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Interim report of a study on gastroenteritis in sentinel practices in the Netherlands (NIVEL) 1996-1999. Results of the first two years

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SAMENVATTING

Inleiding In 1996 is een onderzoek gestart naar gastro-enteritis bij patiënten die zich met gastro-enteritis bij de huisarts melden. Dit onderzoek wordt uitgevoerd in samenwerking met het Nederlands Instituut voor Onderzoek van de Gezondheidszorg (NIVEL) en heeft de volgende doelen: schatten van (trends in) de incidentie van gastro-enteritis waarvoor een huisarts wordt geconsulteerd, evalueren van het effect bij mensen van een preventief programma bij productie-dieren om het aantal *Salmonella*- en *Campylobacter*-infecties terug te dringen, schatten van het relatieve belang van een breed panel van micro-organismen in het veroorzaken van gastro-enteritis en het identificeren van risicofactoren. De dataverzameling zal in 1999 worden afgerond. In dit rapport worden de resultaten van de eerste twee jaar van dit onderzoek gepresenteerd.
Methode Het onderzoek bestaat uit twee delen: een enumeratie-studie en een patiënt-controleonderzoek. Alle patiënten die een NIVEL-huisarts (40-45 peilstations) consulteren worden geturfd, naar geslacht en leeftijdsgroep. Huisartsen die deelnemen aan het patiënt-controleonderzoek (33-36 peilstations) vragen bovendien elke patiënt die hen consulteert voor gastro-enteritis en een op leeftijd gematchte controle om een vragenlijst in te vullen en een fecesmonster te verzamelen.
Resultaten De incidentie van gastro-enteritis waarvoor een huisarts wordt geconsulteerd, was 77 per 10.000 persoonjaren van mei 1996 tot mei 1998. De incidentie was significant hoger bij personen tot 5 jaar dan bij personen van 5 jaar en ouder. Ook werd een hogere incidentie gevonden voor vrouwen en voor stedelijke gebieden. Een lagere incidentie werd gevonden in de noordelijke regio in vergelijking tot de rest van Nederland. Van alle patiënten die een deelnemende huisarts consulteerden nam 40% deel aan het patiënt-controleonderzoek. In 34% van deze patiënten en in 7% van de controles werd een pathogeen in de feces aangetoond. Dit percentage was hoger in de leeftijdsgroepen tot 15 jaar (47%), en bij patiënten die minder dan 7 dagen klachten hadden voor zij de huisarts consulteerden (46%). *Campylobacter* spp werd geïsoleerd in de feces van 10% van de patiënten, *Salmonella* spp in 4% en *Shigella* spp en *Yersinia* spp in minder dan 1%. Deze bacteriën werden vrijwel niet gevonden bij controles. VTEC werd gevonden bij minder dan 1% van zowel patiënten als controles. Rotavirus en SRSV werden elk gevonden bij 5% van de patiënten, adenovirus bij 3% en astrovirus bij 1%. *Giardia lamblia* werd zowel bij patiënten (6%) als bij controles gevonden (4%). *Entamoeba histolytica*, *Cryptosporidium* en *Cyclospora* werden ieder gevonden bij 1-2% van de patiënten. *Dientamoeba fragilis* werd veel gevonden bij patiënten (10%) en nog vaker bij controles (15%). Als onafhankelijke risicofactoren voor gastro-enteritis werden onder meer gevonden: het hebben van een chronische maag-darmaandoening (OR=6.5 95% b.i. 3.6-11.4) en reizen naar Azië (OR=25.8 95% b.i. 3.0-220.9) en andere ontwikkelingslanden (OR=8.7 95% b.i. 1.1-70.4). Voor bacteriële, virale en parasitaire gastro-enteritis werden verschillen in risicofactoren gevonden; bijvoorbeeld, parasitaire

gastro-enteritis bleek samen te hangen met zwemmen in een zwembad en met het aanwezig zijn van een kind dat de basisschool bezoekt in het huishouden.
Conclusie In de incidentie van huisartsconsulten voor gastro-enteritis van 77 per 10,000 persoonjaren lijkt een lichte daling te observeren t.o.v. de incidentie van 90 per 10,000 persoonjaren in een vergelijkbaar onderzoek in 1992-1993. De belangrijkste verwekkers van gastro-enteritis waarvoor de huisarts wordt geconsulteerd waren *Campylobacter* spp, *Salmonella* spp, rotavirus, SRSV en *Giardia lamblia* en *Dientamoeba fragilis*. Deze laatste twee werden echter ook veel bij controles aangetroffen. De incidentie en het percentage positief voor *Salmonella spp*, *Salmonella* Enteritidis en *Campylobacter* leken enigszins gedaald ten opzichte van een vergelijkbaar onderzoek in 1992-1993. De risicofactoren voor de verschillende groepen pathogenen kunnen dienen als handvat bij het bepalen van preventieve maatregelen voor het oplopen van een infectie met deze pathogenen. Definitieve resultaten en meer uitgebreide risicoanalyses zullen worden gepresenteerd nadat de gegevensverzameling is afgerond.

ABSTRACT

Introduction In 1996, a study has started on gastroenteritis among patients presenting to a general practitioner for gastroenteritis. This study is performed in collaboration with the Netherlands Institute of Primary Health Care (NIVEL) and has the following objectives: to estimate (trends in) the incidence of gastroenteritis for which a general practitioner is consulted, to evaluate the effect on humans of preventive measures in production animals to reduce the number of *Salmonella* and *Campylobacter* infections, to estimate the relative importance of a broad panel of micro-organisms causing gastroenteritis and to identify risk factors. The data collection of this study will be completed in 1999. In this report the results from the first two years of the study are presented.

Methods The study consists of two parts: an enumeration study and a case control study. All cases presenting to NIVEL-general practitioners (40-45 sentinel practices) are enumerated, by age group and gender. Furthermore, general practitioners that participate in the case-control study (33-36 sentinel practices) invite every presenting case of gastroenteritis and an age-matched control to collect a stool sample and complete a questionnaire.

Results The incidence of gastroenteritis for which a general practitioner is consulted was 77 per 10,000 person years from May 1996 up till May 1998. The incidence was significantly higher in persons aged <5 years than in persons of 5 years and older. A higher incidence was also found for women and for urban regions. A lower incidence was found in the northern region in comparison to other regions of the Netherlands. Of all cases presenting to a participating general practitioner, 40% took part in the case control study. In 34% of these cases and in 7% of controls a pathogen was detected in the stool samples. This percentage was higher in the age groups <15 years (47%) and in cases with a duration of symptoms of 7 days or less before presenting to the general practitioner (46%). *Campylobacter* spp was isolated from the stool samples of 10% of cases, *Salmonella* spp in 4% and *Shigella* spp and *Yersinia* spp in <1%. These bacteria were found almost exclusively in cases. VTEC was found both in <1% of cases and controls. Rotavirus and SRSV were each found in 5% of cases, adenovirus in 3% and astrovirus in 1%. *Giardia lamblia* was found in cases (6%) as well as in controls (4%). *Entamoeba histolytica*, *Cryptosporidium* and *Cyclospora* were each found in 1-2% of cases and hardly in controls. *Dientamoeba fragilis* was very frequent in cases (10%) and even more in controls (15%). Independent risk factors for gastroenteritis were, amongst others, having a chronic gastrointestinal disorder (OR=6.5 95% c.i. 3.6-11.4) and travel to Asia (OR=25.8 95% c.i. 3.0-220.9) and to other developing countries (OR=8.7 95% c.i. 1.1-70.4). For bacterial, viral and parasitic gastroenteritis, differences in risk factors were observed; for instance, parasitic gastroenteritis was associated with swimming in a swimming pool and the presence of a child in elementary school in the household.

Conclusion The incidence of consultations at a general practitioner for gastroenteritis of 77 per 10,000 person years is a slightly lower than the incidence of 90 per 10,000

person years in a similar study in 1992-1993. The most important pathogens in gastroenteritis cases were *Campylobacter* spp, *Salmonella* spp, rotavirus, SRSV, *Giardia lamblia* and *Dientamoeba fragilis*. However, the latter two were found frequently in controls as well. The incidence and percentage positive of *Salmonella* spp., *Salmonella* Enteritidis and *Campylobacter* spp were slightly lower than in a similar study in 1992-1993. Risk factors for the different groups of pathogens can be used as tools in the design and implementation of measures for preventing infections with these pathogens. Final results and more extensive risk analyses will be presented after the data collection is completed.

LIST OF ABBREVIATIONS

RIVM	National Institute of Public Health and the Environment
NIVEL	National Institute of Primary Health Care
OR	Odds ratio
c.i.	confidence interval
GP	general practitioner
GP-cc	general practitioners participating in case-control study
GP-np	general practitioners not participating in case-control study
GE	gastroenteritis

1. INTRODUCTION

Gastroenteritis (GE) is a syndrome characterised by diarrhoea and/or vomiting. It can be caused by an infection with several different micro-organisms, amongst which bacteria, viruses and parasites, but also by a number of non-infectious agents, such as toxins and chemical substances. The morbidity of gastroenteritis is high; in the Netherlands, gastroenteritis ranks among the top ten of diseases with the highest incidence[1]. Recent studies have shown that several complications are related to preceding infections with gastrointestinal pathogens, such as Guillain-Barré syndrome after a *Campylobacter* infection[2] and hemolytic uremic syndrome after infection with *E.coli* O157 or *Shigella*[3].

In the Netherlands, two studies have been performed to estimate the incidence of gastroenteritis and the relative importance of different pathogens. In a study in collaboration with general practitioners (GP) in two cities (Amsterdam and Helmond) from 1987-1991, an incidence was found of 15 GP-consultations for gastroenteritis per 1,000 person years[4]. In 1992 en 1993, a national study was done in cooperation with GP's from the Netherlands Institute of Primary Health Care (NIVEL)[5] which estimated the incidence at 9 GP-consultations for gastroenteritis per 1,000 person years[6]. *Salmonella* spp. were found in 5% and 4% of stool samples of patients in the study in Amsterdam and Helmond[4] and in the national study[6], respectively; for *Campylobacter* spp. the corresponding percentages were 14% and 15%.

In the past years the knowledge about gastroenteritis has greatly increased and new micro-organisms have been recognised as gastrointestinal pathogens. Preventive measures have been introduced to reduce the number of *Salmonella* infections in production animals[7]. It is anticipated that the number of *Campylobacter* infections will decrease as well as a result of these measures, because an overlap is expected between the route of transmission and the reservoirs of *Campylobacter* and *Salmonella*.

In 1996, a new study on gastroenteritis in GP practices has started with the following objectives:

- estimate the incidence and trends in the incidence of gastroenteritis for which a GP is consulted
- determine whether there has been a decrease in the incidence of salmonellosis and campylobacteriosis of at least 50% compared to the study in 1992-1993
- estimate the relative importance of different pathogens causing gastroenteritis
- estimate the importance of different risk factors for gastroenteritis and for infections with specific pathogens

In this study, a broad diagnostic panel is being used to increase the percentage of patients in which a pathogen is detected, i.e. to decrease the diagnostic deficit. The

inclusion of controls without GE allows the study of risk factors and the study of the relationship between infection and disease.

In this report the results of the first two years of the study that started in 1996 are presented. Extensive data analyses will be performed after the completion of the data collection in 1999. A detailed description of the motives and methods of this study as well as data from the first year, have been described elsewhere[8, 9].

2. METHODS

The study consists of two parts: estimation of the incidence of gastroenteritis by enumeration of consultations for gastroenteritis by all sentinel practices of the NIVEL, and a case-control study to study the aetiology and risk factors.

2.1 Incidence of gastroenteritis

All sentinel practitioners report the number of consultations for gastroenteritis on a weekly basis by gender and age group (0 year, 1-4 years, 5-9 years....85+) of the patients. The case definition for gastroenteritis used in this study is:

- three or more loose stools a day *or*
- vomiting with at least two additional symptoms (diarrhoea, abdominal pain, abdominal cramps, fever, nausea, blood in stool, mucus in stool) *or*
- diarrhoea with at least two additional symptoms (vomiting, abdominal pain, abdominal cramps, fever, nausea, blood in stool, mucus in stool).

Consultations by telephone are not reported.

2.2 Case-control study

A selection of all sentinel practitioners takes part in the case-control study (GPcc). Gpcc invite every patient consulting for GE to participate in the study as a case. For every case, the next patient consulting with other complaints than gastroenteritis in the same age group (0-11 years, 12 years and older) is invited to participate in the study as a control. Cases and controls receive study material (i.e. a questionnaire and a stool sample kit with two containers for stool samples of which one contains a fixative). The completion of the questionnaire and the collection of the stool sample can be done at home and is supposed to be done on the day of the consultation. Samples and completed questionnaires are sent directly to the National Institute of Public Health and the Environment (RIVM).

Stool samples are tested at the RIVM for *Campylobacter spp, Salmonella spp, Yersinia spp* and *Shigella spp* by culture; *E. coli* O157/VTEC by culture and PCR; rotavirus group A, adenovirus 40/41 and astrovirus by ELISA; Small Round Structured Viruses (SRSV) by PCR[10,11]; *Giardia lamblia, Dientamoeba fragilis, Entamoeba histolytica, Entamoeba coli, Blastocystis hominis, Endolimax nana, Cryptosporidium* and *Cyclospora* by microscopy on fixated samples.

The data from the questionnaires is entered in Epi-Info [12]. For the analyses, data is converted by DBMS-copy[13] into SAS data sets. The data analysis was done in SAS[14].

2.2.1 Registration forms

GP's register all cases and controls who received study material on a registration form with the number of the study material. Patients with gastroenteritis who did not receive study material or who consulted the GP by telephone are also registered on this form.

2.3 Analysis

2.3.1 Calculation of the incidence

The incidence of gastroenteritis was estimated by dividing the number of patients enumerated by the number of person years in the study. The number of person years was calculated as the product of the size of the practice population and the percentage of weeks in which a practice had completed the enumeration form in one year.

2.3.2 Response

The response of cases and controls was estimated as the percentage of cases and controls registered on the registration form as having received study material, from a questionnaire was received at RIVM. The completeness of the enumeration and the selection of cases and controls was estimated by comparing the cases enumerated with the cases from whom a questionnaire was received at the RIVM by week number, practice, age group and gender.

2.3.3 Study population

Excluded from the analyses were cases with self-reported symptoms that did not meet the case definition and controls with self-reported symptoms that did meet the case-definition. If in a matched couple the case did not meet the case-definition and the control did, it was assumed that they had accidentally received the wrong questionnaire and the case was included as a control in the analyses and vice versa.

2.3.3.1 Comparison of cases and controls

In the comparison of cases and controls only complete couples were included in the analyses. Unmatched cases were coupled with unmatched controls, based on practice (if possible), week number and age group. Analyses were done separately for the original pairs and for all pairs (including pairs matched afterwards). Because the results did not differ significantly, the results presented here are based on all pairs. Differences between cases and controls were tested univariately with the Mac Nemar test for dichotomous data, Bowker's test for symmetry for categorical data and Wilcoxon rank sum-test for continuous data. Multivariate analyses were done with conditional logistic regression. Multivariate models were tested with the following

dependent variables: gastroenteritis, bacterial gastroenteritis, viral gastroenteritis, parasitic gastroenteritis and gastroenteritis with (possibly) non-pathogenic parasites. In the models for gastroenteritis with a specific group of micro-organisms, couples with controls with one of these micro-organisms were excluded. All variables that differed significantly ($p<0.10$) in the univariate analyses were included in the model. Age groups were always included in the model. Although matching on the two age groups has made the interpretation of the OR's for more detailed age groups impossible, inclusion of these age groups in the model corrects for the confounding effect of age on other variables. Variables that had no significant impact on the model were excluded, by manual backward selection. The significance of the impact was determined by the likelihood ratio and the influence on the OR's of other variables. The percentage of cases in which no micro-organism was found i.e. the diagnostic deficit was compared for the standard diagnostic panel (*Salmonella*, *Campylobacter*, *Yersinia*, *Shigella*, rotavirus, adenovirus), all pathogens excluding *Dientamoeba fragilis* (standard diagnostic panel and *Giardia lamblia*, *Entamoeba histolytica*, *Cyclospora*, *Cryptosporidium*) and all pathogens including *Dientamoeba fragilis*. *Blastocystis hominis*, *Dientamoeba fragilis*, *Endolimax nana* and *Entamoeba coli* were considered as (possibly) non-pathogenic.

2.4 Executive team

The recruitment of cases and controls is done by the GPs of the NIVEL. Testing of the stool samples on bacteria and parasites is done in the Laboratory for Infectious Diseases Diagnostics and Screening (LIS) of the RIVM; the tests for viruses are done in the Research Laboratory for Infectious Diseases (LIO) of the RIVM. The epidemiology and coordination is done by the Department of Infectious Diseases Epidemiology (CIE) of the RIVM.

3. RESULTS

3.1 Incidence of gastroenteritis

The NIVEL sentinel practice network of GPs consisted of 43 practices in 1996, and of 42 practices in 1997 and 1998. All practices participated in the enumeration study, covering a total population of 142,921 persons in 1996, 154,528 persons in 1997 and 148,177 persons in 1998.

Table 1. Incidence of gastroenteritis consultations

	enumerated	person years	incidence per 10,000 p.yr.	95% c.i.
GP-np+GP-cc May '96-May '98	1483	255,538	58	55-61
cases enumerated and/or receiving study material*	1622	210.031	77	
GP-cc May'96-May'98	1365	210,031	65	62-69
GP-np May'96-May'98	118	45,322	26	22-31

GP-cc: participating in case-control study

GP-np: GP's not participating in case-control study

* see paragraph 3.2.1

The incidence of consultations for gastroenteritis (GE) based on the enumeration of all practices was 58 per 10,000 person years from May 1996-May 1998 (table 1). The incidence of consultations at GP-cc was significantly higher than the incidence of consultations at GP-np (OR=2.5; 95% c.i. 2.1-3.0).

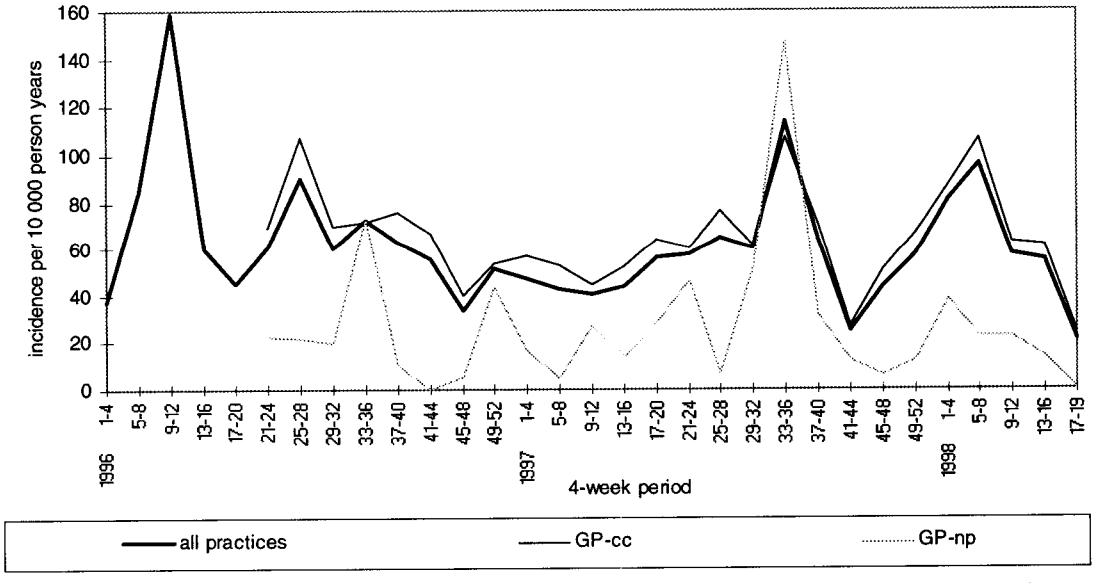


Figure 1. Incidence of consultations for gastroenteritis per 10,000 person years by week, based on enumeration by all practices, GP-cc and GP-np.

In 1996, a clear winter peak was observed in the incidence of GE-consultations (week 9-12: March) (figure 1). A peak in this period was not observed in 1997. In 1998, a peak in the incidence occurred again in the winter, already starting in the last weeks of 1997, reaching a maximum in weeks 5-8 of 1998 (February). A low summer peak was observed in weeks 25-28 of 1996 (June/July) and a higher summer peak in weeks 33-36 of 1997 (August). The incidence of consultations at GP-np was almost constantly lower than the incidence of consultations at GP-cc, with the exception of week 33-36 in 1997 (August); the summer peak in 1997 was higher at GP-np.

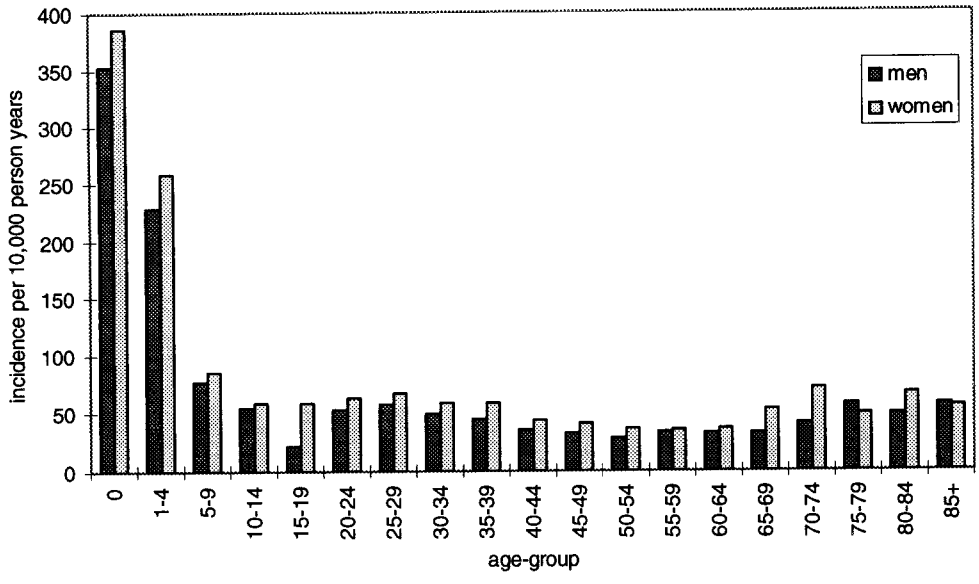


Figure 2. Incidence of gastroenteritis by age and gender based on enumeration of all practices from Jan '96- May'98.

The incidence of gastroenteritis was significantly higher in women than in men (RR=1.1; 95% c.i. 1.09-1.32) and consistent in all almost age groups (figure 2). In children under 5 years of age the incidence was higher than in persons ≥ 5 years (RR=5.3; 95% c.i. 4.8-5.8). In men the incidence was lowest in the age group of 15-19 years of age (figure 2). The age and sex distribution of the incidence was similar when only data from GP-cc were analysed.

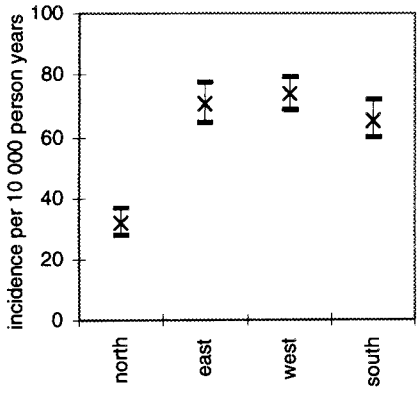


Figure 3a. Incidence based on enumeration of all practices (Jan'96-May'98) by region with 95% c.i.
north: Groningen, Friesland, Drenthe
east: Overijssel, Gelderland, Flevoland
west: Utrecht, Noord- en Zuid-Holland
south: Zeeland, Noord-Brabant, Limburg.

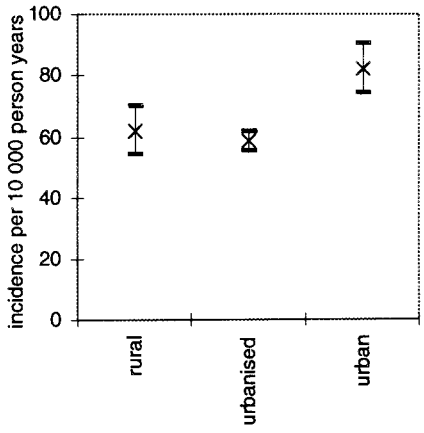


Figure 3b. Incidence based on enumeration of all practices (Jan'96-May'98) by degree of urbanisation with 95% c.i.
according to the classification of Statistics Netherlands[15]

The incidence in the northern region was lower than in the other regions (RR=0.5; 95% c.i. 0.4-0.5) (figure 3a) and the incidence in urban areas was higher than in less urban areas (RR=1.4; 95% c.i. 1.2-1.6) (figure 3b).

3.2 Case-control study

3.2.1 Level of participation

In 1996 and in 1997, 33 practices participated in the case control study, in 1998, 36 practices participated. From May 1996 until May 1998, 210,031 person years were included in the case-control study.

The registration forms were used by 23 practices for a varying number of weeks. Based on the data from these forms the response of cases was 75% (489 questionnaires received at RIVM /648 cases who received study material) and the response of controls 74% (411 questionnaires received at RIVM /553 controls that received study material). Figure 4 shows the overlap between enumerated cases, cases that received study material and cases from whom a questionnaire was received at the RIVM. The following calculations are based upon the assumption that the response of cases that are registered on the registration form was similar to the response of cases that are not registered. In addition it was assumed that the response of cases that were enumerated was similar to the response of cases that were not enumerated.

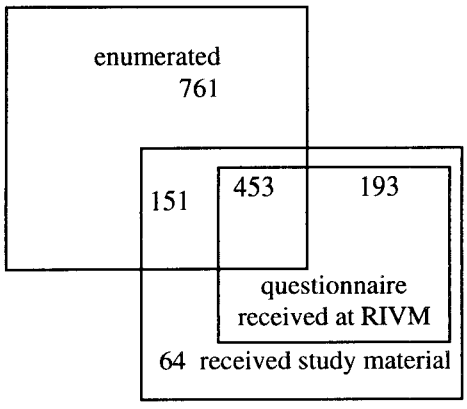
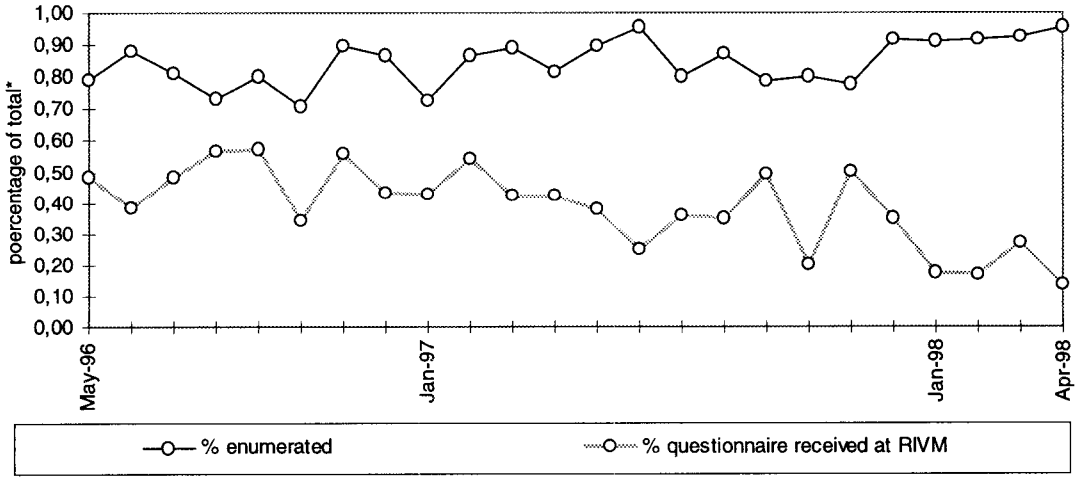


Figure 4. Overlap of cases enumerated, receiving study material and sending in questionnaires.

Total number of cases enumerated	1365
Total number of questionnaires of cases received at RIVM	646
Total number of cases that received study material	861

In total, 1622 cases were enumerated and/or received study material. Of these cases 84% was enumerated, 53% received study material and of 40% a questionnaire was received at the RIVM (figure 4). Of the total of cases enumerated and/or receiving study material, the percentage from which a questionnaire was received at RIVM was 50% in the first year (May 1996-May 1997) and 31% in the second year (May 1997-May 1998). The incidence of gastroenteritis-consultations based on the number of cases that were enumerated and/or received study material was estimated to be 77 per 10,000 person years.



* total = cases enumerated and/or from whom a questionnaires was received at RIVM

Figure 5. Completeness of enumerated cases and cases from whom a questionnaire was received at RIVM related to the total number of cases by 4-week periods from May 1996 until May 1998.

The percentage enumerated and the percentage from whom a questionnaire was received varied over time (figure 5). In 1996, no trend was observed, whereas in 1997,

a decreasing trend was observed in the percentage from whom a questionnaire was received, with a sharp decrease at the end of the year. In 1998, this percentage stayed low.

3.2.2 Study population

From 10 May 1996 up till 10 May 1998, 646 cases and 522 controls submitted stool samples and questionnaires to the RIVM. Of the cases, 43 (7%) were excluded because they did not have gastroenteritis; of the controls, 104 (20%) were excluded because they had gastroenteritis. 309 originally matched couples (case and control) were available and 75 extra couples could be formed out of the remaining cases and controls. In total, 384 couples were included in the analyses comparing cases and controls.

Characteristics of cases

Table 2. Percentage of cases with self-reported symptoms during the episode.

	suffer(ed) from	
	n	%
vomiting	253	42.0
loose stools	589	97.7
frequent stools	468	77.6
abdominal pain	458	76.0
abdominal cramps	459	76.1
nausea	362	60.0
fever	234	38.8
mucus in stool	147	24.4
blood in stool	67	11.1

Nearly all cases reported loose stools (table 2). Vomiting was reported by 42% of cases of which only 9 (1.5%) did not report loose or frequent stools. Nausea, abdominal pain, and abdominal cramps were reported by more than half of all cases. Blood and mucus in the stool were relatively infrequently observed.
People with diarrhoea reported a median of 6 loose stools per day on the worst days (P_{25}-P_{75}: 4-8 stools a day).

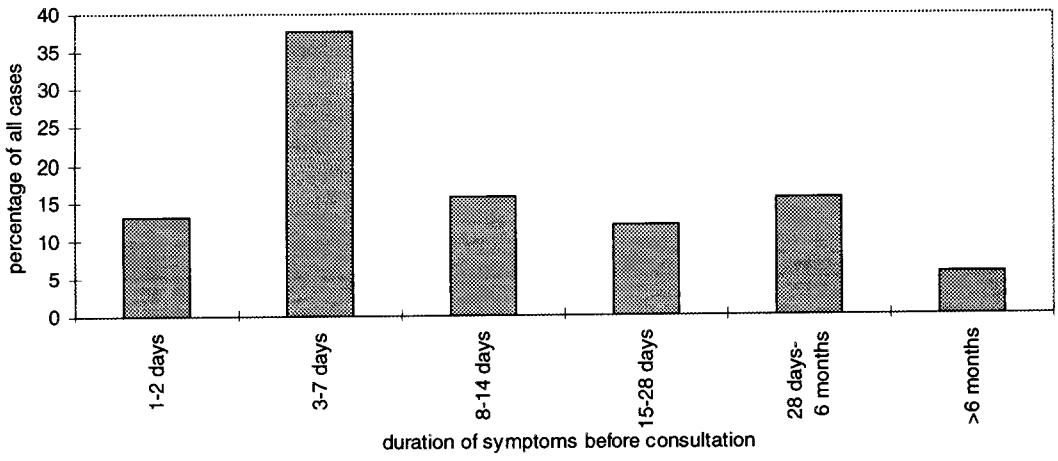


Figure 6. Percentage of cases by reported duration of symptoms before consulting a GP

The median duration of symptoms before consulting a GP was 7 days, but 21% of cases reported a duration of more than four weeks (figure 6).

Table 3. Suspected causes of gastrointestinal symptoms as reported by cases.

suspected cause	number (603 cases*)	percentage
food	52	8.6
. *barbecue*	*4*	*0.7*
. *chicken*	*5*	*0.8*
. *other meat*	*7*	*1.2*
. *fish*	*2*	*0.3*
. *Chinese food*	*3*	*0.5*
. *eating outdoors other than Chinese food*	*5*	*0.8*
. *other*	*26*	*4.3*
international travel	49	8.1
infection with bacteria, viruses or parasites	33	5.5
other syndrome (Crohn, coeliakie, Henoch Schonlein etc.)	18	3.0
psychological	16	2.7
stomach flu	16	2.7
infected by other persons with the same symptoms	9	1.5
use of antibiotics	8	1.3
allergy	7	1.2
the weather	7	1.2
swimming	5	0.8
lack of hygiene	5	0.8
chronic symptoms	4	0.7
alcohol	1	0.2
other	11	1.8
don't know	376	62.4
no answer	11	1.8

* some of the cases mentioned several suspected causes

The majority of cases (62%) reported having no idea of the cause of their complaints (table 3). Food and travel were incriminated most frequently by the remainder (8.6% and 8.1%, respectively). Infections with all different types of pathogens and stomach

flu were mentioned by respectively 5.5% and 2.7% of cases who did not mention any suspected route of infection.

Table 4. Diagnoses of GP at consult as reported by controls

	number	%
no consult for clinical symptoms	81	19.3
skin disorders	28	6.7
throat, nose and ear disorders	28	6.7
disorders of muscular system	28	6.7
diarrhoea	21	5.0
gastrointestinal disorder other than diarrhoea	17	4.1
accompanying family-member with diarrhoea	17	4.1
disorder of respiratory system	11	2.6
flu	8	1.9
disorder of urinary system	8	1.9
high blood pressure	7	1.7
head ache	6	1.4
disorder of the eyes	5	1.2
mental disorder	4	1.0
wound	3	0.7
pregnancy	2	0.5
rubella	1	0.2
inguinal hernia	1	0.2
not clear	142	34.0
total	418	100.0

The diagnosis of the GP at the consult at which controls were recruited, as reported by controls, included diagnoses as well as complaints (table 4). Of the controls, 34% gave uninterpretable answers to this question. Five percent reported having consulted the GP for diarrhoea but reported no gastrointestinal symptoms. Nineteen percent of controls were selected from patients who reported not consulting the GP for clinical complaints.

3.2.3 Comparison of cases and controls

Health status

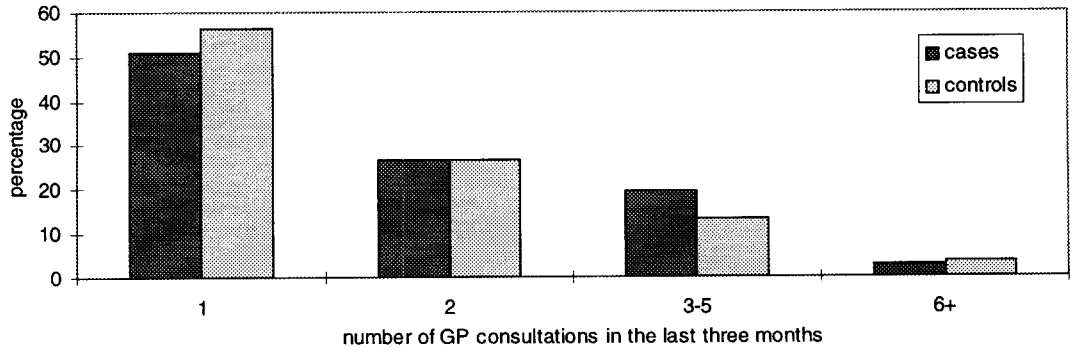


Figure 7. Number of GP consultations by cases and controls in the last three months (including the consult in which cases and controls were recruited for the study).

The frequency of GP consultations in the last three months was comparable for cases and controls (figure 7). More than half of the cases and the controls had consulted the GP only once (the consult in which they were recruited for the study) in the last three months.

Table 5. Health status indicators of cases and controls

	% of cases	% of controls	OR	95%-c.i.
chronic gastrointestinal disorder*	28.0	7.5	4.5	2.8-7.1
under treatment of specialist	18.1	18.4	1.0	0.7-1.5
regular use of medication	32.3	36.6	0.8	0.6-1.1

* for more than 1 month

The presence of gastrointestinal disorders for more than one month was more frequent in cases than in controls (table 5). The percentage under treatment of a specialist or using regular medication did not differ between cases and controls.

Socio-demographic factors

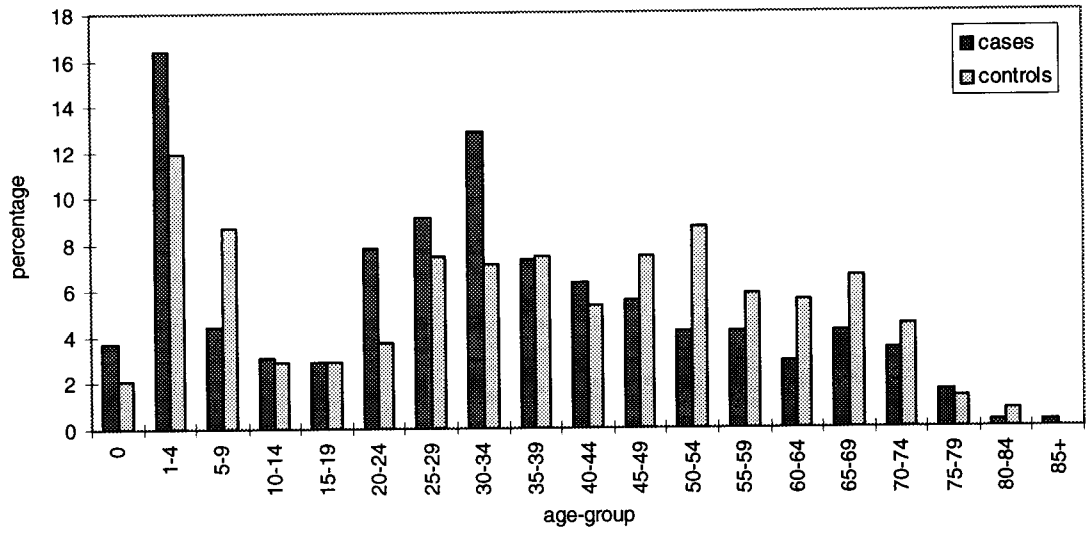


Figure 8. Age distribution of cases and controls.

The age groups of 0-34 years of age were overrepresented in cases, with the exception of 5-9 year-olds, that were underrepresented and 10-19 year-olds that were equally represented (figure 8). The age groups of 45-74 years were overrepresented in controls. The median age of cases (31 years) was significantly lower than of controls (36 years) (test of medians: p=0,001).

The distribution of all socio-demographic factors is presented in appendix 1 (table 1). In table 6 the factors that significantly differed between cases and controls are presented ($p<0.10$).

Table 6. Univariate analyses of socio-demographic factors that are significantly different between cases and controls (n=384 couples)

	% of cases	% of controls	OR	95% c.i.
age group				
0-4 years	20.3	15.1	2.3	1.2-4.4
5-34 years*	40.0	32.3	1.0	-
35-59 years	27.3	34.1	0.5	0.3-0.7
60+ years	12.5	18.5	0.4	0.3-0.7
gender				
male	43.9	38.9	1.2	0.9-1.7
female*	56.1	61.1	1.0	-
nationality				
Dutch*	93.7	98.4	1.0	-
non-Dutch	6.3	1.6	4.6	1.7-12.1
native country of mother of respondent				
the Netherlands*	86.7	91.8	1.0	-
other than the Netherlands	13.3	8.2	1.7	1.1-2.8
level of education **				
low	40.4	47.5	1.0	0.7-1.5
intermediate	33.5	25.5	1.5	1.0-2.3
high*	26.1	27.0	1.0	-

*reference-category
**<18 years: education of parents, ≥18 years: education of respondent. Low=up to MAVO/MULO, middle=up to MBO, high=HBO or university.

The age-group of 0-4 years of age was overrepresented in cases (table 6). More cases than controls were men and had a non-Dutch nationality. The native country of the mother of cases was more often outside the Netherlands than the native country of the mother of controls. An intermediate level of education was more frequent among cases than among controls.

Risk factors for gastroenteritis

The univariate analyses of potential risk factors in cases and controls is presented in appendix 1 (table 2). In table 7, the analyses are shown for factors that differed significantly between cases and controls.

Table 7. Distribution of factors that significantly differed between cases and controls in the univariate analyses (p<0.10) (n=384 couples).

	% of cases	% of controls	matched OR	95% c.i.
*international travel***				
no travel*	82.6	93.6	1.0	-
to Asia	5.4	0.8	20.8	2.8-156.0
to other developing country***	3.7	0.3	14.0	1.8-106.5
to developed country***	8.3	5.4	2.0	1.0-3.8
*swimming in marine waters***				
yes	8.2	2.2	5.4	2.1-14.0
no*	91.8	97.8	1.0	-
child in diapers in household				
no child in diapers*	72.3	77.1	1.0	-
child in cloth diapers	3.5	3.0	1.6	0.6-4.1
child in paper diapers	24.3	20.0	1.5	1.0-2.4
*consunption of Chinese take-away food***				
yes	24.7	18.9	1.4	1.0-2.1
no*	75.3	81.1	1.0	-
*consumption of food from canteen***				
yes	36.1	28.2	1.3	1.0-1.9
no*	63.9	71.8	1.0	-
store eggs in refrigerator				
yes	70.1	63.9	1.4	1.0-2.0
no*	29.9	36.1	1.0	-
defrost chicken				
on kitchen counter	25.6	23.8	0.8	0.5-1.2
in refrigerator	30.8	38.4	0.6	0.4-0.9
in microwave	14.8	14.5	0.7	0.4-1.2
in other place	3.2	2.6	1.0	0.4-2.5
never defrost chicken*	25.6	20.6	1.0	-
heating up left-overs				
in stove	35.5	33.4	0.6	0.3-1.0
in microwave	55.3	60.1	0.5	0.3-0.8
in other place	3.3	3.9	0.4	0.2-1.0
never heating up left-overs*	5.9	2.7	1.0	-

* reference category
** for cases: in the week before the start of symptoms; controls: in the week before completing the questionnaire
*** other developing countries: Africa, south or central America; developed countries: Europe, north America

Cases had travelled more often than controls (table 7). The highest risk was observed for travel to Asia, followed by travel to other developing countries and developed countries. Other risk factors were swimming in marine waters, having a child in paper diapers in the household, consumption of take-away Chinese food, consumption of food from a canteen and storing eggs in the refrigerator. Defrosting chicken in the refrigerator compared to never defrosting chicken was associated with a decreased risk of gastroenteritis.

The use of antibiotics in the week before sampling did not differ between cases and controls (6% and 7% respectively). The use of higher quantities of alcohol than normal (own judgement of respondent) in the week before the start of symptoms was higher in cases (10%) than in controls (4%) (OR=2.6, 95% c.i. 1.2-5.5).

Table 8. Multivariate model for gastroenteritis (n=384 couples)

	% in cases	% in controls	OR	95% c.i.
age group				
0-4 years	20.3	15.1	3.6	1.7-7.5
5-34 years*	40.0	32.3	1.0	-
35-59 years	27.3	34.1	0.4	0.3-0.7
60 years or older	12.5	18.5	0.3	0.1-0.5
nationality				
Dutch*	93.7	98.4	1.0	-
non-Dutch	6.3	1.6	5.9	1.7-20.5
gender				
male	43.9	38.9	1.7	1.1-2.5
female	56.1	61.1	1.0	-
chronic gastrointestinal disorder				
yes	28.0	7.5	6.5	3.6-11.4
no*	72.0	92.5	1.0	-
*international travel***				
no travel*	82.6	93.6	1.0	-
to Asia	5.4	0.8	25.8	3.0-220.9
to other developing country***	3.7	0.3	8.7	1.1-70.4
to developed country***	8.3	5.4	2.3	1.1-5.1
*heating up left-overs***				
in stove	35.5	33.4	0.4	0.1-1.3
in microwave	55.3	60.1	0.5	0.2-1.1
in other	3.3	3.9	0.4	0.2-0.8
never heating up left-overs*	5.9	2.7	1.0	-

* reference category
** for cases: in the week before the start of symptoms; controls: in the week before completing the questionnaire
*** other developing country: Africa, south or central America; developing country: Europe, north America

In table 8 the final multivariate model for gastroenteritis is presented. Travel to Asia was the main risk factor associated with a point estimate of a 26 times higher risk of gastroenteritis, followed by travel to another developing country and travel to a developed country. In addition, persons with a non-Dutch nationality, men and persons with a gastrointestinal disorder had an increased risk of gastroenteritis. All places of heating up left-overs were associated with a decreased risk.

3.2.4 Microbiological agents

In table 9 the results of the diagnostic tests are presented for cases and controls, divided into pathogenic micro-organisms (above the line) and (possibly) non-pathogenic micro-organisms (below the line).

Table 9. Presence of micro-organisms in stools of cases and controls.

	cases (n=602)		controls (n=418)	
	number	%	number	%
Campylobacter spp.	60	10.0	1	0.2
C. jejuni	51	8.5	0	0.0
C. coli	6	1.0	0	0.0
other *Campylobacter spp.*	3	0.5	1	0.2
Salmonella spp.	22	3.7	0	0.0
S. Typhimurium	7	1.1	0	0.0
S. Enteritidis	7	1.1	0	0.0
Other *Salmonella* spp.	8	1.3	0	0.0
Shigella flexneri	1	0.2	0	0.0
Yersinia enterocolytica	3	0.5	1	0.2
VTEC	3	0.6	3	0.8
E.coli O98 K-	1	0.2	0	0.0
E.coli O157 K-H-	1	0.2	0	0.0
E.coli O26	0	0.0	1	0.2
E.coli O145 K-	0	0.0	1	0.2
Not typed	1	0.2	1	0.2
rotavirus	30	5.0	5	1.2
adenovirus	15	2.5	2	0.5
astrovirus*	2	1.2	0	0.0
SRSV	30	5.0	3	0.7
Giardia lamblia	34	5.7	15	3.6
Entamoeba histolytica	5	0.8	2	0.5
Cryptosporidium	10	1.7	0	0.0
Cyclospora	7	1.2	1	0.2
Dientamoeba fragilis	61	10.2	62	14.8
Blastocystis hominis	135	22.5	131	31.3
Entamoeba coli	13	2.2	11	2.6
Endolimax nana	7	1.2	7	1.2

* astrovirus had only been tested in the first 150 samples of cases and 150 samples of controls
Above line: pathogenic micro-organisms; below the line: (possibly) non-pathogenic micro-organisms.

Campylobacter was the most frequently isolated pathogen in cases. Of all *Campylobacter* isolates present in cases 85% was *Campylobacter jejuni.* Many different serotypes of *Salmonella* were found, with S.Typhimurium and S. Enteritidis dominating, each representing 32% of all *Salmonella*-isolates. *Yersinia enterocolytica* and *Shigella flexneri* were isolated from less than one percent of cases. *Campylobacter* spp, *Salmonella* spp, *Yersinia* spp and *Shigella* spp were almost exclusively isolated

from cases. Verocytotoxin-producing *E.coli* consists of several types of *E.coli* in which genes coding for verocytotoxin 1 (vt1) and/or 2 (vt2) were found as well as the attaching and effacing gene (eae). VTEC were found in cases as well as in controls in low percentages. The serotype O157 of *E. coli* was found in only one case, who did not develop haemorrhagic uremic syndrome (HUS). Small Round Structured Viruses (SRSV) and rotavirus were the most frequently found viruses. Each virus was present in stools of 1% to 5% of cases and 0% to 1% of controls. Astrovirus was only tested in the first 150 samples of cases and 150 samples of controls. Therefore, the results of astrovirus do not cover the period of a whole year yet. *Giardia lamblia* was present in 6% of cases and 4% of controls. The other pathogenic parasites were found in 1% to 2% of cases and hardly in controls. The parasites that are (possibly) non-pathogenic (below the line in table 9) were found more in controls than in cases.

Table 10. Percentages of cases that reported suffering from the different symptoms by micro-organism (only presented for micro-organisms present in at least 20 cases).

	Camp.	Salm.	rota.	SRSV	Giard.	Dien.	Blast.	total
vomiting	33	36	87	73	38	44	41	42
loose/watery stools	100	100	100	90	97	98	95	98
frequent stools	90	96	80	67	85	69	70	78
nausea	55	59	67	83	56	61	67	60
fever	52	64	77	33	44	46	35	39
abdominal pain	80	95	53	73	76	82	84	76
abdominal cramps	78	91	43	73	79	71	81	76
blood in the stool	35	18	3	13	9	5	7	11
mucus in the stool	37	59	23	13	18	15	16	24

(Camp=*Campylobacter*, Salm=*Salmonella*, rota.=rotavirus, Giard.=*Giardia lamblia*, Dien.=*Dientamoeba fragilis*, Blast.=*Blastocystis hominis*, total=all cases)

Loose or watery stools were reported by almost all cases (table 10). *Campylobacter*-positive cases reported fever and the presence of blood in their stool relatively often. Fever was also reported relatively often by *Salmonella* cases, as were the symptoms mucus in the stool, abdominal pain and abdominal cramps. In cases with rotavirus and SRSV, vomiting was a relative common symptom. In addition, cases with rotavirus reported fever more often, and abdominal pain and cramps less often. In cases with *Giardia lamblia, Dientamoeba fragilis* and *Blastocystis hominis,* the frequency of reported symptoms was comparable to the frequency in the total group of cases.

The median duration of symptoms before consulting a GP in cases with a bacterial pathogen was 5 days (P_{25}-P_{75}:3-8 days), in cases with a viral pathogen the median duration was 4 days (P_{25}-P_{75}:2-8 days), in cases with a parasitic pathogen the median duration was 11 days (P_{25}-P_{75}:5-30 days) and in cases with a (possibly) non-pathogenic parasite the median duration was 10 days (P_{25}-P_{75}:4-35 days).

3.2.4.1 Risk factors for different diagnostic groups of gastroenteritis

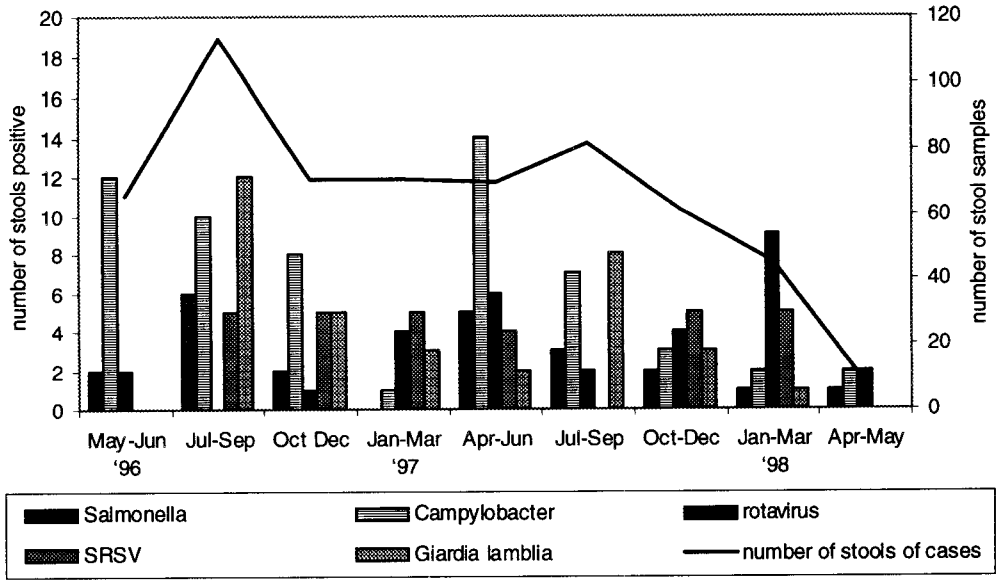


Figure 9. Seasonal distribution of the number of stools positive for Salmonella, Campylobacter, rotavirus, SRSV, Giardia lamblia and the number of stool samples examined.

The peak of *Salmonella* was found in the third quarter of 1996 and the second quarter of 1997 (figure 9). In 1996 and 1997, the peak in *Campylobacter* was the highest in the second quarter of the year and decreased during the rest of the year. The highest peak for rotavirus was found in the first quarter of 1998. This peak already started in the last quarter of 1997. In 1996, the first quarter was not included in the study and no peak was observed in the rest of the year. In 1997, a low peak in rotavirus was observed in the first and second quarter. For SRSV no seasonal pattern was observed, but no SRSV were found in the second quarter of 1996, nor in the third quarter of 1997. The peak for *Giardia lamblia* was observed in the third quarter of 1996 and 1997. The number of stool samples of cases examined decreased during the study period and showed a peak in the third quarter of 1996 and a lower peak in the third quarter of 1997.

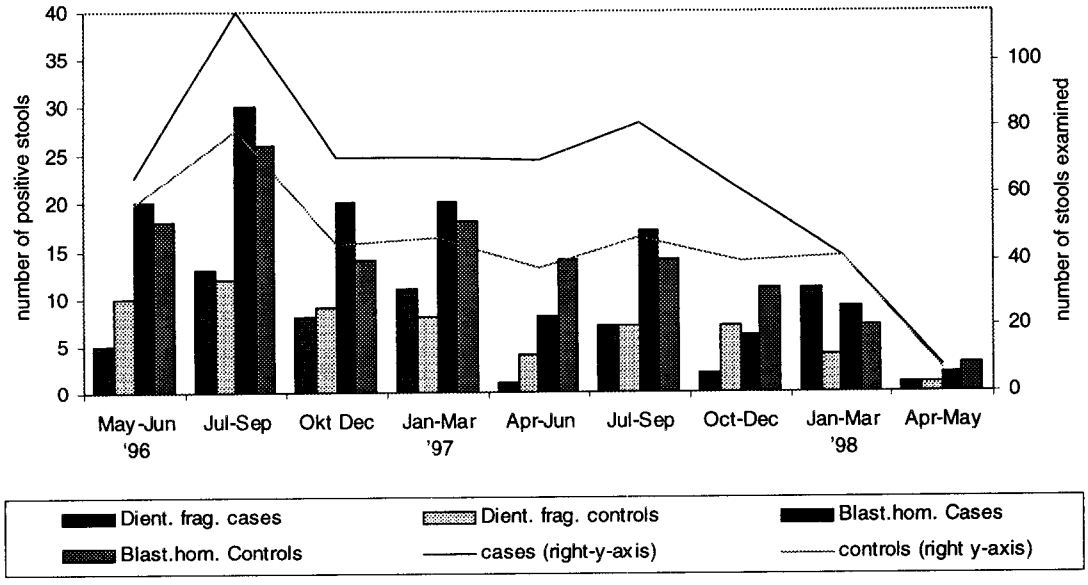


Figure 10. Seasonal distribution of Dientamoeba fragilis, Blastocystis hominis and the number of stool samples examined of cases and controls.

The number of stools positive for *Blastocystis hominis* and *Dientamoeba fragilis* was related to the total number of stool samples examined (figure 10). In 1996 and 1997, no seasonal pattern was observed.

The age distribution of these micro-organisms and adenovirus is presented in figures 11-15.

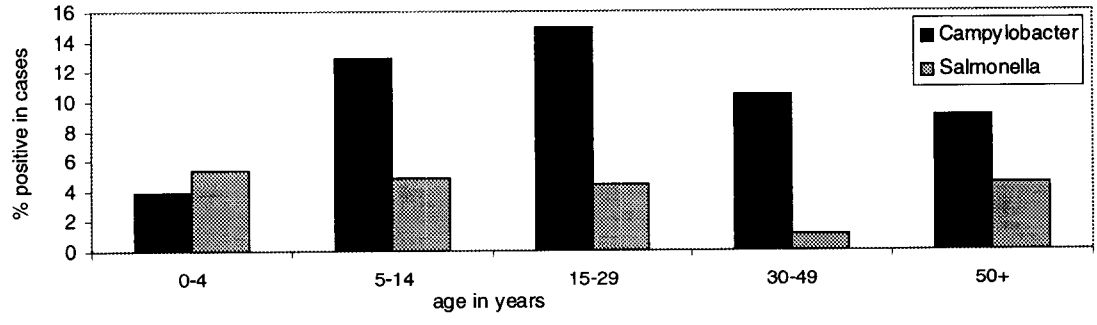


Figure 11. Percentage of cases positive for Salmonella and Campylobacter, by age group.

Campylobacter was isolated relatively often in cases of 5-29 years of age (figure 11). The percentage positive for Salmonella was relatively high in cases up to 29 years of age and in cases of 50 years and older.

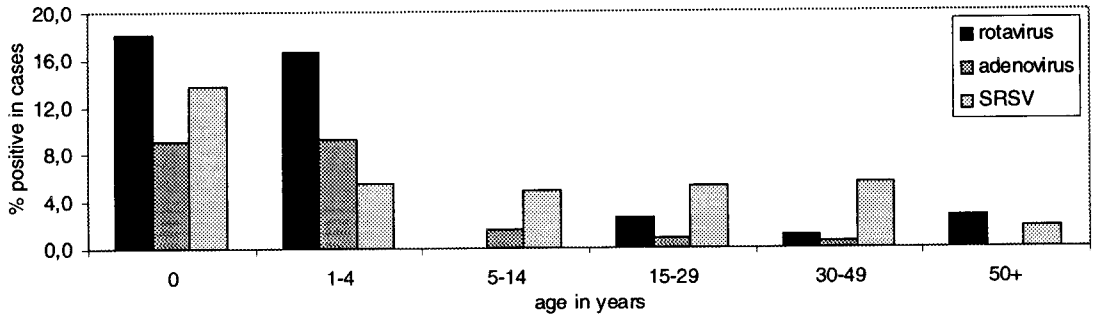


Figure 12. Percentage of cases positive for rotavirus, adenovirus and SRSV, by age group.

For all three viruses, the highest proportion of cases positive were found in the youngest age groups (figure 12). For SRSV, this was limited to the age group of 0 years old, for rotavirus and adenovirus to the age groups up to 4 years old. SRSV was found in approximately 5% of cases of 1 year and older. Adenovirus and rotavirus were less commonly found in cases over the age of 4.

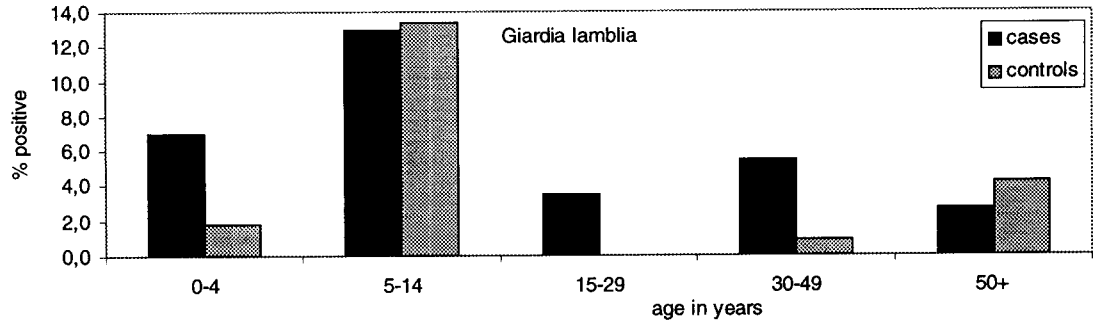


Figure 13. Percentage of cases and controls positive for Giardia lamblia, by age group

In the age group of 5-14 years, the highest proportion of cases and controls with *Giardia lamblia* were found (figure 13). In the age groups of 0-4 years and 15-49 years, the percentage was higher in cases than in controls. In the oldest age group of 50 years and older, the percentage was higher in controls than in cases.

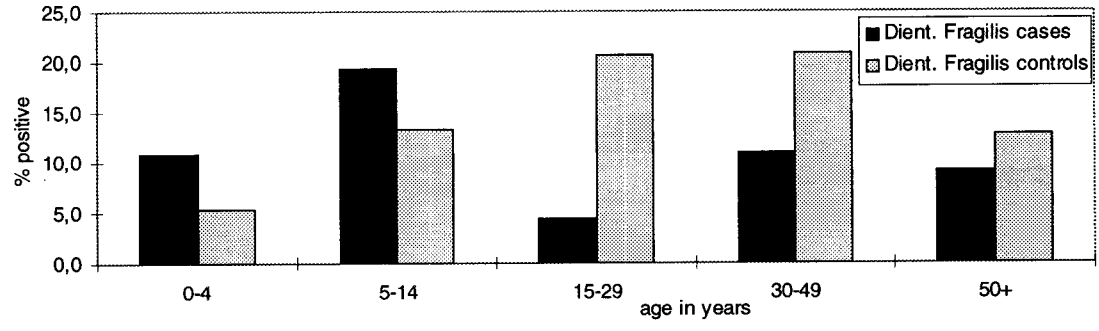


Figure 14. Percentage of cases and controls positive for Dientamoeba fragilis, by age group.

In the age group of 0-14 years, *Dientamoeba fragilis* was found in a higher percentage of cases than of controls. In the older age groups, the opposite was found (figure 14).

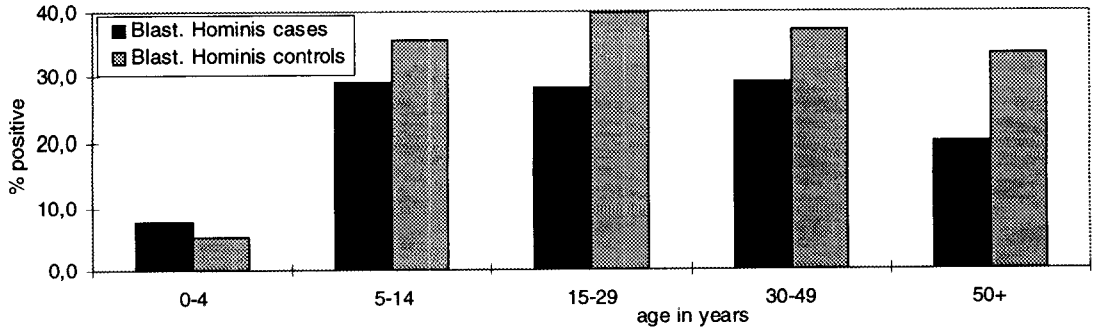


Figure 15. Percentage of cases and controls positive for Blastocystis hominis, by age group.

Blastocystis hominis was found in a higher percentage of controls than of cases in all age groups, except 0-4 year-olds where the percentage in cases was slightly higher than in controls (figure 15).

In appendix 2-5 the distribution of all socio-demographic (table 1) and risk factors (table 2) for bacterial (app. 2), viral (app. 3) and parasitic gastroenteritis (app. 4) are presented as well as for gastroenteritis with non-pathogenic parasites (app. 5). In this paragraph only univariately statistically significant risk factors will be presented (table 11).

Table 11. Risk factors for bacterial gastroenteritis (univariately sign.: p<0.10 and the final multivariate model)

n=52 pairs	univariate analysis		multivariate model	
	OR	95% c.i.	OR	95% c.i.
age group				
0-4 years	2.0	0.4-10.9	11.8	0.8-182.8
5-34 years*	1.0	-	1.0	-
35-59 years	0.4	0.2-1.4	1.2	0.2-6.9
60 years and older	0.3	0.1-1.2	0.7	0.1-4.2
gender				
female*	1.0	-	1.0	-
male	3.8	1.3 - 11.3	9.5	1.6-55.0
under treatment of a specialist			x	
yes	0.1	0.0 - 0.9		
no*	1.0	-		
*level of education****			x	
low	1.6	0.4 - 5.9		
intermediate	4.3	1.2 - 15.7		
high*	1.0	-		
*international travel **				
yes	3.7	1.0-13.2	14.9	2.0-110.2
no*	1.0	-	1.0	-
*eaten shrimps**				
yes	0.2	0.0-1.0	0.05	0.0-0.5
no*	1.0	-	1.0	-

x = excluded from the logistic regression model
* reference-category
** cases: in the week before the start of symptoms; controls: in the week before completing the questionnaire.
***<18 years: education of parents, ≥18 years: education of respondent. Low=up to MAVO/MULO, middle=up to MBO, high=HBO or university.

Because of instable OR's, all categories of international travel have been grouped (table 11). The strongest association with bacterial GE was observed for female gender and international travel. The consumption of shrimps was associated with a decreased risk. A low and intermediate level of education was univariately associated with an increased risk of bacterial GE and being under treatment of a specialist was associated with a decreased risk, but these associations disappeared after adjustment for other risk factors.

Table 12. Risk factors for viral gastroenteritis (univariately significant: p<0.10 and multivariate model).

n=44 pairs	univariate analysis		multivariate model	
	OR	95% c.i.	OR	95% c.i.
age group				
0-4 years	~	~	~	~
5-34 years*	1.0	-	1.0	-
35-59 years	0.6	0.1-2.7	0.3	0.0-1.9
60+ years	0.4	0.1-2.5	0.3	0.0-0.7
*level of education****			x	
low	2.0	0.6-6.5		
intermediate	2.8	0.9-9.0		
high*	1.0	-		
*consumption of pork meat***				
no*	1.0	-	1.0	-
yes	0.2	0.0-0.7	0.1	0.0-0.7
*consumption of chicken***			x	
no*	1.0	-		
yes, raw or undercooked	~	~		
yes, well done	0.5	0.2-1.1		

~ not possible to calculate an OR with confidence interval
x = excluded from the logistic regression model
* reference category
** cases: in the week before the start of symptoms; controls: in the week before completing the questionnaire.

The distinction between consumption of well done pork meat and undercooked pork meat was ignored in this analyses, because of the low percentage of persons consuming undercooked pork meat caused instable OR's (table 12). Although the OR of youngest age-group was infinite, this category was included in the analyses for its impact on the other variables.

Consumption of pork meat decreased the risk of viral gastroenteritis. A low and intermediate level of education and cooling left-overs on the kitchen-counter or in the refrigerator increased the risk of viral gastroenteritis. However this association disappeared after adjusting for other risk factors. The decreased risk of viral gastroenteritis associated with the consumption of chicken also disappeared in the multivariate analyses.

Table 13. Risk factors for parasitic gastroenteritis (univariately significant: p<0.10 and multivariate model)

n=35 pairs	univariate analysis		multivariate model	
	OR	95% c.i.	OR	95% c.i.
age group			x	
0-4 years	0.3	0.0-3.2		
5-34 years*	1.0	-		
35-59 years	0.4	0.1-2.1		
60 years and older	0.3	0.1-1.8		
*level of education****			x	
low	1.7	0.5-6.6		
intermediate	3.8	0.9-16.6		
high*	1.0	-		
material of chopping board			x	
wood	8.5	1.0-73.0		
plastic	7.6	0.9-63.6		
glass, porcelain etc.*	1.0	-		
*swimming in swimming pool***				
yes	5.0	1.1-22.8	6.5	1.0-40.9
no*	1.0	-	1.0	-
a child at elementary school in household				
yes	8.5	2.0-36.8	8.5	1.6-45.2
no*	1.0	-	1.0	-

* reference category
x = excluded from the logistic regression model
** cases: in the week before the start of symptoms; controls: in the week before completing the questionnaire.
***<18 years: education of parents, ≥18 years: education of respondent. Low=up to MAVO/MULO, middle=up to MBO, high=HBO or university.

Swimming in a swimming pool and living in a household with a child at elementary school were associated with an increased risk of parasitic gastroenteritis (table 13). An intermediate level of education and a wooden or plastic chopping board were univariately associated with an increased risk of parasitic gastroenteritis, but the association disappeared after adjusting for the other risk factors. No age groups were significantly associated with an increased or decreased risk for parasitic GE.

Table 14. Risk factors for gastroenteritis with (possibly) non-pathogenic parasites (univariately significant (p<0.10) and multivariate model).

n=61 pairs	univariate analysis		multivariate model	
	OR	95% c.i.	OR	95% c.i.
age group				
0-4 years	0.7	0.2-2.5	0.5	0.1-2.7
5-34 years*	1.0	-	1.0	-
35-59 years	0.5	0.2-1.4	0.3	0.1-1.8
60 years and older	0.4	0.1-1.3	3.5	0.3-36.4
employed				
yes	4.7	1.3-16.3	9.1	1.2-68.4
no*	1.0	-	1.0	-
regular use of medicine			x	
yes	0.4	0.2-0.9		
no*	1.0	-		
a baby in diapers in the household			x	
no diapers*	1.0			
cloth diapers	1.0	0.1-16.0		
paper diapers	3.0	1.0-9.3		
a child at a day care centre in the household				
yes	5.5	1.2-24.8	83.9	2.7->100
no*	1.0	-	1.0	-
a child at elementary school in household				
yes	2.3	0.9-6.1	7.5	1.2-47.1
no*	1.0	-	1.0	-
defrost chicken				
on kitchen counter	0.6	0.2-1.9	0.2	0.0-1.6
in refrigerator	0.2	0.1-0.7	0.2	0.0-1.0
in microwave	0.7	0.2-2.5	3.1	0.3-29.0
in other place	1.1	0.2-7.1	10.0	0.4-263.1
never defrost chicken*	1.0	-	1.0	-

x = excluded from the logistic regression model
* reference category

An association with an increased risk of GE with (possibly) non-pathogenic parasites was observed for persons that were employed and persons living in a household with a child in day-care or a child in elementary school (table 14). An association with a decreased risk was observed for defrosting chicken in the refrigerator. Living in a household with a baby in paper diapers was associated with an increased risk and regular use of medicine with a decreased risk; these associations disappeared after adjusting for other risk factors.

Diagnostic deficit

In 33.8% of all stool samples of cases and in 7,4% of stool samples of controls a pathogen was detected. (i.e. *Salmonella* spp, *Campylobacter* spp, *Yersinia* spp, *Shigella* spp, VTEC, rotavirus, adenovirus, astrovirus, SRSV, *Giardia lamblia, Entamoeba histolytica, Cryptosporidium* and *Cyclospora* are considered pathogens). If *Dientamoeba fragilis* was regarded a pathogen, the percentage in cases increased to

40.3%, but the percentage in controls increased more strongly to 21.3%. *Blastocystis hominis, Endolimax nana* and *Entamoeba coli* were not considered pathogens.

The standard panel included *Salmonella* spp, *Campylobacter* spp, *Yersinia* spp, *Shigella* spp, rotavirus, adenovirus. The total panel included the standard panel plus other pathogens: VTEC, SRSV, astrovirus, *Giardia lamblia, Entamoeba histolytica, Cryptosporidium, Cyclospora. Dientamoeba fragilis* is presented separately. When only the standard diagnostic panel of *Salmonella* spp, *Campylobacter* spp, *Shigella* spp, *Yersinia* spp, rotavirus and adenovirus was tested, 21.4% of stools of cases would have been positive and 2.2% of stools of controls. Testing on a broad panel of pathogens almost doubled the percentage of cases in whose stools a pathogen could be found, as compared to testing on the standard diagnostic panel. However, the percentage of controls in whose stools pathogens were found increased as well from 2.2% to 7.4%.

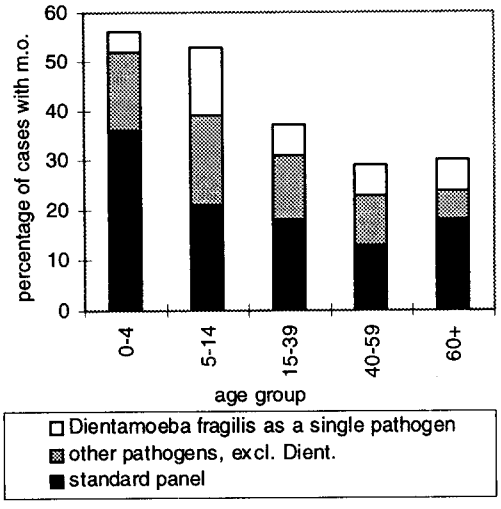


Figure 16a. Percentage (additional) of cases in whose stools a group of micro-organisms were detected, by age group

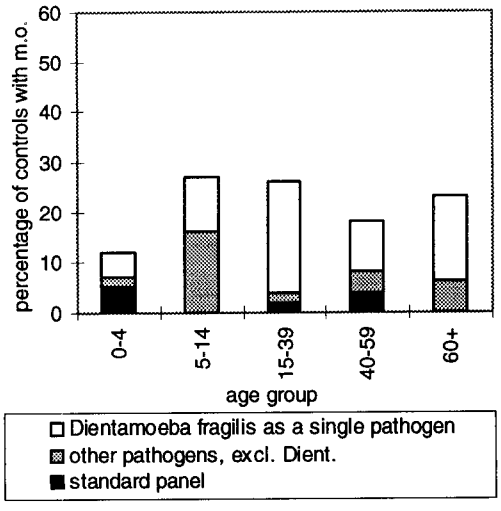


Figure 16b. Percentages (additional) of controls in whose stool different groups of micro-organisms were detected, by age group

The percentage of cases in which a pathogen (excluding *Dientamoeba fragilis*) was detected was highest in 0-4 year-olds (52%) and decreased with increasing age to 24% in the age group of 60 years and older (figure 16a). In controls, the percentage in which a pathogen was present was the highest in the age group of 5-14 years (when excluding *Dientamoeba fragilis*); and in the age groups of 5-39 years (when including *Dientamoeba fragilis*) (figure 16b). When the diagnostic panel was reduced to the standard panel, again the highest percentage of cases with a pathogen was found in the youngest age groups. The pathogens from the standard diagnostic panel were hardly ever present in controls. The absolute gain of testing on a broad panel of pathogens compared to the standard panel was highest in the youngest age groups and decreased with age.

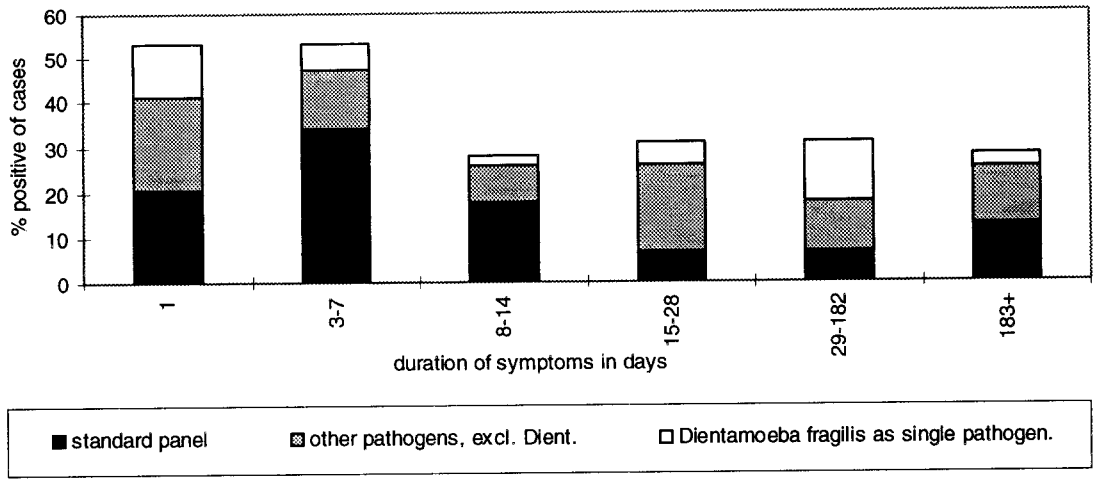


Figure 17. Percentages (additional) of cases in which the different groups of pathogens were present by duration of symptoms before consulting a GP.

The percentage of cases in which a pathogen was present also depended on the duration of symptoms before the sample was collected (figure 17). In cases with symptoms for a week or less the percentage positive was higher than in cases with symptoms for more than one week (excluding *Dientamoeba fragilis*) OR=2.4 (95% c.i. 1.7-3.3).

Another factor that influenced the detection of pathogens was the duration between the collection of the stool samples and the arrival at the RIVM. In 36% of the stools that had been in the mail-system for less than 5 days, a pathogen was present (excluding *Dientamoeba fragilis*) compared to 14% of samples that were in the mail system for 5 days or more (OR=3.6; 95%-c.i. 1,1-12,4). Four percent of all samples of cases were in the mail system for 5 days or more.

Table 15. Presence of different groups of pathogens in stool samples of cases, by characteristics of stool sample and symptoms of case.

cases with:	% of cases positive for bacteria	viruses	pathogenic parasites
as observed at RIVM			
blood in stool sample			
yes	26.1	4.4	17.4
no	12.3	12.6	9.0
as reported by case			
blood in stool sample			
yes	40.3	7.5	11.9
no	11.2	13.1	8.6
as observed at RIVM			
mucus in stool sample			
yes	18.7	13.6	7.1
no	10.8	13.1	9.8
as reported by case			
mucus in stool sample			
yes	21.2	10.4	6.6
no	10.7	13.6	10.2
as observed at RIVM			
consistency of stool sample			
watery	33.3	11.1	12.2
watery or semi-firm	17.1	21.4	14.3
semi-firm	11.3	11.3	9.0
firm	8.3	11.5	6.4
as reported by case			
symptoms of case			
vomiting	11.9	22.5	8.7
diarrhoea	14.8	12.2	9.0

In stool samples containing blood, bacteria and pathogenic parasites were more often detected and viruses were less often detected than in stool samples containing no blood (table 15). The relationship was stronger for blood in the stool as reported by the case, than for blood observed in the stool samples received at RIVM. Stool samples that contained mucus were more often positive for bacteria and less often for pathogenic parasites than stool samples not containing mucus. From watery stool samples bacteria were more often isolated than from more firm stools samples. Stool samples for which no distinction could be made between watery and semi-firm, contained more often viruses than stool samples of other consistencies. In firm and semi-firm stool samples a pathogen was found in a lower percentage than in watery stools. In samples of cases that reported vomiting, a virus was found twice as often as in samples of cases that only reported diarrhoea.

3.2.5 Incidence of Salmonellosis and Campylobacteriosis

In 3.7% of cases, *Salmonella* was detected and in 10.0% Campylobacter. S. Enteritidis was found in 1.3% of cases. Based on the incidence of gastroenteritis of 77 per 10,000 persons years the following incidences were calculated:

Salmonella gastroenteritis: 2.8 per 10,000 person years
Salmonella Enteritidis gastroenteritis: 1.0 per 10,000 person years
Campylobacter gastroenteritis: 7.7 per 10,000 person years

3.2.6 Disease burden

Table 16 shows the disease burden among GE cases as measured by the use of medication, bed rest and absence from work or school.

Table 16. Disease burden due to gastroenteritis in cases.

	number	% of all cases	
use of medication	320	54.7	
antibiotics	27	4.6	
pain killers	103	17.6	
anti diarrhoeic medication	153	26.2	
ORS	51	8.7	
bed rest	263	45.3	
average duration in days	3.0		P_{25}: 1; P_{50}: 2; P_{75}: 4 days
			% of working cases
absence from work	122	20.9	56.5
average duration in days	2.9		P_{25}: 1; P_{50}: 2; P_{75}: 3 days
			% of school going cases
absence from school	22	5.9	56.4
average duration in days	3.7		P_{25}: 1; P_{50}: 2.5; P_{75}: 5 days
absence from day care centre	55	9.4	
average duration in days	3.2		P_{25}: 2; P_{50}: 2; P_{75}: 4 days
absence of care taker	44	7.8	
average duration in days	2.0		P_{25}: 2; P_{50}: 2; P_{75}: 3 days

More than half of all cases used medication for their gastro intestinal complaints; mainly analgesics and anti-diarrhoeic medication (table 16). Of school going cases, 56% stayed home from school. Of working cases 56% stayed home from work. Of all cases, 45% had to stay in bed for a median of 2 days and 36% of cases had to stay home from work, school or day care centre. In 12 of the 44 cases the absence of a care taker from work or school was needed, the cases missed school or could not attend the day care centre. In total, the 603 cases in this study missed 708 days from work, school or day care centre.

4. DISCUSSION

4.1 Incidence of gastroenteritis

The incidence of gastroenteritis consultations (based on all patients that were reported and/or received study material) was 77 per 10,000 person years. This is slightly lower than the incidence of 90 per 10,000 person years in a comparable study in 1992 and 1993 among the same group of general practitioners (GP's), using the same case definition and the same method of calculating the total number of patients[16]. A study in Wales in 1992, found an incidence of 241 per 10,000 person years[17]. In a study in England in 1992-1993, an incidence of 210 per 10,000 person years was found[18]. Although the case definitions used in England and Wales were slightly different from the one used in our study, it can be concluded that the incidence of GE in general practices in the UK is substantially higher than in the Netherlands. It is not possible to determine whether these differences are due to a different presentation rate or to a different incidence of GE in the population, because the study in England reported a presentation rate of 5:1 and the study in Wales of 27:1. The estimate of the presentation rate in the Netherlands is 10:1, based on a population based study in 1991[21].

The incidence of consultations at GP's that participated in the case-control study (GP-cc) was 2.5 times higher than the incidence of GP's that did not participate (GP-np). This could reflect a difference in consultation behaviour of patients due to a discouragement strategy of GPs for GE consultations. Several GPs mentioned this strategy as the reason for not participating in the case-control study. It could also reflect a differing degree of participation in the weekly enumeration system between GP-cc and GP-np.

The age and sex distribution of gastroenteritis consultations is a reflection of the incidence of the occurrence of gastroenteritis in the population and the relative frequency with which different age and sex groups consult a GP. The pattern of a higher incidence among 0-5 year-olds and women is consistent with other studies in the Netherlands as well as in England [6,17]. National data from Statistics Netherlands show that the ratio of the number of GP-contacts of women versus men is 1.6 [19]. Although this ratio could be due to differences in health status of women and men, it could also reflect a lower threshold to visit a GP for women than for men.

The incidence in the North region of the Netherlands was lower than the incidence in other regions. The incidence in urban regions was 1.4 times higher than in less urban regions. Because practices in the North region of the Netherlands were mainly located

in rural areas, these factors were closely correlated. This is consistent with a study in England, that also reported a higher incidence in urban regions than in rural regions [18].

4.2 Case-control study

4.2.1 Level of participation

Only 40% of the total number of patients participated in the case-control study. In a similar study in 1992-1993 this percentage was 59%[6]. The lower degree of participation was the result of a less complete participation of GP's. During a telephone interview with all GP's in the first months of 1998, the main reasons for this low participation were the extra effort of recruiting controls and the fact that the recruitment had to be done during the short consultation period, without the possibility to anticipate in the planning of the consultation schedule.

4.2.2 Study population

4.2.2.1 Description of cases

The percentage of cases that had complaints for more than four weeks before consulting the GP (21%) is higher than in studies done in the general population[20]. This is supported by data from a population-based study in the Netherlands that found that a longer duration of complaints was related to a higher percentage of patients consulting a GP[21].

The percentage of cases that was included with vomiting as the major symptom and without loose stools was negligible (1.5%). Illness characterised mainly by vomiting is mostly of a shorter duration than illness characterised mainly by diarrhoea[22]. Since long duration of symptoms is probably one of the reasons for consulting a GP, illness characterised by vomiting will relatively seldom lead to a GP consultation. An inventory of procedures used by GP's to include patients, showed that some GP's did not realise that vomiting with two additional symptoms was included in the case definition. In addition many GP's used their own judgement for deciding who was a gastroenteritis case and who was not instead of using the case-definition. However these GP's stated that these two almost entirely overlapped. This is supported by the low percentage of cases that had to be excluded for not meeting the case-definition.

The majority of cases (64%) did not report any suspected cause of their complaints. This implies that they do not know how to prevent this illness and therefore, information on preventing infections in and outside the household might be useful.

4.2.2.2 Description of controls

The question in the control questionnaire about their diagnosis by the GP was answered unsatisfactory by most of the controls. Uninterpretable answers were given by 34% of controls and 5% reported a diagnosis of diarrhoea but did not report diarrhoea as a symptom in the questionnaire. Probably the term diagnosis is not known to everyone and the fact that the GP invited them to take part in a study on diarrhoea might have led to confusion. The more detailed questions on gastrointestinal symptoms were answered more reliably by controls, and these questions were used to exclude controls that met the case definition. In the future, the controls from this study will be compared to controls from a population-based study, to determine possibly relevant selection in the GP controls.

4.2.2.3 Health status of cases and controls

Cases, more often than controls, reported to suffer from a chronic gastrointestinal disorder. The description of these chronic disorders were not clear enough to distinguish between chronic diarrhoea and disorders that increased the risk of gastroenteritis or were partially expressed as diarrhoea. In the multivariate analyses, persons with chronic gastrointestinal disorders had a 6 times higher risk of gastroenteritis than persons without chronic intestinal disorders.

4.2.2.4 Socio demographic factors

The median age of cases was lower than of controls. This is consistent with the higher incidence among the younger age groups, but it is partly due to a higher response rate in the younger age groups than in the older age groups. The percentage of women among cases was lower than among controls. The response among men and women in cases and controls was comparable and the proportion of men in the practice population of the GP's that recruited most cases and controls did not differ from the proportion in the entire population. The ratio of women versus men in cases in the case-control study is similar to the ratio in cases enumerated (women: men: 1.2:1). The ratio of women to men in all practice consultations in the Netherlands is 1.6:1 [19], therefore controls come from a population with more women.

Among cases a higher percentage had an intermediate level of education. Although GP's reported to be inclined to select persons with a higher level of education, among controls the percentage with a low level of education was higher than in the general Dutch population, suggesting that the total practice population had a lower level of education than the general Dutch population [23]. The fact that the level of education was not a significant factor in the multivariate analyses suggests that level of education

is not the real risk factor but is a proxy for other risk factors, such as frequency of travelling or difference in food handling.

Controls were less often of a non-Dutch nationality. This is probably partly due to selection bias of controls (both self selection and selection by GP's) caused by the fact that the study material was only available in Dutch and it was easier for the GP to explain in Dutch. GP's admitted to be inclined to select controls that were fluent in Dutch. After consultation of practices with a high proportion of patients of a non-Dutch nationality, the gain of translating the questionnaire did not seem to compensate the effort of the translation. On the other hand, the percentage of controls with a non-Dutch nationality (1.6%) was comparable with the percentage in the general Dutch population in 1996 of 2.5%[24]. Although the representativeness of the total practice population regarding nationality is not known, this suggests that controls are representative for the practice population, suggesting that a non-Dutch nationality is indeed a risk factor for gastroenteritis. Univariately, a higher percentage of cases had a mother who was born outside the Netherlands. This could indicate that the mother is often responsible for the food preparation and might reflect differences in the culture of food preparation and in the type of food package of the household.

4.2.2.5 Risk factors for gastroenteritis

Cases and controls were matched on the age groups 0-11 and 12+, but within these age groups the distribution of age was different for cases and controls. Because matching has influenced the distribution of age among controls, no quantitative conclusions can be drawn from the OR's presented for age group. Nevertheless, age groups were included in the analysis to correct for confounding, due to differences in age between cases and controls.
The most prominent risk factor was travelling to Asia or to other developing countries. The risk of gastroenteritis was lower for persons who heat up left-overs than for persons who never heat up left-overs.
Travelling to Asia or other developing countries poses a risk for gastroenteritis, because of the difference in food culture, the exposure to a different set of micro-organisms and the lower hygienic standards in most developing countries. Although these are major risk factors associated with a 26-fold and 8-fold increase in risk of gastroenteritis, only 5% of cases had been to Asia and 4% to another developed country and less than 1% of controls, and therefore, the impact of this risk factor is relatively small.

Eating left-overs is usually correlated with an increased risk of gastroenteritis, because of the risk of growth of micro-organisms when keeping left-overs under the wrong conditions. In this study, the risk of gastroenteritis was increased in persons who never heated up left-overs. This could be due to a decreased risk of gastroenteritis in persons who are repeatedly exposed to contaminated left-overs and have build up some degree

of immunity. The fact that none of the factors related to food handling or to food consumption were significant risk factors in the multivariate analyses could be due to an inclination of cases to give socially acceptable answers. Additionally, the discriminating capacity of these questions is probably minimal, due to the fact that exposure to potentially contaminated food in the general population is very common.

4.2.2.6 Microbiological agents

Campylobacter was the most frequent pathogen in cases, followed by *Giardia lamblia,* SRSV, rotavirus and *Salmonella.* Bacterial and viral pathogens were found almost exclusively in cases. Giardia lamblia was found in cases as well as in controls. *Entamoeba histolytica, Cryptosporidium* and *Cyclospora* were found in approximately 1% of cases and 0.5% or less in controls. The (possibly) non-pathogenic parasites were found more in controls than in cases.

The distribution of *Campylobacter* by age, in terms of percentage, showed a peak in persons aged 5-29 years. Other studies, that presented incidences, have found two peaks in the incidence of *Campylobacter*: in the youngest age group and in young adults. In the young age groups, the number of samples is high, and therefore the percentage positive for *Campylobacter* is relatively low. *Salmonella* was found more in the younger age groups. This is consistent with findings from other studies in general practices as well as in the general population [4,21]. Viruses were detected mostly in the age groups <5 years, however, SRSV was also present in approximately 5% of older age groups. The fact that SRSV is often the cause in outbreaks in homes for the elderly, indicates that it is an important pathogen in causing gastroenteritis in the older age groups as well [10,11]. The highest percentage positive for *Giardia lamblia* was found in the age group 5-14 years of age in cases as well as in controls (>12%). This is a risk group for *Giardia lamblia*, as they are usually in school. The percentage positive for *Dientamoeba fragilis* was higher in cases than in controls in the age groups up to 14 years of age only. For *Blastocystis hominis* the percentage in cases was higher than in controls in the age group of 0-4 years of age. Although the pathogenicity of these micro-organisms in healthy persons is questionable, this suggests that they might cause disease in young children but not in adults, due to, for instance, agent specific immunity.

Risk factors for different diagnostic groups of gastroenteritis cases

The analyses of risk factors for the different diagnostic groups of gastroenteritis include only a small number of couples and instable odds ratio's were found frequently, indicating that the results of this interim-analyses can only be used as an indication. In addition, due to multiple testing, an average of 5% of tests are expected to be significant by coincidence, because a 5% significance level is used.

Risk factors for bacterial gastroenteritis

The main risk factor for bacterial gastroenteritis was international travel, associated with an increase in risk of 15 times. Unfortunately, in the model, no distinction could be made between the different countries of destination, because of the low number of controls that had travelled.

The socio demographic high risk groups for bacterial gastroenteritis consisted of men and persons with an intermediate level of education. Being under treatment of a specialist was negatively associated with bacterial gastroenteritis, which is probably a result of the fact that controls are also consulting patients. International travel was associated with a high risk. The fact that no association was found between bacterial gastroenteritis and consumption of chicken or other foods or the handling of food is probably due to the low discriminative capacity of these analyses. Consumption of shrimps was negatively associated with bacterial gastroenteritis. Since several outbreaks have been associated with shrimps contaminated with bacterial pathogens, such as *Salmonella* and *Shigella*, it is likely that the consumption of shrimps is not protective itself, but a proxy for other protective factors.

Risk factors for viral gastroenteritis

The consumption of pork meat was protective of viral gastroenteritis. Although age groups were included in the model, the classification of the age groups was very broad and the age group of 0 years of age could not be included separately, because of low numbers. In this age group most viral gastroenteritis cases occurred and consumption of pork meat is not common in this age group.

Risk factors for parasitic gastroenteritis

Intermediate level of education was again found to be a risk factor. The age group of 5-34 years had the highest risk of parasitic gastroenteritis. This includes school-going persons. Importance of transmission of parasites in schools is supported by the fact that a significant risk factor was living in a household with a child at elementary school. Another risk factor was swimming in a swimming pool. The cysts of some parasites, such as *Giardia lamblia* and *Cryptosporidium* are very resistant to chlorination and can therefore survive in swimming pools where the main prevention against infection is chlorination [22]. Using a wooden or plastic chopping board was also a risk factor as opposed to other materials, which were mainly glass and porcelain, suggesting that contamination through chopping boards might play a role in the transmission of parasites. Since wooden and plastic chopping boards become rugged after extensive use, cysts can remain in the grooves. Additionally wooden chopping boards cannot be washed in a dish washer and are therefore usually hand-washed at temperatures that are not higher than 60 degrees; the temperature needed for killing of these parasites.

Risk factors for gastroenteritis with (possibly) non-pathogenic parasites

Persons who were employed and persons living in a household with a child in a day care centre or in elementary school had a higher risk of gastroenteritis with these (possibly) non-pathogenic parasites. This suggests that a high contact rate of persons is of importance for the transmission of these parasites. Defrosting chicken in the refrigerator was associated with a decreased risk. Since the reference-group was 'never defrosting chicken' this is not an indication that a refrigerator is a safe place to defrost chicken. Regular use of medicine was also associated with a decreased risk. No plausible explanation for this result was apparent.

4.2.2.7 Clinical picture of different diagnostic groups of gastroenteritis

The symptoms related to infections with the different pathogens have been described extensively by others[22,25,26] and are related to the differences in pathogenesis of the pathogens. In cases that reported from vomiting, viruses were more often found than bacteria or parasites. Parasites were more often present in cases with a longer duration of complaints, compared to viruses and bacteria. The parasites often cause intermittent complaints, which might cause persons to wait longer before consulting a GP. Remarkable is the high percentage of Giardia lamblia cases with fever (44%), because fever is not a common symptom in cases with a *Giardia lamblia*-infection[27].

4.2.2.8 Diagnostic deficit

Although testing on a broad diagnostic panel decreased the diagnostic deficit by 12.4% compared to testing on the standard panel, the diagnostic deficit amongst cases as a whole remains high at 66%. Limiting the study group to cases from whom a stool sample was received within five days after sampling this deficit decreases slightly to 64%. Limiting the study group to acute cases who had not had symptoms for more than one week before consultation, the deficit decreased to 57%. The symptoms of cases in whose stools no pathogen was found could be due to non-infectious causes, to pathogens that are not recognised as causes of gastroenteritis yet, pathogens for which no tests are available, pathogens for which this type of sampling is not appropriate (such as toxins that can only be found in stools produced early after the start of the symptoms) or to a sensitivity of diagnostic tests of less than a 100%. Possibly, for older age groups non-infectious causes, such as stress, chemical toxins, moulds and errors in food consumption play a more important role than in the youngest children, as supported by the increase in deficit with increasing age. Since many of the pathogens, especially the viral and bacterial pathogens, usually cause illness that lasts several days to one week, it is likely that in a large percentage of cases who have had complaints for more than one week the cause is non-infectious. Furthermore pathogens can be excreted for a shorter period than the duration of complaints. If the sample is taken late in the illness, the causative pathogen may no longer be excreted and therefore not be found in faeces.

Many of the pathogens were also found in controls. In 7.4% of controls at least one pathogen was present in the stool. The fact that pathogens are also present in healthy persons implies that probably also among cases some of the detected pathogens are not related to their symptoms. Therefore, the presence of a pathogen in the stool of a case does not necessarily imply that this pathogen caused the symptoms.

4.2.2.9 Incidence of Salmonellosis and Campylobacteriosis

For the evaluation of the preventive program that was introduced in 1997 to reduce the number of *Salmonella* infections in production animals[7], the incidence of Salmonellosis is described separately. Because *Campylobacter* mainly has the same reservoirs and transmission routes as Salmonella the program might also lead to a reduction in *Campylobacter* infection. Consequently *Campylobacter* is also addressed here. Table 16 shows the incidences in 1992-1993 and the current incidences and the isolation percentages in both studies.

Table 17. Incidences per 10,000 person years and isolation percentages of Salmonella spp, Salmonella Enteritidis and Campylobacter in 1992-1993[6] and in 1996-1998.

	1992-1993		1996-1998	
	incidence	% positive	incidence	% positive
Salmonella spp	3.5	4.4	2.8	3.7
Salmonella Enteritidis	1.9	2.4	1.0	1.3
Campylobacter	11.7	14.6	7.7	10.0
gastroenteritis as a whole	90		77	

The incidence of *Salmonella* spp, *Salmonella* Enteritidis and *Campylobacter* all seemed to have decreased since 1992-1993, as did the percentages positive for all three pathogens (table 17). Laboratory-based surveillance in the Netherlands showed no decrease in *Salmonella* Enteritidis-isolations between 1992-1993 and 1996-1998 [28]. These incidences are based on the assumption that the percentage positive for *Salmonella* and *Campylobacter* is the same for patients that participated in the case-control study and patients that did not participate. Although the clinical picture of patients can be related to the decision of the GP to recruit the patients as a case for the case-control study or to the participation rate of patients. Since patients were recruited in the same way in 1992-1993, a comparison of the incidences between these two studies is still valid.

5. CONCLUSION

The incidence of consultations for gastroenteritis was 77 per 10 000 person years from May 1996 to May 1998. The incidence was highest among the youngest age groups, among women and in urban areas. Seasonal peaks were seen in winter and in summer with the exception of the winter of 1997. The incidence was slightly lower than in 1992-1993.

Of patients consulting a GP for gastroenteritis, 40% participated in the case-control study. This percentage decreased during the study course. Male sex, non-Dutch nationality, having a chronic gastrointestinal disorder and having been abroad were risk factors for gastroenteritis. For the different diagnostic groups, differences in risk factors were observed. For instance parasitic GE was associated with swimming in a swimming pool and the presence of a child at elementary school in the household. These differences can be used in designing control programs for the various agents.

Campylobacter was the most frequently isolated pathogen in cases (10.0%). *Salmonella* was found in 3.7% of cases; *Shigella* and *Yersinia* in less than 1% of cases. VTEC was found in 0.6% of cases and 0.8% of controls. Rotavirus was found in 5.0% of all cases; adenovirus in 2.5%; astrovirus in 1.2% and SRSV in 5.0%. *Giardia lamblia* was found in cases (5.7%) as well as in controls (3.6%), *Entamoeba histolytica*, *Cryptosporidium* and *Cyclospora* were found in 1-2% of cases and hardly in controls. *Blastocystis hominis* and *Dientamoeba fragilis* were very frequent in cases as well as in controls. In the youngest age groups the percentage of both these parasites was higher in cases than in controls; in the older age groups this was reversed. Final results and more extensive risk analyses will be presented after the data collection is completed.

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APPENDIX 1.

Table 1. Distribution of socio-demographic factors among cases and controls (n=384 couples)

	% of cases	% of controls	OR	95%-c.i.
age group				
0-4 years	20.3	15.1	2.3	1.2-4.4
5-34 years*	40.0	32.3	1.0	-
35-59 years	27.3	34.1	0.5	0.3-0.7
60+ years	12.5	18.5	0.4	0.3-0.7
gender				
male*	43.9	38.9	1.2	0.9-1.7
female	56.1	61.1	1.0	-
nationality				
Dutch*	93.7	98.4	1.0	-
non-Dutch	6.3	1.6	4.6	1.7-12.1
native country of respondent				
the Netherlands*	92.5	95.7	1.0	-
other country	7.5	4.3	1.7	0.9-6.2
native country father of respondent				
the Netherlands*	11.5	8.3	1.0	-
other country	88.5	91.7	1.5	0.9-2.4
native country mother of respondent				
the Netherlands*	86.7	91.8	1.0	-
other country	13.3	8.2	1.7	1.1-2.8
employed				
yes*	38.1	34.0	1.0	-
no	61.9	66.0	1.3	0.9-1.9
schoolgoing				
yes*	24.4	23.4	1.0	-
no	75.6	76.6	0.8	0.4-1.5
level of education **				
low	40.4	47.5	1.0	0.7-1.5
intermediate	33.5	25.5	1.5	1.0-2.3
high*	26.1	27.0	1.0	-

*reference category

**until 18 years education of parents, 18 years and older: own education. Low=up to MAVO/MULO, middle=up to MBO, high=HBO or university)

Table 2. Univariate analyes of all risk factors for cases versus controls (n=384 couples).

	% in cases	% in controls	matched OR	95%-c.i.
chronic gastrointestinal disorder				
yes	28.0	8.0	4.5	2.8-7.1
no*	72.0	92.0	1.0	-
under treatment of specialist				
yes	18.1	18.4	1.0	0.7-1.5
no*	81.9	81.6	1.0	-
regular use of medication				
yes	32.3	36.6	0.8	0.6-1.1
no*	67.7	63.4	1.0	-
*others with gastrointestinal symptoms***				
yes	16.2	13.2	1.3	0.8-2.0
no*	83.8	86.8	1.0	-
*use of antibiotics***				
yes	5.6	7.0	1.1	0.9-1.5
no*	94.4	93.0	1.0	-
*unusually large quant. of alcohol***				
yes	9.5	4.4	2.6	1.2-5.5
no*	90.5	95.6	1.0	-
*international travel***				
no travel*	82.6	93.6	1.0	-
to Asia	5.4	0.8	20.8	2.8-156.0
to another developing country	3.7	0.3	14.0	1.8-106.5
to developed country	8.3	5.4	2.0	1.0-3.8
swimming in surface waters				
yes	4.3	2.7	1.6	0.7-3.9
no*	95.7	96.3	1.0	-
swimming in marine waters				
yes	8.2	2.2	5.4	2.1-14.0
no*	91.8	97.8	1.0	-
swimming in swimming pool				
yes	17.8	15.6	1.3	0.8-1.9
no*	82.2	84.4	1.0	-
child in diapers in household				
no diapers*	72.3	77.1	1.0	-
cloth daipers	3.5	3.0	1.6	0.6-4.1
paper daipers	24.3	20.0	1.5	1.0-2.4
pets in household				
no pets*	46.2	47.1	1.0	-
dog	15.3	13.0	1.2	0.8-2.0
cat	16.4	13.5	1.3	0.8-2.0
fish	1.3	2.1	0.6	0.2-2.2
rabbit	5.2	7.6	0.7	0.3-1.3
dog and cat	7.0	7.6	0.9	0.5-1.7
other combination of pets	8.6	9.1	0.9	0.6-1.6

Table 2. Continued.

	% in cases	% in controls	matched OR	95%-c.i.
farming animals in household				
no farming animals*	94.7	94.0	1.0	-
poultry	1.8	3.1	0.5	0.2-1.5
other farming animals	2.0	1.2	1.3	0.4-4.8
*played in sand box***				
yes	10.7	10.2	1.1	0.6-2.2
no*	89.3	99.8	1.0	-
*consumption of pork meat***				
no	34.5	30.2	1.0	-
yes, raw or not well done	3.9	4.4	0.8	0.4-1.6
yes, well done	61.6	65.4	0.8	0.6-1.1
*consumption of beef***				
no	34.2	31.7	1.0	-
yes, raw or not well done	8.1	7.6	1.0	0.6-1.8
yes, well done	57.7	60.7	0.9	0.6-1.2
*consumption of chicken***				
no	40.7	41.1	1.0	-
yes, raw or not well done	4.2	2.6	1.6	0.7-3.5
yes, well done	55.1	56.3	1.0	0.7-1.3
*consumption of fish***				
no	64.9	65.9	1.0	-
yes, raw or not well done	4.2	3.9	1.1	0.5-2.3
yes, well done	30.9	30.2	1.0	0.8-1.4
*consumption of shrimps***				
yes	8.0	7.3	1.1	0.6-2.1
no*	92.0	92.7	1.0	-
*consumption of barbecued meat***				
yes	13.6	8.9	1.4	0.8-2.4
no*	86.4	91.1	1.0	-
*consumption of barbecued fish***				
yes	2.8	1.2	2.5	0.8-8.0
no*	97.2	98.8	1.0	-
*consumption of raw egg (-products)***				
yes	5.4	3.8	1.1	0.5-2.5
no*	94.6	96.2	1.0	-
*consumption of soft-boiled eggs***				
yes	33.5	36.6	0.9	0.7-1.3
no*	66.5	63.5	1.0	-
*consumption of raw milk***				
yes	4.5	6.2	0.7	0.3-1.3
no*	95.5	93.8	1.0	-
*consumption of left-overs***				
yes	23.7	26.4	0.8	0.5-1.2
no*	76.3	74.6	1.0	-

Table 2. Continued.

	% in cases	% in controls	matched OR	95%-c.i.
*consump. of chinese take away food***				
yes	24.7	18.9	1.4	1.0-2.1
no*	75.3	81.1	1.0	-
*consumption of food from canteen***				
yes	36.1	28.2	1.3	1.0-1.9
no*	63.9	71.8	1.0	-
*consumption of salad***				
yes	31.2	35.0	0.9	0.6-1.2
no*	68.8	65.0	1.0	-
store eggs in refrigerator				
yes	70.1	63.9	1.4	1.0-2.0
no*	29.9	36.1	1.0	-
defrost chicken				
on kitchen counter	25.6	23.8	0.8	0.5-1.2
in refrigerator	30.8	38.4	0.6	0.4-0.9
in microwave	14.8	14.5	0.7	0.4-1.2
in other place	3.2	2.6	1.0	0.4-2.5
never defrost chicken*	25.6	20.6	1.0	-
heating up left-overs				
yes, in stove	35.5	33.4	0.6	0.3-1.0
yes, in microwave	55.3	60.1	0.5	0.3-0.8
yes, in other	3.3	3.9	0.4	0.2-1.0
no, never heating up left-overs*	5.9	2.7	1.0	-
cooling left-overs				
on kitchen counter	49.7	49.4	0.5	0.3-1.0
in refrigerator	39.3	39.6	0.6	0.3-1.0
in other place	4.1	6.7	0.3	0.1-0.7
never cooling left-overs*	6.9	4.3	1.0	-
store leftovers				
yes, in refrigerator	76.1	73.9	0.9	0.6-1.5
yes, on kitchen counter	15.2	14.8	1.0	0.5-1.8
yer, in other place	3.3	4.9	0.8	0.3-1.7
no, never store left-overs*	5.5	6.4	1.0	-
use one chopping board for raw meat and other foods				
yes	49.9	49.0	1.0	0.8-1.4
no*	50.1	51.0	1.0	-
clean chopping board between use for meat and other products	48.8	51.2	1.0	0.4-2.7
yes	51.2	48.8	1.0	-
no*				
material of chopping board				
wood	49.0	51.0	0.9	0.6-1.5
plastic	42.9	41.5	0.9	0.5-1.4
other*	8.1	7.5	1.0	-

Table 2. Continued.

	% in cases	% in controls	matched OR	95%-c.i.
child in household at day care centre				
yes	49.5	51.9	1.2	0.7-2.0
no*	50.5	48.1	1.0	-
child in household at primary school				
yes	49.5	54.0	1.1	0.8-1.6
no*	50.5	46.0	1.0	-

* reference category

**cases: in week before complaints; controls: in week before completing questionnaire

APPENDIX 2.

Table 1. Univariate analyses of socio demographic factors in cases with bacterial pathogens and matched controls without bacterial pathogen (n=39 couples)

risk factor	% in cases	bacteria % in controls	OR	95% c.i.
age-group				
0-4	28.9	25.0	2.0	0.4-10.9
5-34*	46.2	34.6	1.0	-
35-59	42.3	28.9	0.4	0.2-1.4
60+	28.9	46.2	0.3	0.1-1.2
gender				
female	46.7	71.1	1.0	-
male*	53.3	28.9	3.8	1.3-11.3
nationality				
Dutch*	94.2	98.1	1.0	-
non-Dutch	5.8	1.9	3.0	0.3-28.8
native country of respondent				
the Netherlands*	98.1	98.1	1.0	-
other country	1.9	1.9	1.0	0.1-16.0
native country father of resp.				
the Netherlands*	88.0	94.2	1.0	-
other country	12.0	5.8	2.0	0.5-8.0
native country mother of resp.				
the Netherlands*	86.7	95.6	1.0	-
other country	13.3	4.4	2.3	0.6-9.0
employed				
yes	45.2	42.9	1.0	-
no*	54.8	57.1	1.0	0.4-2.9
school going				
yes	20.0	5.3	5.0	0.6-42.8
no*	80.0	94.7	1.0	-
*level of education***				
low	38.5	46.2	1.6	0.4-5.9
intermediate	32.7	11.5	4.3	1.2-15.7
high*	23.1	36.5	1.0	-

* reference category

** <18 years education of parents, 18 years and older: own education. Low=up to MAVO/MULO, middle=up to MBO, high=HBO or university)

Table 2. Univariate analyses of risk factors for cases with bacteria versus matched controls without bacteria (n=39 couples).

risk factor	bacteria			
	% in cases	% in controls	OR	95% c.i.
chronic gastrointestinal disorder				
yes	18.6	9.3	2.3	0.7-7.3
no*	81.4	90.7	1.0	-
under treatment of specialist				
yes	4.7	23.3	0.1	0.0-0.9
no*	95.4	76.7	1.0	-
regular use of medication				
yes	25.0	43.2	0.5	0.2-1.2
no*	75.0	56.8	1.0	-
*others with gastrointestinal symptoms***				
yes	12.0	8.0	1.7	0.4-7.0
no*	88.0	92.0	1.0	-
*use of antibiotics***				
yes	4.8	14.3	0.3	0.1-1.7
no*	95.2	85.7	1.0	-
*unususally large quant. of alcohol***				
yes	15.4	7.7	2.5	0.5-12.9
no*	84.6	92.3	1.0	-
*international travel***				
no travel*	76.9	92.2	1.0	-
to Asia	3.9	0.0	~	~
to other developing country	3.9	1.9	2.0	0.2-22.1
to developed country	15.4	5.8	3.5	0.7-16.8
*swimming in surface waters***				
yes	0.0	2.0	~	~
no*	100.0	98.0	1.0	-
*swimming in marine waters***				
yes	11.74	4.6	6.0	0.7-49.8
no*	88.6	95.5	1.0	-
*swimming in swimming pool***				
yes	18.2	11.4	1.6	0.5-4.9
no*	81.8	88.6	1.0	-
child in diapers in household				
no diapers*	80.8	74.9	1.0	-
cloth diapers	1.9	3.9	0.5	0.0-5.5
paper diapers	17.3	21.2	0.7	0.2-2.4
pets in household				
dog	17.3	25.0	0.5	0.1-1.9
cat	11.5	9.6	1.2	0.3-5.0
fish	1.9	1.9	1.0	0.1-16.0
rabbit	7.7	3.9	1.7	0.3-10.3
dog and cat	7.7	9.6	0.7	0.7-3.3
other combination of more pets	11.5	9.6	1.2	1.2-4.8
no pets*	42.4	40.4	1.0	-

Table 2. Continued.

risk factor	bacteria			
	% in cases	% in controls	OR	95% c.i.
farming animals in household				
no farming animals*	94.2	94.2	1.0	-
poultry	1.9	1.9	1.5	0.1-34.8
other farming animals	3.9	1.9	2.3	0.2-33.2
*played in sand box***				
yes	11.5	15.4	0.5	0.1-2.7
no*	88.5	84.6	1.0	-
*consumption of pork meat***				
no*	30.8	17.3	1.0	-
yes, raw/undercooked	7.7	7.7	0.5	0.1-2.7
yes, well done	61.5	75.0	0.5	0.2-1.2
*consumption of beef***				
no*	44.2	34.6	1.0	-
yes, raw/undercooked	5.8	11.5	0.4	0.1-1.9
yes, well done	50.0	53.9	0.7	0.3-1.8
*consumption of chicken***				
no*	48.0	44.2	1.0	-
yes, raw/undercooked	1.9	3.9	0.5	0.0-5.7
yes, well done	53.9	51.9	1.1	0.5-2.3
*consumption of fish***				
no*	71.1	67.3	1.0	-
yes, raw/undercooked	3.9	7.7	0.5	0.1-2.8
yes, well done	25.0	28.0	0.9	0.3-2.5
*consumption of shrimps***				
yes	5.0	15.0	0.2	0.1-1.0
no*	95.0	85.0	1.0	-
*consumption of barbecued meat***				
yes	14.6	7.3	1.5	0.4-5.3
no*	84.4	92.7	1.0	-
*consumption of barbecued fish***				
yes	4.1	0.0	~~	
no*	95.9	100.0		
*consumption of raw egg (-products)***				
yes	7.9	10.5	1.0	0.2-5.0
no*	92.1	89.5	1.0	-
*consumption of soft boiled egg***				
yes	32.5	37.5	0.7	0.3-1.8
no*	67.5	62.5	1.0	-
*consumption of raw milk***				
yes	4.4	4.2	0.5	0.1-5.5
no*	95.6	95.8	1.0	-
*consumption of left-overs***				
yes	29.7	13.5	2.3	0.7-7.3
no*	70.3	86.5	1.0	-
*consump. of chinese take away food***				
yes	24.4	17.1	1.4	0.5-3.8
no*	75.6	82.9	1.0	-

Table 2. Continued

risk factor	bacteria			
	% in cases	% in controls	OR	95% c.i.
*consumption of food from canteen***				
yes	41.5	39.0	1.2	0.5-2.6
no*	58.5	61.0	1.0	-
*consumption of salad***				
yes	32.5	45.0	0.7	0.3-1.6
no*	67.5	55.0	1.0	-
store eggs in refrigerator				
yes	65.1	62.8	1.3	0.5-3.2
no*	34.9	37.2	1.0	-
defrost chicken				
on kitchen counter	15.4	19.2	0.7	0.2-2.7
in refrigerator	30.8	36.5	0.8	0.3-2.5
in microwave	21.2	13.5	1.5	0.4-5.6
in other place	1.9	1.9	1.0	0.1-16.0
never defrost chicken*	30.7	28.8	1.0	-
heating up left overs				
on stove	30.8	26.9	0.4	0.0-4.4
in microwave	61.5	69.2	0.3	0.0-3.0
other	1.9	1.9	0.3	0.0-11.2
never heat up left-overs*	5.8	2.0	1.0	-
cooling left overs				
on kitchen counter	46.2	36.5	0.3	0.0-3.3
in refrigerator	44.2	55.8	0.2	0.0-1.8
in other place	1.9	5.8	0.1	0.0-2.0
never cool left-overs*	7.7	1.9	1.0	-
store left overs				
in refrigerator	69.2	80.8	0.4	0.1-1.4
on kitchen counter	11.5	13.5	0.4	0.1-1.9
in other place	3.9	0.0	~	~
never store left-overs*	15.4	5.7	1.0	-
use one chopping board for meat and other products				
yes	57.1	50.0	1.1	0.5-2.4
no*	42.9	50.0	1.0	-
clean chopping board between use for meat and other products				
yes	96.4	96.2	1.0	0.1-16.0
no*	3.6	3.9	1.0	-
material of chopping board				
wood	44.2	53.9	0.2	0.0-1.5
plastic	46.2	44.2	0.2	0.0-2.1
other material*	9.6	1.9	1.0	-
person in household at day care centre				
yes	11.5	13.5	0.8	0.2-3.4
no*	88.5	86.5	1.0	-
person in household in element. school				
yes	32.7	40.4	0.6	0.2-1.7
no*	67.3	59.6	1.0	-

* reference category

** cases: in the week before symptoms; controls: in the week before completion of questionnaire

APPENDIX 3

Table 1. Distribution of socio-demographic factors in cases with viral gastroenteritis and matched controls without viruses (n=44 couples).

risk factor	% in cases	viruses % in controls	OR	95% c.i.
age group				
0-4	56.8	38.6	~~	~
5-34*	27.3	38.6	1.0	-
35-59	9.1	11.4	0.6	0.1-2.7
60+	6.8	11.4	0.4	0.1-2.5
gender				
male*	50.0	63.6	1.0	-
female	50.0	36.4	2.0	0.8-5.3
nationality				
Dutch*	90.9	97.7	1.0	-
non-Dutch	9.1	2.3	~~	~
native country respondent				
the Netherlands*	97.7	97.7	1.0	-
other country	2.3	2.3	~~	~
native country father of respondent				
the Netherlands*	88.4	90.9	1.0	-
other country	11.6	9.1	1.3	0.3-6.0
native country mother of respondent				
the Netherlands	81.8	93.2	1.0	-
other country	18.2	6.8	3.5	0.7-16.8
employed				
yes	76.7	81.4	1.3	0.3-4.7
no*	23.3	18.6	1.0	-
school going				
yes	11.8	11.1	2.0	0.2-22.1
no*	88.2	88.9	1.0	-
*level of education***				
low	34.1	31.8	2.0	0.6-6.5
intermediate	40.9	27.3	2.8	0.9-9.0
high*	20.5	38.6	1.0	-

*reference category

**until 18 years education of parents, 18 years and older: own education. Low=up to MAVO/MULO, middle=up to MBO, high=HBO or university)

Table 2. Univariate analyses of riskfactors for cases with viral gastroenteritis and matched controls without viruses (n=44 couples).

risk factor	% in cases	viruses % in controls	OR	95% c.i.
chronic gastrointestinal disorder				
yes	11.4	2.3	5.0	0.6-42.8
no*	88.6	97.7	1.0	-
under treatment of specialist				
yes	11.4	9.3	1.0	0.3-4.0
no*	88.6	90.7	1.0	-
regular use of medication				
yes	22.7	15.9	1.8	0.5-6.0
no*	77.3	84.1	1.0	-
*others with gastrointestinal symptoms***				
yes	24.4	13.6	2.3	0.6-9.0
no*	75.6	86.4	1.0	-
*use of antibiotics***				
yes	4.6	6.8	0.7	0.1-4.0
no*	95.5	93.2	1.0	-
unusually high quant. of alcohol				
yes	16.7	0.0	~	~
no*	83.3	100.0	1.0	-
*international travel***				
no travel*	88.6	97.7	1.0	-
to Asia	6.8	0.0	~~	~
to other developing country	0.0	0.0	~~	~
to developed country	4.6	2.3	~~	~
*swimming in surface waters***				
yes	0.0	0.0	~~	~~
no*	100.0	100.0	1.0	-
*swimming in marine waters***				
yes	2.3	2.3	1.0	0.1-16.0
no*	97.7	97.7	1.0	-
*swimming in pool***				
yes	20.5	18.2	1.3	0.3-4.7
no*	79.6	81.8	1.0	-
child in diapers in household				
no diapers*	45.4	54.5	1.0	-
cloth diapers	2.3	2.3	1.3	0.1-22.4
paper diapers	52.3	43.2	1.7	0.6-4.7
pets in household				
dog	18.2	15.9	1.4	0.4-4.7
cat	15.9	13.6	1.5	0.4-5.5
fish	0.0	0.0	~	~
rabbit	2.3	6.8	0.2	0.0-2.5
dog and cat	6.8	4.6	2.6	0.2-31.9
other combination of more pets	2.3	11.4	0.1	0.0-1.5
no pets*	50.0	40.9	1.0	-

Table 2. Continued

risk factor	% in cases	viruses % in controls	OR	95% c.i.
farming animals in household				
poultry	2.3	6.8	0.3	0.0-3.2
other farming animals	4.6	0.0	~~	~
no farming animals*	93.1	93.2	1.0	-
*played in sand box***				
yes	22.7	22.7	1.0	0.3-3.1
no*	77.3	77.3	1.0	-
*consumption of pork meat***				
no*	38.6	4.6	1.0	-
yes, raw/undercooked	2.3	81.8	0.1	0.0-1.3
yes, well done	59.1	13.6	0.2	0.0-0.7
*consumption of beef***				
no*	49.9	38.6	1.0	-
yes, raw/undercooked	4.6	0.0	~	~
yes, well done	45.5	61.4	0.6	0.2-1.4
*consumption of chicken***				
no*	50.1	34.1	1.0	-
yes, raw/undercooked	4.6	0.0	~	~
yes, well done	45.5	65.9	0.5	0.2-1.1
*consumption of fish***				
no*	72.7	68.1	1.0	-
yes, raw/undercooked	2.3	2.3	0.9	0.1-14.9
yes, well done	25.0	29.6	0.8	0.3-2.0
*consumption of shrimps***				
yes	7.0	7.3	1.0	0.1-7.1
no*	93.0	92.7	1.0	-
*consumption of barbecued meat***				
yes	4.7	2.4	2.0	0.2-22.1
no*	95.4	97.6	1.0	-
*consumption of barbecued fish***				
yes	2.3	2.4	1.0	0.1-16.0
no*	97.7	97.6	1.0	-
*consumption of raw egg (-products)***				
yes	4.8	7.1	0.7	0.1-4.0
no*	95.2	92.9	1.0	-
*consumption of soft-boiled egg***				
yes	22.0	39.0	0.5	0.2-1.4
no*	78.1	61.0	1.0	-
*consumption of raw milk***				
yes	0.0	4.8	~~	~~
no*	100.0	95.2	1.0	-
*consumption of left-overs***				
yes	16.3	32.6	0.3	0.1-1.2
no*	83.7	67.4	1.0	-
*consumption of chinese take away food***				
yes	15.9	16.7	0.8	0.3-2.7
no*	84.1	83.3	1.0	-

Table 2. Continued

risk factor	viruses			
	% in cases	% in controls	OR	95% c.i.
*consumption of food from canteen***				
yes	16.7	26.2	0.6	0.2-1.7
no*	83.3	73.8	1.0	-
*consumption of salad***				
yes	16.7	26.2	0.6	0.2-1.7
no*	83.3	73.8	1.0	-
store eggs in refrigerator				
yes	75.6	65.1	1.5	0.5-4.2
no*	24.4	34.9	1.0	-
defrost chicken				
on kitchen counter	34.1	20.5	1.3	0.3-6.0
in refrigerator	25.0	43.2	0.5	0.1-2.5
in microwave	18.2	15.9	0.7	0.1-4.2
in other place	2.3	0.0	~	~
never defrost chicken*	20.4	20.4	1.0	-
heating up left-overs				
on stove	31.8	34.1	0.4	0.0-6.4
in microwave	59.1	59.1	0.4	0.0-6.7
other	2.3	2.3	0.7	0.0-15.4
never heat up left-overs*	6.8	4.5	1.0	-
cooling left-overs				
on kitchen counter	59.1	47.7	1.7	0.3-10.8
in refrigerator	31.8	31.8	1.3	0.2-8.8
in other place	2.3	11.4	~	~
never cool left-overs*	6.8	9.1	1.0	-
store left-overs				
in refrigerator	75.0	75.0	1.0	0.2-5.0
on kitchen counter	15.9	6.8	4.0	0.3-60.3
in other place	0.0	9.1	~	~
never store left-overs*	9.1	9.1	1.0	-
use of one chopping board for meat and other products				
yes	51.2	54.8	0.9	0.3-2.4
no*	48.8	45.2	1.0	-
clean chopping board between use for meat and other products				
yes	90.5	100.0	~~	~
no*	9.5	0.0	1.0	-
material chopping board				
wood	52.3	38.6	1.7	0.4-7.3
plastic	34.1	45.5	0.8	0.2-3.6
other material*	13.6	15.9	1.0	-
child in household at day care centre				
yes	29.6	22.7	1.4	0.5-3.8
no*	70.5	77.3	1.0	-
child in household at element. school				
yes	40.9	50.0	0.6	0.2-1.7
no*	59.1	50.0	1.0	-

* reference category

** cases: in week before complaints; controls: in week before completing questionnaire

APPENDIX 4

Table 1. Distribution of socio demographic factors in cases with pathogenic parasites and matched controls without pathogenic parasites (n=22 couples).

risk factor	pathogenic parasites			
	% in cases	% in controls	OR	95%-c.i.
age group				
0-4	20.0	25.7	0.3	0.0-3.2
5-34*	51.4	68.5	1.0	-
35-59	20.0	25.7	0.4	0.1-2.1
60+	8.6	17.1	0.3	0.1-1.8
gender				
female*	60.0	57.1	1.0	-
male	40.0	42.9	0.9	0.3-2.6
nationality				
Dutch*	91.4	94.3	1.0	-
non-Dutch	8.6	5.7	1.5	0.3-9.0
native country of respondent				
the Netherlands*	91.4	97.1		
other country	8.6	2.9		
native country father of respondent				
the Netherlands*	91.4	91.2	1.0	-
other country	8.6	8.8	1.0	0.2-5.0
native country mother of respondent				
the Netherlands*	88.6	97.1	1.0	-
other country	11.4	2.9	4.0	0.4-35.8
employed				
yes	38.2	31.2	2.0	0.5-8.0
no*	61.8	68.8	1.0	-
school going				
yes	8.7	18.2	0.3	0.0-3.2
no*	91.3	81.8	1.0	-
level of education				
low	37.1	37.1	1.7	0.5-6.6
intermediate	31.4	40.0	3.8	0.9-16.6
high*	31.4	14.3	1.0	-

*reference category

**until 18 years education of parents, 18 years and older: own education. Low=up to MAVO/MULO, middle=up to MBO, high=HBO or university)

Table 2. Univariate analyses of risk factors for cases with pathogenic parasites versus matched controls without pathogenic parasites (n=22 couples).

risk factor	parasites			
	% in cases	% in controls	OR	95%-c.i.
under treatment of specialist				
yes	11.8	11.8	1.0	0.3-4.0
no*	88.2	88.2	1.0	-
regular use of medication				
yes	25.7	45.7	0.5	0.2-1.2
no*	74.3	54.3	1.0	-
chronic gastrointestinal disorder				
yes	20.6	9.4	2.0	0.5-8.0
no*	79.4	90.6	1.0	-
*use of antibiotics***				
yes	15.2	14.7	1.0	0.3-3.5
no*	84.9	95.3	1.0	-
*use of unusally high quant. of alcohol***				
yes	4.4	4.8	1.0	0.1-16.0
no*	95.7	95.2	1.0	-
*others with gastrointestinal symptoms***				
yes	14.7	14.3	1.0	0.3-4.0
no*	85.3	85.7	1.0	-
*internation travel***				
no travel*	82.8	91.4	1.0	-
to Asia	2.9	0.0	~	~
to other developing country	2.9	0.0	2.0	0.2-22.1
to developed country	11.4	8.6	3.5	0.7-16.8
*swimming in surface waters***				
yes	11.8	3.0	~	~
no*	88.2	97.0	1.0	-
*swimming in marine waters***				
yes	5.9	0.0	~	~
no*	94.1	100.0	1.0	-
*swimming in swimming pool***				
yes	31.3	6.1	5.0	1.1-22.8
no*	68.8	93.9	1.0	-
child in diapers in household				
no diapers*	60.0	34.3	1.0	-
cloth diapers	5.7	2.9	2.4	0.2-30.7
paper diapers	34.3	31.4	1.3	0.4-4.3
pets in household				
dog	22.9	8.6	4.5	0.4-47.1
cat	11.4	20.0	0.4	0.1-1.9
fish	2.9	2.9	1.2	0.0-57.8
rabbit	2.9	11.4	~	~
dog and cat	5.7	8.6	0.3	0.0-4.1
other combination of more pets	8.6	8.6	0.9	0.1-5.5
no pets*	45.6	39.9	1.0	-

Table 2. Continued.

risk factor	pathogenic parasites			
	% in cases	% in controls	OR	95%-c.i.
farming animals in household				
no farming animals*	94.3	97.1	1.0	-
poultry	0.0	2.9	~	~
other farming animals	5.7	0.0	~	~
*played in sand box***				
yes	14.3	17.1	0.5	0.0-5.5
no*	85.7	82.9	1.0	-
*consumption of pork meat***				
no*	14.2	25.7	1.0	-
yes, raw/undercooked	2.9	5.7	0.5	0.0-5.6
yes, well done	82.9	68.6	1.8	0.6-5.6
*consumption of beef***				
no*	28.6	37.3	1.0	-
yes, raw/undercooked	5.7	5.6	0.4	0.0-3.6
yes, well done	65.7	57.1	1.5	0.5-4.6
*consumption of chicken***				
no*	42.9	48.5	1.0	-
yes, raw/undercooked	0.0	2.9	~	~
yes, well done	57.1	48.6	1.3	0.5-3.8
*consumption of fish***				
no*	74.2	68.5	1.0	-
yes, raw/undercooked	2.9	2.9	1.0	0.1-16.0
yes, well done	22.9	28.6	0.7	0.6-14.9
*consumption of shrimps***				
yes	11.8	6.3	2.0	0.4-10.9
no*	88.2	93.8	1.0	-
*consumption of barbecued meat***				
yes	23.5	12.1	3.0	0.6-14.9
no*	76.5	87.9	1.0	-
*consumption of barbecued fish***				
yes	0.0	3.0	~	~
no*	100.0	97.0	1.0	-
*consumption of raw egg (-products)***				
yes	2.9	0.0	~	~
no*	97.1	100.0	1.0	-
*consumption of soft-boiled egg***				
yes	20.6	21.9	1.0	0.3-3.1
no*	79.4	78.1	1.0	-
*consumption of raw milk***				
yes	2.9	0.0	~	~
no*	97.1	100.0	1.0	-
*consumption of left-overs***				
yes	27.3	25.0	1.0	0.3-3.1
no*	72.7	75.0	1.0	-
*consumption of chinese take-away food***	24.2	15.2	2.0	0.5-8.0
yes	75.8	84.9	1.0	-
no*				

Table 2. Continued

risk factor	pathogenic parasites			
	% in cases	% in controls	OR	95%-c.l.
*consumption of food from canteen***				
yes	39.4	30.3	1.3	0.5-3.5
no*	60.6	69.7	1.0	-
*consumption of salad***				
yes	36.4	40.0	1.0	0.4-2.9
no*	63.6	60.0	1.0	-
store eggs in refrigerator				
yes	67.7	67.7	1.0	0.4-2.9
no*	32.4	32.4	1.0	-
defrost chicken				
on kitchen counter	34.3	31.4	1.2	0.3-4.5
in refrigerator	28.6	22.9	1.4	0.4-5.4
in microwave	8.6	14.3	0.7	0.1-3.8
in other place	5.7	5.7	1.4	0.4-5.4
never defrost chicken*	22.8	25.7	1.0	-
heating up left-overs				
on stove	34.3	31.4	0.8	0.2-4.2
in microwave	51.4	51.4	0.7	0.1-3.3
other	0.0	5.7	~	~
never heat up left-overs*	14.3	11.5	1.0	-
cooling left-overs				
on kitchen counter	48.6	42.9	1.1	0.1-9.1
in refrigerator	45.7	42.9	1.0	0.1-7.0
in other place	0.0	8.6	~	~
never cool left-overs*	5.7	5.6	1.0	-
store left-overs				
in refrigerator	65.7	68.6	0.8	0.2-3.1
on kitchen counter	11.4	14.3	0.6	0.1-4.2
in other place	5.7	2.9	1.6	0.1-25.6
never store left-overs*	17.2	14.2	1.0	-
use one chopping board for meat and other products				
yes	57.1	50.0	1.3	0.6-3.2
no*	42.9	50.0	1.0	-
clean chopping board between use for meat and other products				
yes	85.7	94.4	2.0	0.2-22.1
no*	14.3	5.6	1.0	-
material chopping board				
wood	51.4	42.9	8.5	1.0-73.0
plastic	45.7	34.3	7.6	0.9-63.6
other material*	2.9	22.8	1.0	-
child in household at day care centre				
yes	22.9	25.7	0.8	0.3-2.7
no*	77.1	74.3	1.0	-
child in household in element. school				
yes	54.3	11.4	8.5	2.0-36.8
no*	45.7	88.6	1.0	-

* reference category

** cases: in the week before symptoms; controls: in the week before completion of questionnaire

APPENDIX 5

Table 1. Distribution of socio demographic factors in cases with (possibly) nonpathogenic parasites and matched controls without (possibly) nonpathogenic parasites (n=61 couples).

risk factor	(possibly) non-pathogenic parasites			
	% in cases	% in controls	OR	95%-c.i.
age group				
0-4	11.5	13.1	0.7	0.2-2.5
5-34*	42.6	29.6	1.0	-
35-59	34.4	39.3	0.5	0.2-1.4
60+	11.5	18.0	0.4	0.1-1.3
gender				
female*	52.5	60.7	1.0	-
male	47.5	39.3	1.4	0.7-3.0
nationality				
Dutch*	93.3	100.0	1.0	-
non-Dutch	6.7	0.0	~	~
native country of respondent				
the Netherlands*	91.7	98.3	1.0	-
other country	8.3	1.7	4.0	0.4-35.8
native country father of resp.				
the Netherlands*	88.3	88.3	1.0	-
other country	11.7	11.7	0.8	0.3-2.7
native country mother of resp.				
the Netherlands*	90.0	91.7	1.0	-
other country	10.0	8.3	1.0	0.3-3.5
employed				
yes	50.9	70.0	3.0	1.1-8.3
no*	49.1	30.0	1.0	-
school going				
yes	13.6	2.3	0.2	0.0-1.7
no*	86.4	97.7	1.0	-
level of education				
low	35.7	50.9	1.5	0.6-3.6
intermediate	32.1	20.8	0.8	0.3-1.7
high*	32.1	28.3	1.0	-

Table 2. Univariate analyses of risk factors cases with (possibly) nonpathogenic parasites and matched controls without (possibly) nonpathogenic parasites (n=61 couples).

risk factor	(possibly) non-parasites			
	% in cases	% in controls	OR	95%-c.i.
under treatment of specialist				
yes	15.0	23.2	0.4	0.1-1.4
no*	85.0	76.8	1.0	-
regular use of medication				
yes	25.0	43.9	0.4	0.2-0.9
no*	75.0	56.1	1.0	-
chronic gastrointestinal disorder				
yes	18.3	12.1	1.3	0.5-3.8
no*	81.7	87.9	1.0	-
*use of antibiotics***				
yes	11.7	7.1	1.5	0.4-5.3
no*	88.3	92.9	1.0	-
*use of unusually high quant. of alcohol***				
yes	8.9	2.4	4.0	0.4-35.8
no*	91.1	97.6	1.0	-
*others with gastrointestinal symptoms***				
yes	12.3	14.3	0.8	0.3-2.2
no*	87.7	85.7	1.0	-
*internation travel***				
no travel*	77.1	96.8	1.0	-
to Asia	8.2	1.6	~	~
to other developing country	4.9	0.0	~	~
to developed country	9.8	1.6	~	~
*swimming in surface waters***				
yes	6.7	0.0	~	~
no*	93.3	100.0	1.0	-
*swimming in marine waters***				
yes	6.7	1.8	~	~
no*	93.3	98.2	1.0	-
*swimming in swimming pool***				
yes	16.7	21.8	0.9	0.3-2.4
no*	83.3	78.2	1.0	-
child in diapers in household				
no diapers*	77.1	90.2	1.0	-
cloth diapers	1.6	1.6	1.0	0.1-16.0
paper diapers	21.3	8.2	3.0	1.0-9.3
pets in household				
dog	14.8	6.6	3.1	0.8-11.6
cat	26.2	14.8	3.1	1.0-9.8
fish	1.6	3.3	~	~
rabbit	3.3	4.9	1.2	0.2-7.9
dog and cat	9.8	8.2	1.8	0.4-9.4
other combination of more pets	8.2	14.8	0.8	0.2-2.9
no pets*	36.1	47.4	1.0	-

Table 2. Continued.

risk factor	(possibly) non-pathogenic parasites			
	% in cases	% in controls	OR	95%-c.i.
farming animals in household				
no farming animals*	90.1	96.7	1.0	-
poultry	3.3	3.3	~	~
other farming animals	0.0	0.0	~	~
*played in sand box***				
yes	4.9	8.2	0.3	0.0-3.2
no*	95.1	91.8	1.0	-
*consumption of pork meat***				
no*	36.1	29.5	1.0	-
yes, raw/undercooked	4.9	6.6	0.6	0.1-3.1
yes, well done	59.0	63.9	0.8	0.4-1.6
*consumption of beef***				
no*	32.8	41.0	1.0	-
yes, raw/undercooked	11.5	4.9	3.6	0.7-19.8
yes, well done	55.7	54.1	1.4	0.6-3.1
*consumption of chicken***				
no*	49.2	49.2	1.0	-
yes, raw/undercooked	6.6	1.6	3.6	0.4-33.7
yes, well done	42.6	49.2	0.8	0.4-1.9
*consumption of fish***				
no*	63.9	63.9	1.0	-
yes, raw/undercooked	3.3	8.2	0.3	0.0-2.4
yes, well done	32.8	27.9	1.3	0.5-3.3
*consumption of shrimps***				
yes	11.9	7.8	1.7	0.4-7.0
no*	88.1	92.2	1.0	-
*consumption of barbecued meat***				
yes	14.3	11.5	1.2	0.4-3.5
no*	85.7	88.5	1.0	-
*consumption of barbecued fish***				
yes	6.8	2.0	4.0	0.4-35.8
no*	93.2	98.0	1.0	-
*consumption of raw egg (-products)***				
yes	8.8	0.0	~	~
no*	91.2	100.0	1.0	-
*consumption of soft-boiled egg***				
yes	40.0	34.0	1.2	0.5-2.8
no*	60.0	66.0	1.0	-
*consumption of raw milk***				
yes	6.8	2.0	3.0	0.3-28.8
no*	93.2	98.0	1.0	-
*consumption of left-overs***				
yes	25.5	21.2	1.3	0.5-3.5
no*	74.6	78.9	1.0	-
*consumption of chinese take-away food***				
yes	31.0	22.2	1.4	0.4-4.4
no*	69.0	77.8	1.0	-

Table 2. Continued

risk factor	(possibly) non-pathogenic parasites			
	% in cases	% in controls	OR	95%-c.i.
*consumption of food from canteen***				
yes	40.4	28.3	1.8	0.7-4.2
no*	59.7	71.7	1.0	-
*consumption of salad***				
yes	32.1	26.9	1.4	0.6-3.2
no*	67.9	73.1	1.0	-
store eggs in refrigerator				
yes	67.8	66.7	1.2	0.5-2.8
no*	32.2	33.3	1.0	-
defrost chicken				
on kitchen counter	27.8	24.6	0.6	0.2-1.9
in refrigerator	18.0	39.3	0.2	0.1-0.7
in microwave	14.8	11.5	0.7	0.2-2.5
in other place	6.6	3.3	1.1	0.2-7.1
never defrost chicken*	32.8	21.3	1.0	-
heat up left-overs				
on stove	32.8	39.3	0.9	0.2-3.7
in microwave	57.4	42.6	1.0	0.3-3.7
other	8.2	1.6	~	~
never heat up left-overs*	1.6	16.5	1.0	-
cooling left-overs				
on kitchen counter	39.3	47.5	0.5	0.1-1.8
in refrigerator	34.4	32.8	0.7	0.2-2.5
in other place	4.9	3.3	0.8	0.1-7.2
never cool left-overs*	21.4	16.4	1.0	-
store left-overs				
in refrigerator	63.9	62.3	2.0	0.7-5.9
on kitchen counter	16.4	13.1	2.6	0.6-12.6
in other place	6.6	1.6	7.1	0.7-77.9
never store left-overs*	13.1	23.0	1.0	-
use one chopping board for meat and other products				
yes	49.1	56.1	0.9	0.4-2.1
no*	50.9	43.9	1.0	-
clean chop. board between use for meat and other products				
yes	3.7	6.1	~	~
no*	96.3	93.9	1.0	-
material chopping board				
wood	59.7	47.3	2.0	0.7-5.7
plastic	35.1	43.6	1.2	0.4-3.8
other material*	5.3	9.1	1.0	-
child in household at day care centre				
yes	18.0	3.3	5.5	1.2-24.8
no*	82.0	96.7	1.0	-
child in household in element. school				
yes	37.7	24.6	2.3	0.9-6.1
no*	62.3	75.4	1.0	-

* reference category

** cases: in the week before symptoms; controls: in the week before completion of questionnaire