incidence of gastroenteritis and consultation rate because of the illness. Incidence rates between 0·19 and 1·4 per person-year have been reported [2–5]. The consultation rate has varied from 0·008 to 0·033 per person-year [2, 4]. In a previous survey in Norway in 1986, the incidence of acute gastroenteritis was 1·5 per person-year among people above 15 years of age, which means about 5 million episodes per year [6]. The consultation rate was 0·3 per person-year. In Norway, and other Nordic countries, the prevalence of certain infectious agents in domestic animals and food products of animal origin is considerably lower than in other European countries [7–9]. There are concerns that globalization of the food market may result in increased risk of food-borne disease and increase the incidence of gastrointestinal infections.

We conducted a national survey to estimate the incidence and the burden of gastroenteritis in Norway. This information is important for planning control measures, setting priorities and guide prevention strategies for gastroenteritis, especially food-borne diseases.

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MATERIAL AND METHODS

The survey was carried out during the one-year period from 15 June 1999 through 14 June 2000. Statistics Norway was responsible for the sampling, collection, and collation of data. The Norwegian Institute of Public Health (NIPH) and the National Food Authority planned the survey and constructed the questionnaire. Data analysis was performed by NIPH.

A total of 3000 persons were selected at random from the population registry (a governmental registry of all Norwegian residents). A pretested questionnaire was mailed to all persons selected for the survey together with a letter of information in which they were asked to return the completed questionnaire to Statistics Norway. Seasonal variation in the incidence of gastroenteritis was taken into account by distributing the questionnaires randomly to 1/12 of the persons every month. One week after submission of the questionnaire, a reminder was mailed to all study subjects. Those who had not responded within 3 weeks, received a second reminder accompanied by a new copy of the questionnaire. For children under 15 years of age, parents were asked to fill out the questionnaire.

The questionnaire collected information about demographic characteristics, occurrence of gastroenteritis during the 4 weeks before the questionnaire was completed, symptoms of gastroenteritis, medical care and days lost from work. Persons who reported symptoms of gastroenteritis were queried about selected exposures in the 2 weeks before illness onset, while asymptomatic persons were questioned about the 2 weeks before completing the questionnaire. The exposures included were: travel abroad, eating outside of the home, eating meat products purchased abroad, drinking water that was not from waterworks or from bottles and contact with domestic animals. Information describing the quality and supply of drinking water in the household was also collected. All study subjects were asked about chronic gastrointestinal illness, previous abdominal surgery and regular medications.

A case was defined as a person who had the following symptoms during the 4 weeks before completion of the questionnaire: (1) diarrhoea (i.e. three or more loose stools/24 h), or (2) at least three of the following symptoms: vomiting, nausea, abdominal cramps or fever $\geqslant 38\ ^{\circ}C$. Nineteen persons (1·0% of respondents) with chronic diarrhoeal illness were excluded.

We analysed data by using the software package EpiInfo 6.04 (Centers for Disease Control and Prevention [CDC], Atlanta). The incidence density was calculated by using the number of persons with gastroenteritis during the 4-week period as numerator and the number of observation weeks as denominator. We compared respondents meeting the case definition to asymptomatic respondents with regard to the characteristics and exposures indicated above. Four-weekly attack rates (incidence proportions) and relative risks with 95% confidence intervals were calculated. For proportions, 95% confidence intervals were calculated by normal approximation to the binomial distribution. Kruskal-Wallis test was used in comparison of continuos variables.

RESULTS

One thousand eight hundred and forty-three (61%) persons completed the questionnaire; 51% were men. Median age was 38 years (range 0–96 years). Respondents represented fairly well the population, with respect to age and geographical distribution (Tables 1, 2). Response rates were lowest among persons aged 15–24 years and highest among persons aged 40–64 years (Table 1).

Gastrointestinal symptoms were reported by 265 (14%) respondents during the 4-week period before completing the questionnaire; 114 (43%) of them were men. Median age was 20 years (range 0–93). The proportion of symptomatic persons was highest among children aged 0–4 years (23%), followed by respondents aged 25–39 years (19%), and those aged 15–24 years (19%) (Table 1). The proportion of symptomatic respondents varied between 11·2 and 17·8% in the seven regions of Norway (Table 2).

One hundred seventy-one (9·3%) respondents met the case definition; 56% were women. Women were more likely to meet the case definition than men (10·7% *vs.* 7·9%; RR 1·4, 95% CI 1·0–1·8). Median age was 30 years (range 1–87). Persons aged 25–39 years were most likely to meet the case definition, and persons aged 65 years or more were least likely (Table 1). The proportion of cases by region varied from 7·9 to 11·7% (Table 2). Diarrhoea was the most frequent symptom (88%), followed by abdominal pain/cramps (77%), nausea (71%), vomiting (42%) and fever (28%). One hundred and forty-three cases felt that their symptoms had resolved when the questionnaire was completed (28 were still symptomatic). For these cases the median duration of

Table 1. *Gastrointestinal symptoms and cases of acute gastroenteritis by age group in a 4-week period among a sample of the Norwegian population, 1999–2000*

Age (years)	Population	%	Respondents	%	Gastrointestinal symptoms (%)	Cases (%)	95% CI*
0–4	302387	6·8	116	6·3	26 (22·9)	15 (12·9)	6·8–19·0
5–14	592330	13·2	270	14·7	46 (17·0)	29 (10·7)	7·0–14·4
15–24	544122	12·1	179	9·7	34 (19·0)	20 (11·2)	6·6–15·8
25–39	1011876	22·6	398	21·6	77 (19·3)	55 (13·8)	10·4–17·2
40–64	1344750	30·0	622	33·7	66 (10·6)	44 (7·1)	5·1–9·1
⩾65	683032	15·3	258	14·0	16 (6·2)	8 (3·1)	1·0–5·2
Total	4478497	100·0	1843	100·0	265 (14·4)	171 (9·3)	8·0–10·6

* 95% CI for percentages.

Table 2. *Gastrointestinal symptoms and cases of acute gastroenteritis in a 4-week period among a sample of the Norwegian population, by region, 1999–2000*

Region*	Population	%	Respondents	%	Gastrointestinal symptoms (%)	Cases (%)	95% CI†
Southeastern Norway							
Oslo region	974519	21·8	413	22·4	65 (15·7)	38 (9·2)	6·4–12·0
Inland counties	369804	8·3	163	8·8	29 (17·8)	19 (11·7)	6·7–16·6
Other counties	862841	19·3	346	18·8	54 (15·6)	33 (9·5)	6·4–12·6
Southwestern Norway	631079	14·1	241	13·1	27 (11·2)	19 (7·9)	4·5–11·3
Western Norway	785966	17·5	329	17·9	43 (13·1)	31 (9·4)	6·3–12·6
Central Norway	389960	8·7	163	8·8	20 (12·3)	15 (9·2)	4·8–13·6
Northern Norway	464328	10·4	184	10·0	27 (14·7)	16 (8·7)	4·6–12·8
Total	4478497	100·0	1843	100·0	265 (14·4)	171 (9·3)	8·0–10·6

* Counties in the regions:
Southeastern Norway:
Oslo region: Oslo, Akershus
Inland counties: Hedmark, Oppland
Other counties: Østfold, Vestfold, Buskerud, Telemark
Southwestern Norway: Aust-Agder, Vest-Agder, Rogaland
Western Norway: Hordaland, Sogn og Fjordane, Møre og Romsdal
Central Norway: Sør-Trøndelag, Nord-Trøndelag
Northern Norway: Nordland, Troms, Finnmark
† 95% CI for percentages.

illness was 3 days (range 1–60). The incidence density during the whole period was 1·2 cases per person-year. Response date was available for 1106 participants (60%), and incidence density among them varied by month from 0·5 to 1·8 cases per person-year, being lowest in the late spring and early summer, and highest in September-October, December and March (Fig. 1).

Altogether 38 cases (23%) contacted a physician because of the illness: 29 (17%) consulted, while an additional 9 cases phoned their doctor, only. Median age of cases consulting a physician was 32 years, and 55% of them were women. Median duration of illness was 5 days (range 1–10 days), and was significantly longer than among cases who did not contact a physician ($P<0·001$). Symptoms were similar to those of all cases. However, among a total of 9 cases with bloody diarrhoea, 5 consulted a physician.

Twenty-three (13%) cases received medication, and 6 of them were treated with antimicrobial drugs. Seven cases were hospitalized, 4 men and 3 women. Median age was 41 years (range 6–78). Median duration of hospitalization was 4 days (range 1–7), and all hospitalized cases were treated with intravenous fluids.

Thirteen (8%) cases reported that stools samples were investigated, and five reported that they knew the causative pathogen, but only two were able to

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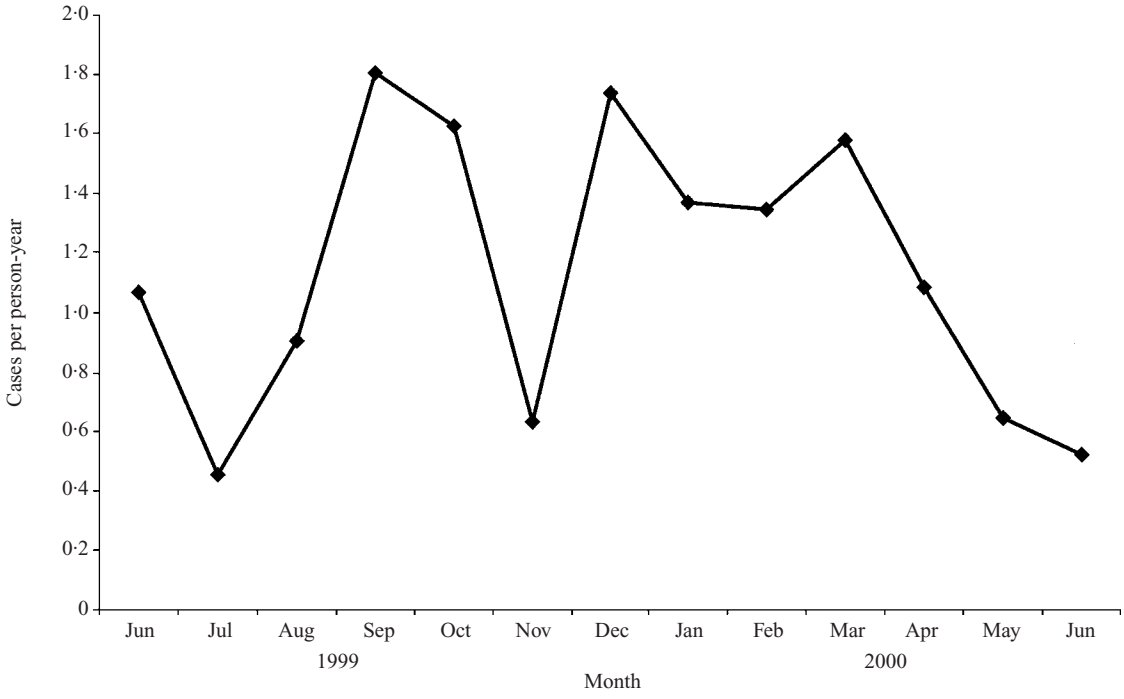

Fig. 1. Incidence of acute gastroenteritis by month, Norway, June 1999 to June 2000.

specify the pathogenic agent involved (shigella and *Staphylococcus aureus*). For 60 (35%) cases the patient or a parent/attendee had to be absent from work at least 1 day because of the illness. The number of days lost from work ranged from 1–14 (median 2 days).

In the whole survey population, none of the various risk factors were significantly associated with illness (Table 3). The respondents were initially stratified into four age groups: 0–14 years, 15–39 years, 40–64 years, and ⩾65 years. In the youngest age group, receiving household water from a private supply (a well or surface source) was identified as a significant risk factor (RR 3·1, 95% CI 1·4–7·1), while using water from a chlorinated source was protective (RR 0·4, 95% CI 0·2–0·9) (Table 4). Travelling outside Norway was significantly associated with an increased risk of illness among respondents aged 21–40 years (RR = 1·8, 95% CI 1·0–3·0). In the remaining age groups, no significant difference between the cases and their asymptomatic counterparts were detected for any of the risk factors (data not shown).

DISCUSSION

This is the second national survey conducted in Norway to estimate the incidence of acute gastroenteritis. Based on our case definition, the estimated incidence was 1·2 per person-year. The consultation rate was 0·2 per person-year, and the hospitalization rate 0·05 per person-year. The limited number of cases did not allow us to reach firm conclusions about geographical, seasonal or age variations in incidence. The result is similar compared with the previous Norwegian survey, which gave an incidence of 1·5 episodes per person-year [6]. In the previous survey, only persons aged 15 or more were interviewed, and the case definition included persons who had diarrhoea, vomiting, nausea, or abdominal pain, i.e. slightly broader than in the present investigation. The consultation rate of cases was also nearly the same as in the previous survey, in which 21% of cases consulted a physician while in our survey the rate was 19%. The hospitalization rate was not addressed in the previous survey.

Compared with most studies in other countries, the incidence found in our survey is high. However, the comparison is difficult because of different case definitions and study designs. In a retrospective, population-based telephone survey conducted in FoodNet sites in the US, the incidence of gastroenteritis, was 1·4 per person-year, a similar result as in our survey [5]. Gastroenteritis in the FoodNet survey was defined as diarrhoea with three or more loose stools or bowel movements in any 24-h period. In previous retrospective studies in the US, the age-adjusted incidence

Table 3. *Risk factors for acute gastroenteritis among a sample of the Norwegian population, 1999–2000*

	Exposed			Not exposed				
Risk factor	Ill	Total	AR	Ill	Total	AR	RR	95% CI
Travel outside Norway	20	169	11·8	150	1539	9·7	1·2	0·8–1·9
Animals in household	70	692	10·1	101	1053	9·6	1·0	0·8–1·4
Eating outside home	100	998	10·0	66	662	10·0	1·0	0·8–1·4
Eating meat bought outside Norway	31	365	8·5	117	1107	10·6	0·8	0·6–1·2
Household water from municipal supply	155	1587	9·8	9	79	11·4	0·9	0·5–1·6
Household water from own supply	31	257	12·1	50	551	9·1	1·3	0·9–2·0
Chlorinated water	73	755	9·7	42	418	10·0	1·0	0·7–1·4
UV-radiated water	8	95	8·4	31	302	10·3	0·8	0·4–1·7

Table 4. *Risk factors for acute gastroenteritis among respondents aged 0–14 years from a sample of the Norwegian population, 1999–2000*

	Exposed			Not exposed				
Risk factor	Ill	Total	Attack rate (%)	Ill	Total	Attack rate (%)	RR	95% CI
Travel outside Norway	2	27	7·4	42	356	11·8	0·6	0·2–2·5
Animals in household	19	183	10·4	25	202	12·4	0·8	0·5–1·5
Eating outside home	26	217	12·0	16	157	10·2	1·2	0·7–2·1
Eating meat bought outside Norway	7	72	9·7	33	255	12·9	0·8	0·4–1·6
Household water from municipal supply	34	341	10·0	5	26	19·2	0·5	0·2–1·2
Household water from own supply	11	53	20·8	9	135	6·7	3·1	1·4–7·1
Chlorinated water	11	155	7·1	15	94	16·0	0·4	0·2–0·9
UV-radiated water	2	14	14·3	10	70	14·3	1·0	0·3–4·1

of gastroenteritis, defined as diarrhoea, vomiting or both, was between 0·81 and 0·87 per person-year [3]. According to FoodNet data, the hospitalization rate for acute diarrhoeal illness is 0·007 per person-year, only one seventh of our result [3].

In Wales, the incidence of gastroenteritis in a retrospective study carried out in 1992 was 7% per month, i.e. about 0·8 per person-year [10]. Case definition in this study included persons with three or more loose stools in a 24-h period. In England, the incidence of gastroenteritis in the general population has been estimated to 0·19 per person-year, only one sixth of our incidence [2]. Case definition included persons with loose stools or significant vomiting (more than once in 24 h, incapacitating or accompanied by cramps or fever). In that study, data was collected prospectively by post cards sent every week by each participant indicating whether he/she had fallen ill or not. The English researchers also collected retrospective data on diarrhoea in a preliminary interview, which gave an incidence of 0·55 per person-year. The consultation rate in England was 0·03 per person-year, considerably lower than in our survey. Hospitalization rate was not investigated in that study [2].

In the Netherlands, again in a population-based prospective study, the incidence of gastroenteritis was 0·28 per person-year, one fourth of our incidence [11]. Case definition included persons with at least three loose stools in 24 h or vomiting at least three times in 24 h, or vomiting or diarrhoea with two or more additional symptoms in 24 h. In a previous Dutch study, about 20% of cases consulted a physician, a similar result as in our survey [12].

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In our survey, 35% of cases (or their parents) were absent from work because of gastroenteritis, while in the previous Norwegian survey, which only included persons older than 15 years, the proportion was 26%. In the Netherlands, 58% of children were absent from school for a median duration of 3 days, and 60% of working patients were absent from work for a median duration of 2 days. These results are not directly comparable to our results, because in the Dutch study all cases had contacted a physician, and may have had a more severe illness [4].

The economic impact of acute gastroenteritis in Norway is high. If we assume that the present data are representative, acute gastroenteritis is responsible for 15 million days of illness, 220000 admissions to hospital, 800000 days of hospital stay, 15 million days lost from work, 900000 physician consultations and 190000 antimicrobial prescriptions among the 4·5 million Norwegians each year. These figures are minimum values, since 28 cases were still symptomatic by the time the questionnaire was completed. However, it should be emphasized that this survey was too limited to enable exact estimates. Moreover, our survey had limitations that may have resulted in overestimation of incidence and economic impact. The response rate was only 61%. Probably persons who had gastroenteritis were more likely to complete the questionnaire than asymptomatic individuals, thus creating a selection bias. In addition, studies conducted elsewhere have emphasized the influence of recall bias in retrospective studies [2, 11]. The respondents may have reported episodes of gastroenteritis that occurred earlier than 4 weeks before completing the questionnaire. This may also have contributed to the comparatively high incidence detected. Studies collecting retrospective, self-reported symptoms tend to give considerably higher figures than prospective studies, and should therefore be interpreted with caution [2, 11]. Compared with retrospective studies elsewhere, the difference was less marked. However, our incidence still was 1·5 to 2 times higher than in most retrospective surveys in other countries [2, 3, 10, 12]. It is unlikely that the incidence of gastroenteritis in Norway would differ significantly from other industrialized countries. Although there is a widespread use of undisinfected drinking water in Norway, the prevalence of pathogens like salmonella and campylobacter in the food chain is comparatively low [7].

Our sample size was not large enough to estimate reliably the hospitalization rate. However, our consultation rate and hospitalization rate support the presumption that our incidence is an overestimate. The hospitalization rate detected would result in 220000 admissions to hospital due to acute gastroenteritis annually. In 2000, however, the total number of hospitalizations in Norway was 692000, of which only 16000 were ascribed to an infectious cause. It would be interesting to conduct a prospective population-based study in Norway to see whether it would give different results.

When the data were analysed as a whole, no risk factor was associated with illness. The list of exposures included in the questionnaire was limited. An exhaustive investigation of risks was not intended. A number of case-control studies of gastrointestinal infections acquired in Norway, have identified a range of risk factors, many of which are specific for a certain disease [13–18].

When the data set was stratified by age group, travelling outside Norway was associated with illness among young adults, an age group that travels a lot. This is in accordance with information from the national surveillance system, which shows that relatively high percentages of several important enteric infections are acquired abroad [19]. It is more difficult to interpret the finding that drinking water from a private well is associated with illness in the youngest age group, only. In the same age group, living in a household with chlorinated drinking water was protective. A possible explanation for these findings is that children are more susceptible. Persons living in a household with a private well are likely to be exposed to waterborne enteric pathogens early in life, while older age groups may have developed immunity from previous infections. Many respondents were unsure about the quality of their drinking water supply, leading to missing values in the data set (Tables 3, 4). Therefore, the results of these questions should be interpreted with caution. Nevertheless, this survey supports previous epidemiological investigations of sporadic cases and outbreaks which have identified the use of undisinfected drinking water as a prominent risk factor for enteric infections in Norway [14, 15, 17, 18].

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