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Results from the National Gastroenteritis Survey 2001 – 2002

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ozfoodnet

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PREFACE: OZFOODNET

The overall brief of OzFoodNet is to enhance the surveillance and understanding of foodborne illness in Australia. OzFoodNet is a collaboration of foodborne disease epidemiologists largely based in Commonwealth and State/Territory health departments, and many other players who make up the wider OzFoodNet working group. The collaboration started in November 2000 and is funded by the Commonwealth Dept of Health and Ageing.

This report contains the results of the OzFoodNet / NCEPH *National Gastroenteritis Survey.* A second report entitled *"How Much Gastroenteritis in Australia is Due to Food? Estimating the Incidence of Foodborne Gastroenteritis in Australia"* contains the results of the OzFoodNet project that focused on gastroenteritis of foodborne origin, and that used the results of the survey described in this paper.

The study team comprises the following people:

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EXECUTIVE SUMMARY

Main Results from the National Gastroenteritis Survey 2001/2

- There is a high burden of gastroenteritis in Australia, with about 17.2 million episodes in a year (95% CI: 14.5 to 19.9 million).

- The Northern Territory has the highest rates in both Indigenous and non-Indigenous people, and rates are highest in Summer and lowest in Autumn. This suggests that climatic variation may influence gastroenteritis in Australia.

- The age groups most at risk of acquiring gastroenteritis are children under five years, and women 20-40 years of age, similar to findings in the US [1]. Older people over 60 years of age were least likely to report gastroenteritis, although the duration of gastroenteritis is longest in this group.

- People with higher household incomes were more likely to report gastroenteritis but those with health insurance were less likely to report gastroenteritis in all income brackets.

- The most common symptoms reported in over half the cases were diarrhoea, loss of appetite, cramps and nausea. Most episodes lasted 1-2 days, and the average number of maximum loose stools in 24 hours was five. Vomiting occurred in less than half of cases, but a small proportion of cases had vomiting only.

- In one year in Australia, it is estimated that there are about 3.7 million visits to doctors for gastroenteritis and over half a million stool tests.

- About seven million people took medications to treat their illness, including close to one million courses of antibiotics.

- Duration of vomiting/diarrhoea was the most important predictor for visiting a doctor and having a stool sample taken. A stool test is done for about one in every 140 episodes of gastroenteritis in the country if the duration is 1-2 days, but for one in every four episodes if the duration is five or more days.

- There were over six million days of lost paid work due to gastroenteritis, nearly half of these being due to a carer needing to look after someone else with gastroenteritis. This is obviously a very significant cost to the community.

INTRODUCTION

Community gastroenteritis and foodborne disease

Infectious gastroenteritis is caused by a heterogeneous mix of pathogens and is acquired by several different routes of transmission. Enteric pathogens can be foodborne or waterborne, or can be passed on by person-to-person or animal-to-person contact, or from the environment. Due to different environmental conditions and pathogens in various parts of Australia, variations in the pattern of gastroenteritis are to be expected across the country and at different times of the year.

The transmission of gastroenteritis through food is of concern to both the community and to industry and there is an expectation that foodborne illness is kept to a minimum. However, despite this high public expectation, there are many aspects of foodborne illness which have not been well understood, including the amount of gastroenteritis caused by food in Australia. Previous estimates of the total amount of foodborne disease in the 1990s varied from 1-2 million to 4.2 million cases per annum [2] [3].

Current surveillance activities and community gastroenteritis

A number of pathogens that cause gastroenteritis are reported to the National Notifiable Diseases Surveillance System. The rates of notifications suggest that community gastroenteritis and foodborne illnesses are likely to vary by person, place and time, both seasonally and by longer term trends.

Seasonally, there are about 30% more reports for *Campylobacter* in October/November each year compared with the Winter months. The number of *Salmonella* and S*higella* reports start to increase in the Summer months and peak around April at about twice the rate observed in October. Over a longer time period, the rates of reported *Campylobacter* and *Salmonella* illnesses have been increasing while *Shigella* rates have been decreasing [4, 5]. It is to be expected that some of the non-notifiable diseases may also vary by place and be seasonal, such as Rotavirus, which is likely to be more common in the Winter months and Adenovirus which is more likely to be found in the Summer [6] [7].

The rates of these reported pathogens also vary across the country, with the Northern Territory and Queensland reporting higher rates of *Salmonell*a than the southern states, while *Campylobacter* rates are higher in South Australia. In particular, the rate of salmonellosis in children under five years of age is about five times greater in NT compared with that of the southern states [5].

While there are data on reported S*almonella* disease going back to the early seventies in the National Enteric Pathogens Surveillance System [8]and since 1990 in the National Notifiable Diseases Surveillance System [5], these systems are extremely dependent on reporting practices which vary across states and over time. A more reliable assessment of the change of gastroenteritis seasonally and over a longer time period and between different geographic and climatic parts of the country is only possible through a standardised data collection methodology. The surveillance systems currently in place have a primary function of detecting outbreaks and triggering a response from Public Health authorities, who have responsibility to intervene and prevent further spread of disease. Estimation of the relationship between the current surveillance systems and the real level of community disease has been poorly understood. Knowledge of the fraction of cases that are reported could prove useful to assess how well the current surveillance systems are working, and, in the longer term, it could potentially also have a role in the ongoing monitoring of the community level of gastroenteritis by the Notifiable Diseases System.

Groups at risk of gastroenteritis

Particular characteristics and behaviours of individuals or groups may put certain people at higher risk of getting gastroenteritis, or of having a more severe illness. Identification of ‘at risk’ groups is of benefit as it raises the possibility of better-targeted and more effective interventions.

Monitoring food safety policies

As there are many avenues of food production involving a whole range of different producers and processors, there are many government organisations involved in the regulation of safe handling of food in the community. Regulation depends on both policy formulation and the development and application of practical strategies, and industry is involved in quality control to try and ensure safe food practices are carried out. While the

importance of control of community food handling is recognised by most, the evidence base for the implementation and evaluation of many safe food practices in the production of food from ‘paddock to plate’ is limited. Ultimately, to assess whether broad community level policies and the implementation of food regulation strategies are working, we need to know the amount of gastroenteritis in the community and whether this is changing over time.

Foodborne gastroenteritis

To estimate the burden of foodborne gastroenteritis two key estimates are required; firstly, the total amount of gastroenteritis in the country and second, the proportion of gastroenteritis that is foodborne. The product of these two estimates gives the total number of cases of foodborne gastroenteritis.

This working paper covers the results of the National Gastroenteritis Survey 2001/2. A second working paper entitled “How Much Gastroenteritis in Australia is Due to Food? Estimating the Incidence of Foodborne Gastroenteritis in Australia” covers the estimation of the amount of foodborne gastroenteritis in one ‘typical year’ around 2000 in Australia.

NATIONAL GASTROENTERITIS SURVEY 2001/2

1. Purpose of the gastroenteritis survey

A national community survey was undertaken between September 2001 and August 2002 in order to gain a better understanding of gastroenteritis in Australia. Interest was focussed on estimating the incidence and severity of gastroenteritis, the reporting of gastroenteritis to established surveillance systems, and identification of groups at risk of gastroenteritis.

The main aim of the survey was to:

- Estimate the incidence of infectious gastroenteritis in the Australian community

Other objectives were to:

- Assess regional and seasonal variation of gastroenteritis
- Describe the symptoms and severity of gastroenteritis
- Describe groups at risk of gastroenteritis by age, sex, locality and socioeconomic status
- Estimate health-seeking behaviours of the community and investigation patterns of GPs
- Collect data to better inform some components of estimates of the 'reported' fraction for gastroenteritis
- Estimate lost productivity due to gastroenteritis
- Investigate some risk factors of gastroenteritis in the community including travel and eating outside the home

2. Survey Methods

2.1 Study Design

The study was a representative, retrospective, cross-sectional survey of the Australian community across all states and was run over a one year period. Data were collected by computer assisted telephone interviews [9], and the survey incorporated a nested case control study to investigate risk factors.

2.2 Study population and sample

The study population was the total Australian community and the sample frame was all people living in residential households with a land telephone line. Interpreters were provided for six languages including Italian, Greek, Cantonese, Mandarin, Vietnamese and Arabic.

The sample frame did not include:

- People in institutions and overseas visitors. In the 2001 Australian Census, it was estimated that approximately 400,000 Australians lived in army barracks, boarding schools, aged care facilities, hotels, hospitals etc, and that there were about 200,000 overseas visitors [10].
- Those who were unable to answer because of an incapacity such as deafness or intellectual disability.
- People who did not speak sufficient English to answer the questionnaire and spoke a language other than those where an interpreter was available.
- People living in households without a land telephone line .
  There are 6.3 million land lines [11] to 7.2 million households in Australia, [12] so at least 14% of households do not have a land line. It is likely that landlines are less common in certain groups such as the remote Indigenous population and those with lower incomes. The increasing numbers of mobile phones may influence the attachment of a landline in some households and possibly certain groups prefer to only have a mobile phone, such as highly mobile workers, and maybe young single adults.

2.2.1 Sample requirements

The primary objective was to measure the incidence of gastroenteritis in the Australian community. As part of a ‘monitoring’ framework, allowance was also made for the event that another year of data collection may occur in a few years time, and that it will be necessary to estimate whether the level of gastroenteritis has changed. Working with the premise that detection of a change in the incidence of gastroenteritis in the future would be

likely, the key factor to determine sample size was the ability to detect a change in incidence with sufficient precision. A shift of 20% was taken as the meaningful difference we would wish to detect. The sample size required for this is about 6,000.

It was also recognised that data which was meaningful at a state and seasonal level would be desirable but that resources were insufficient to allow for this and that it would not be feasible to determine if a ‘meaningful’ variation were statistically significant at this level.

Another key objective that relied on sufficient sample size was estimation of the components of the under-reporting fraction. The under-reporting fraction depends on the proportion of cases who seek medical care, the proportion of these that have stool samples taken, the proportion that are positive, and the proportion that are notified. It was recognized that it would be beneficial if estimates for the first two components could be determined from the gastroenteritis survey with reasonable precision at least at the national level.

To collect data on potential risk factors requires a longer interview than collecting data on incidence only. In order to obtain some data on risk factors but at the same time to maximize the number of interviews and cases, the study was designed to have a case control study on risk factors nested within the larger prevalence study. A full interview including risk factors was done on all cases and on three randomly selected controls per case - this full interview took about 25 minutes. This meant that, for the majority of respondents, the interview collected data on gastroenteritis only and took less than 10 minutes. This strategy allowed more interviews to be done overall and more cases to be obtained for the assessment of symptoms and health seeking behaviour.

2.2.2 Sample selection

State stratification

The sample was stratified by state to gain information about regional variation of gastroenteritis. The objective was to interview a representative sample of 860 households in each state or territory (VIC, NSW/ACT together, NT, QLD, WA, SA, TAS), with a higher number in NSW/ACT due to deliberate over sampling of the Hunter region (a localized OzFoodNet site). This meant that the sample was not a simple random structure and this affects the precision to some degree. The sample in each state was spread out over the year to allow assessment of seasonal changes.

Household selection

Random digit dialing of households was employed to include households not listed in the white pages. Random digit phone numbers were generated based on known telephone prefixes.

The randomly generated phone numbers were matched with the phone business listings and business numbers were deleted. The numbers were then matched with the white pages and blocks of numbers with certain prefixes were identified, where there were no real telephone numbers. These blocks were removed from the sample frame. Matching with the white pages also allowed addresses to be attached. A letter of explanation about the survey was sent to all the households that had addresses.

For the nested case control study, randomly selected controls were identified when the sample of random phone numbers was developed. The objective was to have a long questionnaire given to three controls for each case, so the list of phone numbers of potential controls was based on the expected prevalence of gastroenteritis. These phone numbers were marked for the interviewers to conduct a full questionnaire for the case-control study looking at risk factors.

Random selection of the respondent

The respondent to be interviewed in each household was selected by asking for the person with the most recent birthday.

2.3 Data collection

2.3.1 Initial Telephone Contact

The person answering the telephone was asked whether the number was a residential household and if so, about the person with the most recent birthday and the age of that person. If the selected respondent was under 15 years, the parent/guardian answered on their behalf. If an adolescent was between 15 and 18 years, permission was sought from the parent/guardian to ask the adolescent the questions.

If the selected respondent was not at home, nine further attempts were made to contact the person at different times of the day before moving on to the next randomly selected respondent.

2.3.2 Case definition

For the purposes of identifying cases for the administration of the questionnaire, gastroenteritis was defined as any episode of diarrhoea or vomiting in the past four weeks. If the respondent had a chronic illness with symptoms of diarrhoea or vomiting, the symptoms had to be different from their usual pattern due to the chronic illness. Respondents were also asked about diarrhoea/vomiting in other people in the house in order to study clustering by household.

Case definition for analysis

There is no agreed international definition of gastroenteritis. Most definitions are based on three or more loose stools in 24 hours, and sometimes include vomiting or other symptoms. Some definitions are given in Technical Note 2 which were sourced from major studies around the developed world.

To reach a conservative primary case definition rather than an over inclusive one, those cases with loose stools and/or vomiting who identified a non-infectious cause for their symptoms were excluded (such as pregnancy, alcohol, chronic illness). In order to minimize the influence of respiratory infections that might have concomitant gastrointestinal symptoms, those who had respiratory symptoms in addition to loose stools/vomiting were also excluded, unless the gastrointestinal symptoms were more severe.

The primary definition of gastroenteritis in the respondent:
At least 3 loose stools or 2 vomits in 24 hours, excluding cases who identified a non-infectious cause of their symptoms. If respiratory symptoms were present, then a higher level of gastrointestinal symptoms was required of at least 4 loose stools or 3 vomits.

The primary case definition relates to the respondent. Definitions including other household members and varying constellations of symptoms are not included in the analyses of gastroenteritis described in this report.

2.3.3 Interview instrument

All respondents were asked about vomiting and diarrhoea, chronic illness, food safety perceptions, demographics and socioeconomic status. If the respondent had had diarrhoea or vomiting, they were asked for more details on symptoms and timing, health care utilisation, investigation and treatment practices, and the effect of their illness on work and activities. Extra questions in the case-control extension focused on travel exposure and eating habits; all cases and approximately three times as many controls were asked these extra questions. This longer questionnaire took an average of 25 minutes for cases and 15 minutes for non-cases. The short questionnaire took an average of six minutes to complete.

Some of the questionnaire was based on the population surveys carried out by the Centres for Disease Control in USA [13]. A summary of the variables considered in the questionnaire is listed in Appendix 1.

2.3.4 Data base of respondents

At the end of the questionnaire respondents were asked whether they would be willing to be on a "control bank" database for future studies on health. Similar databases have been held by state health departments for a number of years and have proved invaluable in the investigation of other health issues, in particular in the investigation of communicable diseases that pose a public health threat to the community. The person's first name, date of birth, sex and postcode was held on the database. This national data collection was held and maintained by the Commonwealth Department of Health and Aged Care and provided the source of controls for the OzFoodNet case-control studies on *Salmonella* and *Campylobacter* risk factors.

2.4 Quality control

Interviewer training

Records were maintained by interviewers of phone contact attempts and these were checked to ensure that the randomisation of selection was maintained whenever possible. Interviewers all received training, and more than half were present throughout the whole 12 months of the study. Response rates for each interviewer were examined each month to check for unusual patterns that may have indicated biases by different interviewers.

Response rate

Records of all contact attempts were maintained to establish the response rate in each state.

Reliability

Reliability was checked by a re-interview of 143 respondents who were re-contacted within a maximum of one week of the initial interview. These comprised 50% cases and 50% non-cases. The respondents were re-asked a number of questions relating to diarrhoea and vomiting and demographic characteristics. The calendar period was the same for the two interviews' that is, 'the last four weeks' for the main interview, and the same dates for the second interview. The respondent was also asked if he/she was happy with the way the interview was conducted.

Recall bias

In order to compare two week recall with four week recall, a separate parallel sample was taken of 132 households where the respondent was asked about diarrhoea and vomiting in the last two weeks instead of the last four weeks. This group was randomly selected from the Hunter region, and phoned during five months, in addition to the standard sample. The incidence of the two groups was compared to see if the recall of two weeks led to the same conclusion as the recall over four weeks.

Random selection

In the pilot, a study was done to compare the response rates using a Kish method of random selection of respondents, and selection by last birthday.

Pilot and dress-rehearsal

A pilot of 186 respondents was done prior to the main survey to identify any problems or issues. 10 respondents who had recently had gastroenteritis were identified from the surveillance system in SA and were asked if they were happy to be part of the pilot, to ensure that enough cases were included to detect any problems in the data collection from this group. After correcting issues identified in the pilot, a full dress-rehearsal was conducted in August in Tasmania to check that the survey was running smoothly, before commencing the survey proper.

2.5 Ethics and Consent

The proposal for the National Gastroenteritis Survey was approved by several Ethics Committees. These are listed in Appendix 2.

Verbal consent was obtained at the time of the phone call before administering the questionnaire. Questions about children under 15 years were answered by their carer, adolescents 15-17 years answered for themselves after verbal consent had been obtained from their guardian, and adults 18 years and over answered for themselves.

2.6 Analysis

The sample selection process involved stratification by state, then random selection of households and random selection of one respondent within the household. This led to an age / sex structure in the sample that was different from the underlying population. To obtain results representative of the underlying Australian population, the data were weighted during analysis.

Weighting

Weighting was done by generalized regression estimation and iterative proportional fitting using a programme from the Australian Bureau of Statistics which is based on calibration of estimates to benchmarks [14]. Each unit was initially assigned a selection weight based on their probability of selection that depended on the number of households in the state and the number of telephone lines to each household. These weights were then adjusted so that the survey data reproduces the benchmarks of population counts. There were two successive stages of adjustment, firstly for age / sex counts, then for household size counts.

Standard errors were produced by jackknife standard error estimation.

Further analysis

The data were examined for variation by state and season, age, sex, and socioeconomic status. Risk factors of travel, chronic illness, locality and place of food were also assessed. Symptoms, health seeking behaviour and treatment of cases were examined. Time lost from normal activities and work/school were evaluated. Procedures included comparison of weighted proportions and averages, logistic regression, and survival analysis for duration of gastroenteritis. Analysis was done with SPSS.[1]

[1] SPSS Inc. SPSS For Windows Release 11.5.0. 2002. Chicago, Illinois USA.

3. Survey Results

3.1 Quality Control

Response rate

The response rate was calculated as the proportion of households that were reached by telephone who took part in the survey. This was 67% overall and is shown for each state in Table 1.

Table 1 Response rate and target in each state.

	Qld	NSW/ ACT	Vic	Tas	SA	NT	WA	Total
Response rate	66%	66%	62%	74%	69%	66%	65%	67%
Target	860	1074	860	860	860	860	860	6234
N Interviews	824	1129	892	843	779	824	859	6087

The Northern Territory had a high level of inappropriate phone numbers compared with the other states, with more phone calls unanswered, and more deleted phone numbers.

The 'refusal rate' was 28.0% as defined by the number of refusals divided by the total number of eligible households, including those of 'unknown' eligibility (i.e. the number was not actually contacted and a suitable household confirmed). [15]

Reliability

The level of concordance between responses on the main dataset was high when compared with responses in the reliability check dataset. For the question on *'Any Diarrhoea or Vomiting'* , the concordance was 96% for those who answered 'Yes' on the main dataset, and 94% for those who answered 'No'. The concordance for the same date of birth of the respondent was 92%, and for sex was 96%. For questions on 'others in the household', the concordance for age was lower at 83%. Details are shown in Technical Note 3.

Recall bias

The equivalent proportions of cases with 'gastroenteritis in the last 4 weeks' were similar for the respondents in the Hunter region on the main dataset (6%) and on the two week recall check dataset (5%). Details are given in Technical Note 3.

Random selection within household: Kish grid selection versus last birthday

The Kish grid method requires that the age and sex of all household members are collected at the beginning of the interview [16]. The interviewers reported that problems arose when asking for this information at the beginning of the interview, before rapport was properly established with the household. The response rate was affected by this and was low (45%) when compared with last birthday selection response rate (63%). The results led to the decision to select respondents by last birthday. Details about quality issues regarding this method of selection are given in Technical Note 1.

Pilot and dress-rehearsal

As a result of the pilot a few questions were modified to improve clarity, and the method for random selection of the respondent in the household was changed to those with the last birthday. The full dress-rehearsal in Tasmania showed that the response rate was over 70%, that over 85% of those interviewed agreed to be on the control databank and that the interviewing and CATI data entry were working well.

3.2 Sample characteristics and distribution

This section describes the representativeness of the data by comparing characteristics with the Australian Census.

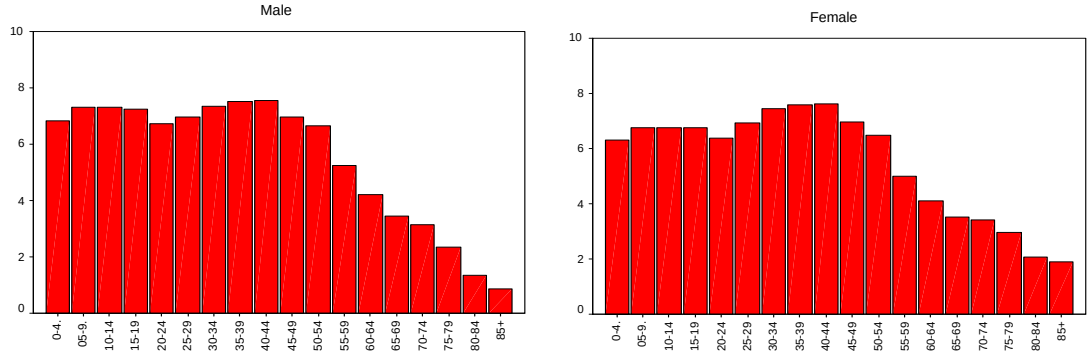
3.2.1 Comparison of survey sample with the Census 2001

Age / sex

The respondent was the index person randomly selected in each household who answered the questionnaire. They were asked about other people in the household as well, and data on age, sex and gastroenteritis was collected for the whole household. The age and sex distribution of the sample of respondents and of all household members is compared with the distribution in the 2001 Australian Census in Figure 1.

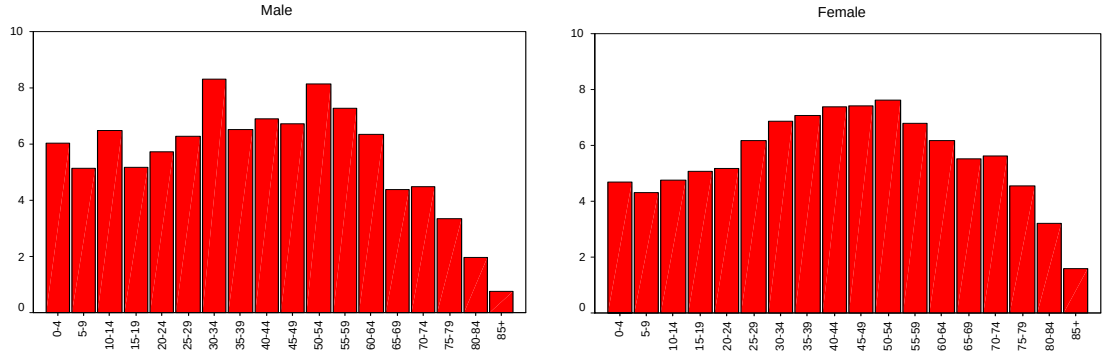
Figure 1 Percentage age sex distribution of the Australian population and community gastroenteritis respondent sample

(i) Australian population 2001 Census.

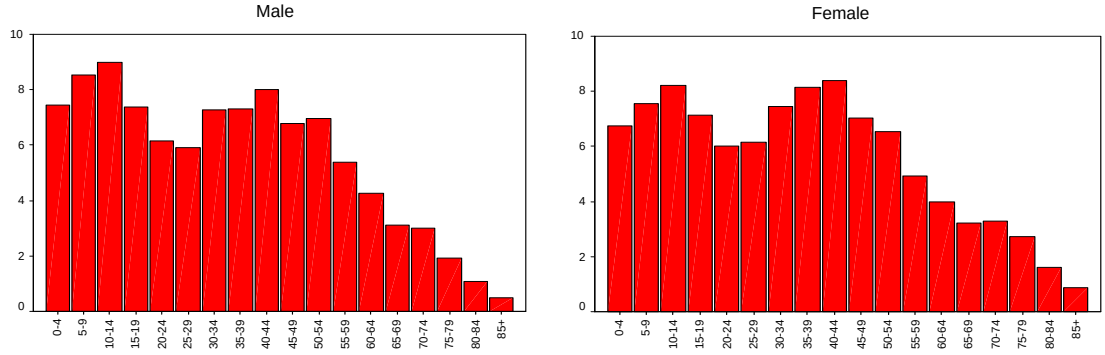


Source: ABS 2001 Census of Population and Housing Basic Community Profile, cat number 2001.0

(ii) Sample of respondents N=6,087



(iii) Sample of all persons in households N=16,351



Overall, 55% of respondents were female which is higher than the Census proportion of 51%. The Figure shows that the sample of respondents has an under-representation of children and over-representation of older people, as is expected by two stage sampling when the household is randomly selected first and then the respondent. This is due to the large number of single person households where the respondent has to be an adult.

The age sex distribution of all members in the households is similar to the Census distribution except that there is a lower proportion of 20-30 year olds in the sample compared with the Census (Figure 1(iii)). The proportion of females in the sample of all household members is 50%.

Age / sex by jurisdiction

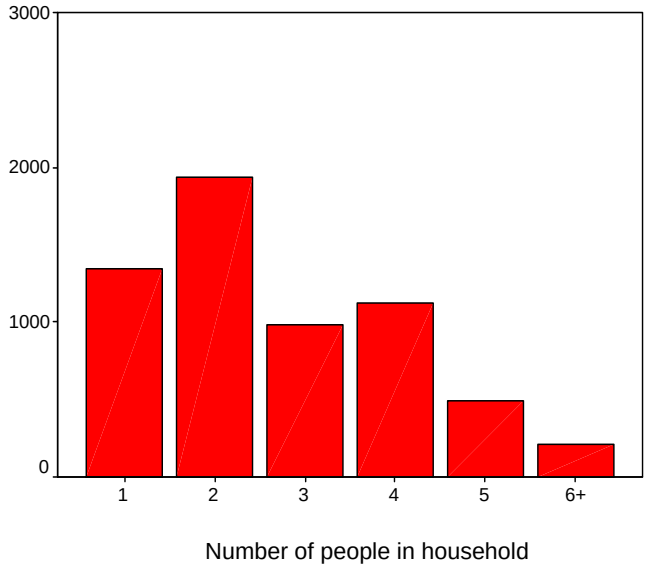
The survey sample was stratified by state/territory with an objective of having 856 interviews in each jurisdiction, with extra in NSW due to deliberate over sampling of the Hunter region. The range of numbers of households interviewed was 779 in SA to 1029 in NSW.

In all jurisdictions the pattern of the age / sex distribution of respondents was basically similar with more adults 25-60 years compared with children or older people. There are more females than males in all ages over 35 years and total females outnumbered total males in most states. The greatest differential by sex was in Western Australia where females accounted for 57% of the respondent sample, and the smallest differential was in NT where the sample was evenly split. Details are shown in Appendix 3.

3.2.2 Household size

The distribution of respondents by household size is shown in Figure 2.

Figure 2 Number of survey respondents by household size



In the total sample, 22% of households had only one person and 32 % of households comprised two people. Another 34% of households comprised 3 or 4 people, and only 11% of households were five or more people. The median was 2, and the mean 2.7 persons per household. In the Census 2001, the mean household size was 2.6 [12].

Household size by jurisdiction

In the survey, household size was largest in the Northern Territory, where the median was three people per household, compared with a median of two people per house in all the other jurisdictions.

Table 2 Average household size of survey sample, by jurisdiction

State	N	Mean
HUNTER	289	2.6
NSW/ACT (exc Hunter)	740	2.7
NT	861	2.9
QLD	824	2.6
SA	779	2.6
TAS	843	2.6
VIC	892	2.7
WA	859	2.7
Total	6087	2.7

The survey mean household size shown in Table 2 is mostly consistent with the Census where the mean household size was 2.6 in most states, was 2.4 in SA and 2.5 in Tasmania and 3 in the NT [12].

All household members: number of persons and household size

In the sample of all household members (N=16,351) 8% of people in the sample lived in single person households, 24% lived in two person households, 18% in three person and 27% in 4 person households. 24% lived in households of 5 or more persons. The number of people in households of different size are shown in Table 3.

Table 3 Sample of all household members by household size[1]

	Sample			Census[1]	
Household size (N persons)	N persons	Percent persons		Percent persons	
1	1348	8.2		8.6	
2	3854	23.6		23.9	
3	2933	17.9		17.4	
4	4461	27.3		23.0	
5	2429	14.9		13.1	
6	862	5.3		.	
7	278	1.7		.	
8	96	0.6		.	
9	36	0.2	8.2	.	14.0
10	25	0.2		.	
11	17	0.1		.	
12	12	0.1		.	
Total	16351	100.0		100.0	

[1] from ABS Australian Community Profile 2001 Census cat 2001.0

The largest proportions of people in the sample lived in households of size two and size four and this was seen in each state.

This pattern is similar to that seen in the Census, as shown in the last column of Table 3. However, there are only 8.2% of people in the sample living in households of size six or more, while there are 14% in the Census.

3.2.3 Distribution of survey sample over time

The sample was stratified by month, with the objective of compiling data that could be compared by season. The sampling aim of the survey was to have 856 respondents in each state evenly distributed across the year (excepting a deliberate over-sampling from the Hunter region). It was known before the survey started that the sample was insufficient to be able to compare data by season within each state. More details of the sample distribution by month and season are shown in Appendix 4.

The months are aggregated into seasons in Table 4: Spring is Sep-Nov2001, Summer Dec-Feb 2002, Autumn Mar-May 2002 and Winter Jun-Aug 2002.

Table 4 Number of respondents by season and state

	SEASON				
	Spring	**Summer**	**Autumn**	**Winter**	**Total**
HUNTER	96	101	39	53	289
NSW/ACT	237	207	132	164	740
NT	186	207	239	229	861
QLD	262	245	150	167	824
SA	274	239	130	136	779
TAS	264	248	172	159	843
VIC	235	239	202	216	892
WA	220	222	199	218	859
Total	**1774**	**1708**	**1263**	**1342**	**6087**
Total Percent	29.1	28.1	20.7	22.0	100.0

While the numbers for Autumn and Winter are somewhat lower than for Spring and Summer, there is still a reasonable distribution of the sample throughout the year within each state.

3.2.4 Demographic characteristics of households and respondents

The survey households are a simple random selection within each state. Some characteristics of survey households are compared with the Census in Table 5. The household characteristics are similar to the Census distribution by size, income and locality.

Table 5 Some characteristics of survey households compared with Census households[1]

Household characteristic	Survey households		Census households*	
	N Total =6087	%	N Total=6744795	%
Household size				
1	1348	22	1616213	24
2	1934	32	2244294	33
3	985	16	1089400	16
4	1122	18	1078277	16
5	491	8	491915	7
6+	207	3	224696	3
Income Household				
<25,000	1705	28	2754187	29
25 to <50,000	1552	26	1737690	26
50 to <100,000	1613	27	1766835	26
>=100,000	545	9	548855	8
Unknown	672	11	759115	11
Locality				
Urban/Town	5017	82		86
Rural Com/farm	1064	18		14
Unknown	6			

[1]from ABS Ausstats: Population distribution Australia Now Year Book Australia 2002 cat 1301.0-2002 and Australian Community Profile 2001 Census cat 2001.0

Some characteristics of the selected respondent within the household are shown in Table 6. Both raw survey and weighted proportions are shown. The survey is not weighted for Indigenous status and education but the proportions are fairly similar to the Census, although the proportion of survey respondents aged over 15 years with less than year 10 education level (41%) is less than in the Census (47%). The proportion in the survey with health insurance (51%) is also higher than administrative statistics (44%) suggesting that the survey sample has some over-representation of more educated people with health insurance. More details about the characteristics of the survey households and respondents are given in Appendix 5.

Table 6 Some characteristics of survey respondents compared with Australian Census[1] subjects

Person characteristic	Raw survey sample *N=6087*		Weighted survey *N=18766578*		Census 2001 *N=18766578*[2]	
	N	**%**	**N**	**%**	**N**	**%**
Sex						
Male	2757	45	9265092	49	9266546	49
Female	3330	55	9501486	51	9502703	51
Age						
0-4yrs	322	5	1255509	7	1243969	7
5-9yrs	286	5	1319896	7	1331926	7
10-19yrs	650	11	2661441	14	2661844	14
20-29yrs	708	12	2559724	14	2560039	14
30-39yrs	872	14	2835401	15	2835864	15
40-49yrs	868	14	2756006	15	2756502	15
50-59yrs	905	15	2218906	12	2219220	12
60-69yrs	686	11	1449453	8	1449594	8
70+yrs	790	13	1710242	9	1710291	9
State						
Queensland	824	14	3585639	19	3585639	19
NSW/ACT	1029	17	6620352	35	6620352	35
Victoria	892	15	4612097	25	4612097	25
Tasmania	843	14	454841	2	454841	2
SAustralia	779	13	1458912	8	1458912	8
NTerritory	861	14	202729	1	202729	1
WAustralia	859	14	1832008	10	1832008	10
Indigenous status						
Indigenous	146	2	317973	2	410003	2
Non-Indigenous	5935	98	18442567	98	18359246	98
Education respondent>15y			*Weighted >15y*		Census>15yN	
Up to year10	1740	34	6109165	41	6180537	47
Post year 10	2905	57				
Unknown	496	10				
Health Insurance						
Yes	3159	52	9516906	51		44[3]
No	2865	47	89766578	48		
Unknown	63	1				

[1]from ABS Ausstats: Population distribution Australia Now Year Book Australia [17] and Australian Community Profile 2001 [12]

[2]Census count excluding overseas visitors [3] From Private Health Insurance Administration Council 2002[18]

3.3 Gastroenteritis

Of the 6087 interviews, 683 respondents reported diarrhoea or vomiting in the previous four weeks, and 450 met the criteria for the primary definition of gastroenteritis.

3.3.1 Incidence

The broad category of 'any diarrhoea or vomiting' includes episodes attributed to non-infectious causes such as pregnancy, medications, chronic illness and alcohol. The broad category also includes 29% of cases with respiratory tract symptoms of cough, sneezing, sore throat or runny nose and in children under five years of age, nearly 50% had concomitant respiratory tract symptoms. The definition of 'gastroenteritis' excludes those with non-infectious causes and requires a higher level of severity of gastrointestinal symptoms if respiratory symptoms are also present.

Extrapolation of estimates to the Australian population are shown in Table 7. About 25 million episodes of vomiting/diarrhoea and 17 million cases of gastroenteritis are estimated to occur in Australia in one year 2001-2, equating to an incidence of 0.9 cases of gastroenteritis per person per year.

Table 7 Number and incidence of cases of vomiting/diarrhoea and gastroenteritis in Australia in one year, 2001-2002

Definition	**N cases Weighted**[1]	
	Estimate	**95% CI**
Any diarrhoea or vomiting (raw n=683/6087 in last 4 weeks)		
Number in one year	25.9million	(23.28million, 28.66million)
Incidence per person per year	1.38	(1.24, 1.53)
Gastroenteritis[2] (raw n=450/6087 in last 4 weeks)		
Number in one year	17.2million	(14.53million, 19.90million)
Incidence per person per year	0.92	(0.77, 1.06)

[1]Weighted by state,age,sex,household size. [2]Gastroenteritis: non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3

3.3.2 Groups at risk of gastroenteritis

Gastroenteritis in the last four weeks varies by place, season and demographic factors as shown by the univariate weighted prevalence in Table 8, and the multivariate logistic regression model in Table 9. Incidence by age / sex, state and season is shown in Figures 4 to 8.

It should be noted that the data are based on the respondent's experience in the last four weeks. The confidence intervals widen when the data are extrapolated from four weekly period prevalence to yearly estimates of the number of cases per person per year (incidence) but the patterns remain the same for the different measures.

There were significant numbers of respondents of 'unknown status' for education, income and health insurance so the proportion 'unknown' has been included in the Table for these characteristics.

Gastroenteritis in the last four weeks (Tables 8 and 9)

Age / sex

Eight percent of women reported gastroenteritis in the last four weeks compared with six percent of men. When controlling for other factors in the multivariate model, the odds ratio is 1.3 (1.07,1.62), and statistically significant ($p = 0.01$). Young children reported more gastroenteritis, and old people the least, with prevalence highest at 11 percent in 0-4 year olds, and lowest at three percent in those over 70 years of age. Compared with other adults, the prevalence is somewhat higher in younger adults 20-40 years of age (9%).

Table 8 Gastroenteritis[1] in the last 4 weeks by demographic factors

	Raw Sample: Total N=6087	**Weighted[2]:** Total N=18766578[3] **Persons with gastroenteritis* in last 4 wks** N=1316307			
Characteristic	**N With characteristic**	**N With gastroenteritis**	**Percent With gastro-enteritis**	**95%CI Low**	**High**
Sex					
Male	2757	580231	6.3	4.73	7.79
Female	3330	736076	7.7	6.12	9.37
Age					
0-4yrs	322	138365	11.0	5.21	16.83
5-9yrs	286	121328	9.2	4.10	14.29
10-19yrs	650	165503	6.2	3.54	8.90
20-29yrs	708	217944	8.5	5.50	11.53
30-39yrs	872	2618556	9.2	6.32	12.15
40-49yrs	868	194197	7.0	3.75	10.34
50-59yrs	905	112619	5.1	3.00	7.15
60-69yrs	686	49101	3.4	1.81	4.97
70+yrs	790	55395	3.2	0.79	5.68
State					
Queensland	824	250126	7.0	4.49	9.46
NSW/ACT	1029	441634	6.6	4.68	8.61
Victoria	892	337527	7.3	5.39	9.25
Tasmania	843	30834	6.8	4.84	8.72
SAustralia	779	104982	7.2	5.03	9.36
NTerritory	861	19499	9.6	6.32	12.91
WAustralia	859	131704	7.2	4.49	9.89
Season					
Spring	1774	345	5.9	4.60	7.26
Summer	1708	440687	8.4	6.53	10.34
Autumn	1263	212761	5.9	3.45	8.27
Winter	1342	317774	7.8	5.32	10.22
Indigenous status					
Indigenous	146	47347	14.9	2.54	27.24
Non-Indigenous	5935	1268960	6.9	5.82	7.94
Education					
Primary	83	18805	5.9	-0.48	12.36
Yrs7-10	681	79447	5.1	2.45	7.83
Yrs11-12	1143	264029	7.9	5.55	10.33
Post school	4056	919466	7.0	5.78	8.14
Unknown	124	34559	9.3		
Income					
<25,000	1705	285712	7.7	5.46	9.94
25 to <50,000	1552	369067	7.6	5.30	9.85
50 to <100,000	1613	380464	7.1	5.15	9.11
>=100,000	545	176093	8.4	4.65	12.20
Unknown	672	104970	4.0		
Health Insurance					
Yes	3159	594957	3.4	-1.77	8.52
No	2865	710393	6.3	4.76	7.74
Unknown	63	10957	8.0		
Locality					
Urban/Town	5017	1114669	7.2	5.78	8.55
Rural Com/farm	1064	201639	6.3	4.49	8.08
Household size					
1	1348	84294	5.2	3.72	6.72
2	1934	253468	5.6	4.21	7.08
3	985	291084	8.9	6.85	10.96
4	1122	320218	7.4	4.77	10.08
5	491	229574	9.3	5.75	12.92
6+	207	137669	5.2	2.26	8.24

[1]non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3
[2]Weighted by state/age/sex/household size. [3]Census 2001:overseas visitors excluded

Table 9 Gastroenteritis by demographic factors: Odds ratios of demographic predictors of gastroenteritis[2], from multivariate model[1]

	P value	Odds Ratio and 95% C.I.		
			Lower	Upper
Sex *reference= male*	**0.01**	**1.3**	1.07	1.62
Age *reference=0-4yrs*	**0.00**			
5-14	0.01	**0.5**	0.33	0.88
15-24	0.21	**0.7**	0.45	1.19
25-44	0.03	**0.6**	0.43	0.96
45-64	0.00	**0.5**	0.31	0.72
65+	0.00	**0.2**	0.15	0.41
State/Territory *reference= Qld*	**0.00**			
NSW/ACT	0.70	**0.9**	0.63	1.36
Vic	0.45	**0.9**	0.57	1.29
Tas	0.95	**1.0**	0.67	1.47
SA	0.96	**1.0**	0.66	1.48
NT	0.00	**1.7**	1.21	2.49
WA	0.28	**0.8**	0.52	1.21
Season *reference= Spring*	**0.02**			
Summer	0.14	**1.2**	0.94	1.58
Autumn	0.07	**0.7**	0.54	1.02
Winter	0.99	**1.0**	0.75	1.34
Income household *reference =<$25,000*	**0.02**			
$25-50,000	0.85	**1.0**	0.78	1.36
$50-100,000	0.09	**1.3**	.96	1.7
$100,000+	0.01	**1.6**	1.13	2.31
Health Insurance *reference=yes*	0.03	**1.3**	1.03	1.64
Education level household *reference =primary*	**0.04**			
Yrs7-10	0.02	**1.3**	1.04	1.73
Yrs11-12	0.19	**0.7**	0.48	1.15
Post secondary	0.75	**1.2**	0.47	2.82

[1]Forward stepwise logistic regression of multivariate model. Variables entered but not retained in the equation were Indigenous status, locality (urban/rural) and household size.
[2]non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3

This age effect is reflected in the multivariate model which shows that compared with young children, the odds ratios for other ages are about half or less, except for an odds ratio of about 0.7 for the younger adults. In terms of absolute numbers of cases, 30-39 year olds contribute as many cases in the country as children under 10 years of age. As shown in Figure 5, this is largely due to a higher rate among women aged 20-40 years, while men do not show an increased rate in this age group.

Household size

Gastroenteritis is more common in households of size three, four and five. Prevalence is around seven to nine percent in these households which are predominantly families with children. The prevalence is lower at five to six percent in households of only one or two people. When controlling for age in the multivariate logistic regression, the variation in gastroenteritis across household size is no longer significant.

State

Across jurisdictions, the Northern Territory has the highest prevalence of gastroenteritis. The population of the Northern Territory is about 30% Aboriginal, and the prevalence of gastroenteritis in Indigenous respondents is twice that of non-Indigenous respondents, although the confidence intervals are wide due to small numbers. The Northern Territory has a statistically significant odds ratio of 1.7 when compared with Queensland in the multivariate model even when controlling for Indigenous status. Indigenous status is non-significant when state is also in the multivariate model. The lowest prevalence is in WA, and the highest is in the NT.

Season

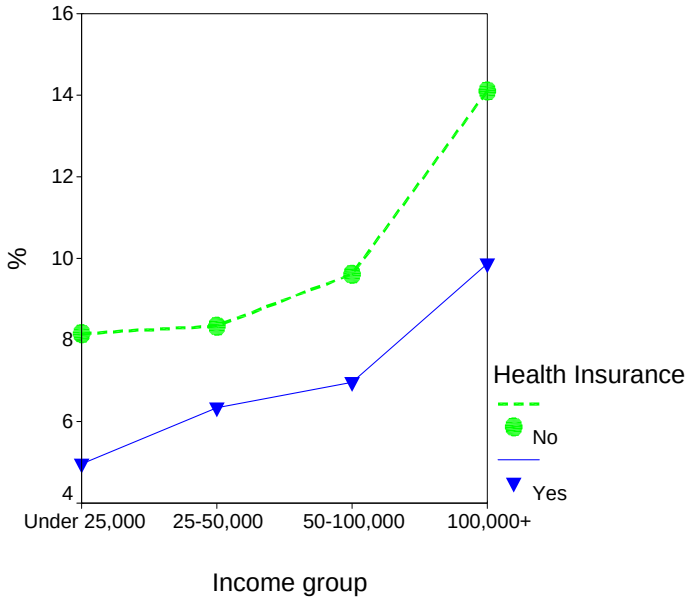
When controlling for age, sex, state and other factors, the multivariate model shows a significant variation across seasons ($p=0.02$). Comparing each season with Spring, there is a greater odds ratio in Summer, and a lower odds ratio in Autumn (0.7), while Winter is about the same as Spring. This indicates that Summer is a risk season for gastroenteritis and Autumn is the time of least risk.

Socioeconomic factors

Socioeconomic status shows a more complex association with gastroenteritis. The univariate prevalences for different income groups do not indicate much variation, but when controlling for other factors in the multivariate model there is a trend to more gastroenteritis in the higher income groups. This suggests that high income is associated with either a higher level of reporting, or with a more risky behaviour that predisposes this group to more gastroenteritis.

Health insurance holders report less gastroenteritis in all income brackets and for both insurance holders and those without, there is a clear gradient of increasing gastroenteritis from lower income households to higher income households, as shown in Figure 3. The association between health insurance and gastroenteritis holds in the multivariate model with a significant odds ratio of 1.3.

Figure 3 Gastroenteritis by income and health insurance



Gastroenteritis definition:non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3

Rural/urban

Respondents in urban areas have a higher prevalence of gastroenteritis in the univariate analyses at 8% compared with 6% in rural areas. However, in the multivariate analysis when controlling for other factors, there is no statistical significance in the differential although the tendency remains.

When the data are considered by state by rural/urban status, there is a differential apparent in NSW. In all other jurisdictions the urban levels are slightly higher than the rural, but in NSW/ACT the rural prevalence is considerably higher than the urban level.

Among urban dwellers, the prevalence of gastroenteritis is high in the Northern Territory (12%) and is around 6 -7% in all other jurisdictions. Among rural dwellers, the prevalence is high in NSW/ACT (9.5%) and the NT (9%), and is around 5-6% in all other jurisdictions.

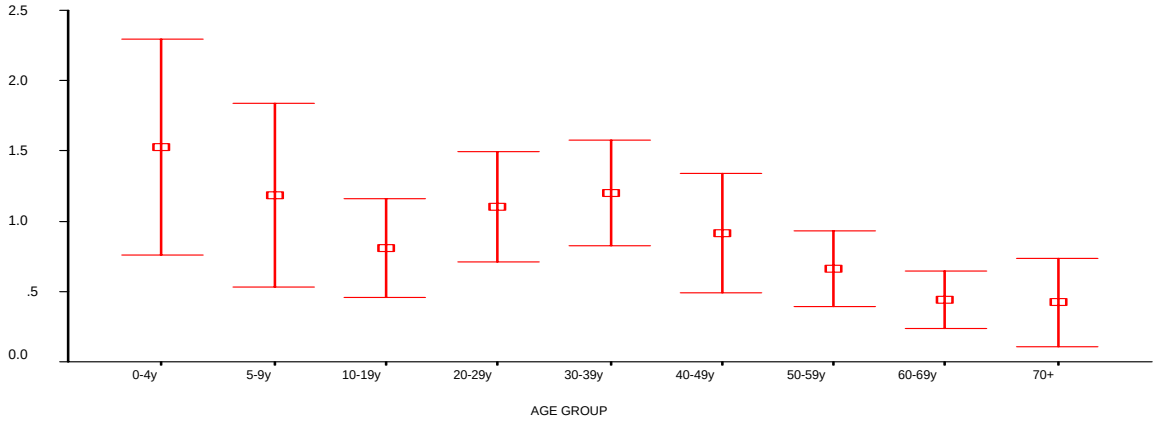
Incidence by age / sex, state and season (Figures 4 to 8)

The data were collected for the 'last four weeks' and in order to calculate cases per person per year, it was weighted and extrapolated to the year. The extrapolation to the year means that the confidence intervals become wider, so the incidence may not be statistically significantly different across factors as a consequence of the extrapolation.

Age / sex

The incidence declines with age between one and 20 years, then is increased in 20-40 year olds, then declines to the lowest levels in 40 to 70 year olds. Incidence varies from 1.5 cases per person per year in children under five years, to less than 0.5 cases per person per year in those over 60 years (Figure 4).

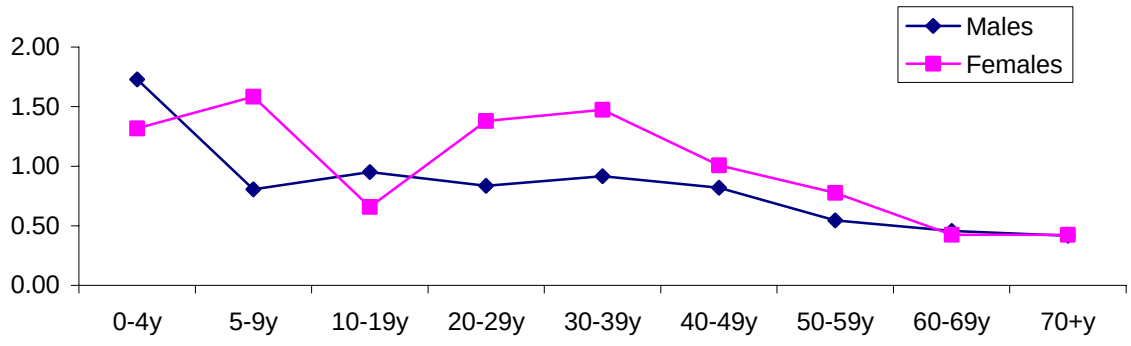
Figure 4 Incidence of gastroenteritis by age. Cases/person/year (95%CI)



Gastroenteritis definition:non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs,
if resp symptoms then stools>= 4 OR vomit>= 3

The higher incidence in 20-40 year olds is mostly due to an increased incidence in females in this age group (Figure 5).

Figure 5 Incidence of gastroenteritis by age and sex. Cases/person/year

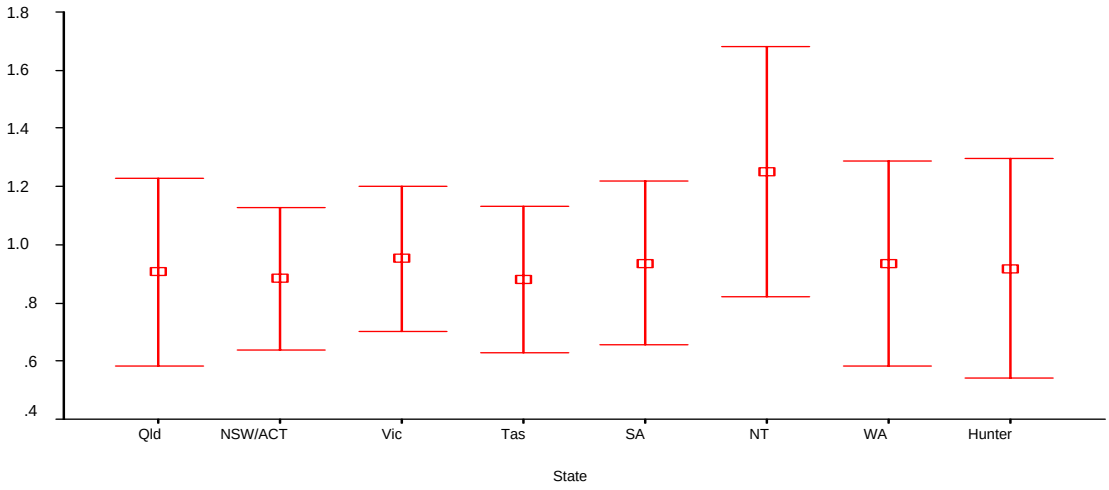


Gastroenteritis definition:non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs,
if resp symptoms then stools>= 4 OR vomit>= 3

State

The incidence is highest in the NT with 1.3 (0.8-1.7) cases per person per year, and the rest of the states are fairly similar to each other at around 0.9 (~0.6-1.2) cases per person per year.

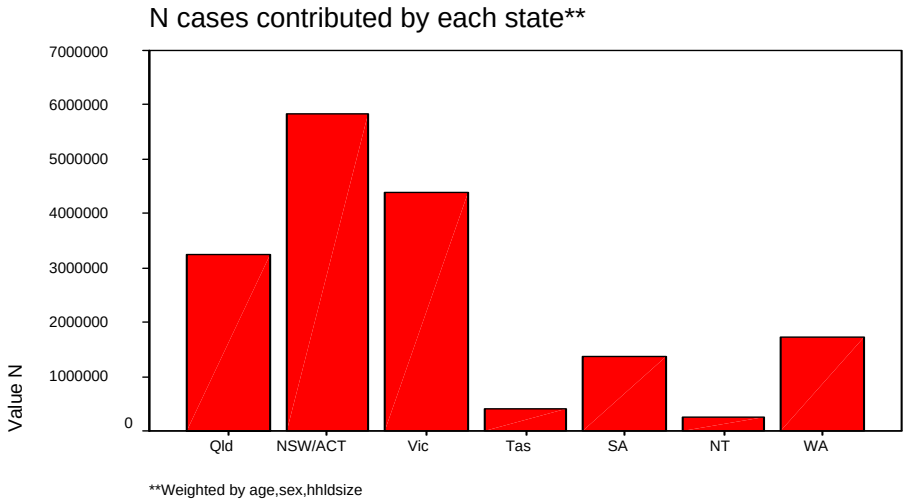
Figure 6 Incidence of gastroenteritis by state. Cases/person/year (95%CI)



Gastroenteritis definition:non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs,
if resp symptoms then stools>= 4 OR vomit>= 3

The extrapolation of the number of cases of gastroenteritis occurring in each state is shown in Figure 7, and this is directly related to the population size as well as to the incidence in each state.

Figure 7 Number of cases of gastroenteritis by jurisdiction.

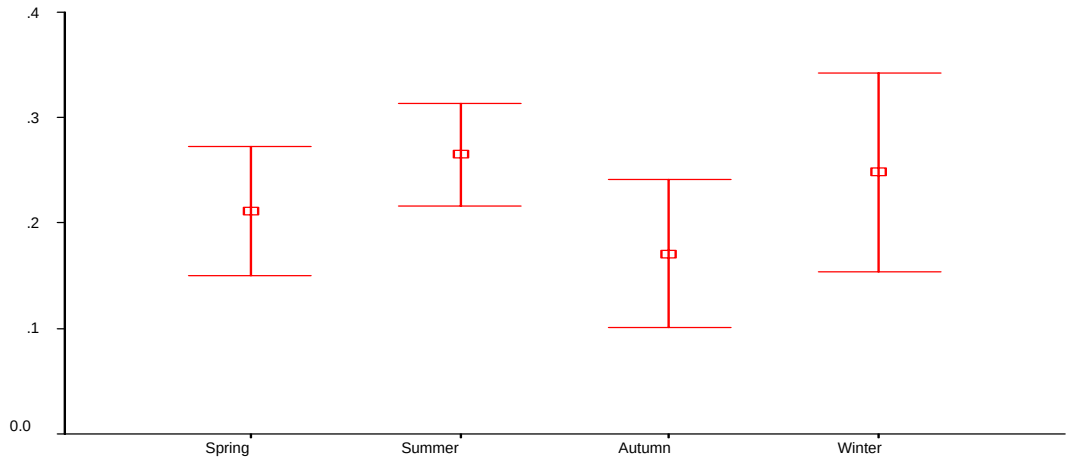


Gastroenteritis definition:non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs,
if resp symptoms then stools>= 4 OR vomit>= 3

Season

The survey was considered as four separate samples for calculating weighted incidence by season. There was some variation in the number of respondents with higher numbers in the first six months, then a correction to reduce numbers in the second six months. This affects the confidence intervals which are somewhat wider in Autumn and Winter. The incidence is about 0.27(0.22-0.32) cases per person per Summer and 0.18 (0.12-0.24) cases per person per Autumn, with Spring and Winter in between.

Figure 8 Incidence of gastroenteritis by season. Cases/person/season (95%CI)



Gastroenteritis definition:non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs,
if resp symptoms then stools>= 4 OR vomit>= 3
Weighted by state/age/sex/household size.

3.4 Severity of Gastroenteritis

Severity of gastroenteritis is assessed by symptoms, duration, health seeking behaviour and time lost to other activities, including work.

3.4.1 Symptoms

The most common symptoms among cases meeting the primary case definition were diarrhoea (weighted prevalence 82%), and cramps, nausea and loss of appetite (all of which were around 60%). Vomiting was present in nearly half the cases. Blood in the stool was present in only 2% of cases. Respiratory tract symptoms were present in a quarter of cases; these cases fulfilled the stricter criteria of at least 4 loose stools or 3 vomits in 24 hours (as discussed in section 2.3.2 on the cases definition).

Table 10 Proportion of cases with gastroenteritis with various symptoms

	Raw Sample			Weighted		
Symptom	**Missing N**	**N with symptom (Total 450)**	**Proportion with symptom**	**Proportion with symptom**	**95% CI Low**	**High**
Aches	21	140	0.33	0.31	0.24	0.37
Appetite Lost	4	292	0.66	0.63	0.54	0.71
Blood	7	13	0.03	0.02	0.01	0.04
Cramps	11	270	0.62	0.60	0.55	0.65
Diarrhoea	0	381	0.85	0.82	0.78	0.87
Fever	8	171	0.39	0.39	0.31	0.46
Headache	23	191	0.45	0.45	0.37	0.52
Nausea	11	254	0.58	0.54	0.46	0.62
Stiff Neck	23	63	0.15	0.15	0.09	0.20
URTI	4	114	0.26	0.25	0.18	0.32
Vomit	0	201	0.45	0.46	0.38	0.55

Gastroenteritis definition:non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs,
if resp symptoms then stools>= 4 OR vomit>= 3 . Weighted by state/age/sex/household size.

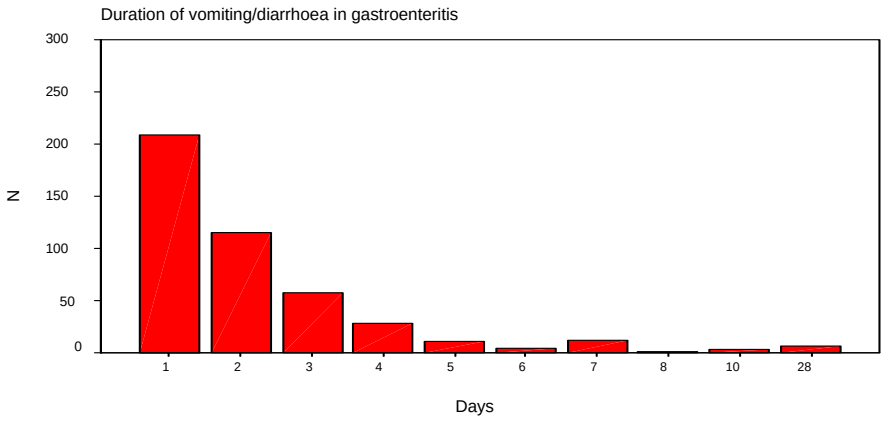
Duration

Duration of illness is considered firstly as duration of vomiting/diarrhoea, and second as duration of any symptoms.

Duration of vomiting/diarrhoea

When only vomiting/diarrhoea are considered, duration was taken from the beginning of either symptom to the end of both symptoms. Raw data of the duration of vomiting/diarrhoea of all cases, finished or not, is shown in Figure 9.

Figure 9 Duration of vomiting/diarrhoea (raw data in days)



This indicates that the majority of cases had vomiting/diarrhoea for one or two days, and that only 8% of cases had these symptoms for over four days. There were five cases with duration of diarrhoea for four weeks.

At the time of interview, the majority of cases had finished their episode of illness but 9.6% still had symptoms of vomiting/diarrhoea. Among cases that had finished the vomiting/diarrhoea at the time of the interview, the unweighted median duration of vomiting/diarrhoea was two days and the mean was just over two and a half days as shown in Table 11. There was a shorter duration among those cases with vomiting with a median of one day – this applied when there was either vomiting only, or vomiting/diarrhoea together. Weighting the mean resulted in little change in the duration.

Table 11 Duration[1] of vomiting/diarrhoea among all those with gastroenteritis[2], and among those cases with symptoms of vomiting and diarrhoea

	Unweighted			Weighted
	N	**Median (days)**	**Mean (days)**	**Mean (days)**
All Gastroenteritis	424	2	2.6	2.7
Vomiting				
Any vomiting	186	1	1.9	
Only vomiting	15	1	1.4	
Diarrhoea				
Any diarrhoea	364	2	2.5	
Only diarrhoea	238	2	2.6	

[1]In cases that had finished episode of gastroenteritis. The two categories of any vomiting and diarrhoea include those cases of gastroenteritis with both symptoms and with one symptom only.
[2]Gastroenteritis definition:non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3 . Weighted by state/age/sex/household size.

As it is more likely that cases of longer duration are not 'finished' at the time of interview, duration was also calculated using survival analysis which takes account of cases that are still current at the time of interview. The survival curve for all cases is shown in Figure 10 and the mean and median duration of diarrhoea/vomiting by age group are shown in Table 12. The median duration for all ages is 2 days, and the mean is 3.2 days.

Figure 10 Duration of vomiting/diarrhoea: All ages

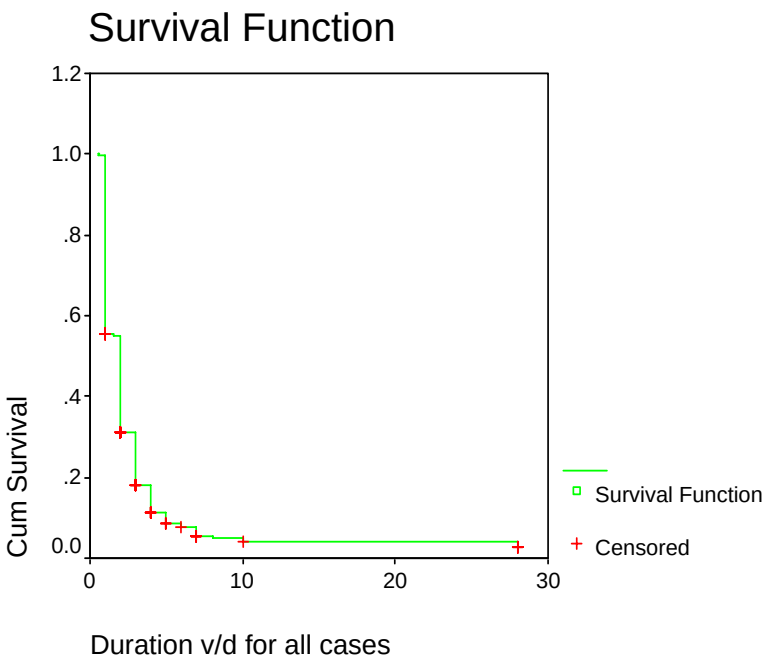


Table 12 Duration[1] of vomiting/diarrhoea among all those with gastroenteritis[2], by age group

Age group	N	N not finished	Mean and 95%CI	Percentile 25	Percentile 50 Median and 95% CI	Percentile 75
0-4yrs	42	3	2.4 (1.95,2.90)	3.0	2.0 (1.23,2.77)	1.0
5-14yrs	48	1	1.8 (1.40,2.13)	2.0	1.0 (. ,)	1.0
15-24yrs	56	5	3.1 (1.41,4.72)	3.0	2.0 (1.72,2.28)	1.0
25-44yrs	153	20	4.1 (2.84,5.35)	3.0	2.0 (1.66,2.34)	1.0
45-64yrs	114	9	2.2 (1.85,2.63)	2.0	2.0 (. ,)	1.0
65yrs+	37	5	4.5 (2.08,6.85)	5.0	2.0 (1.21,2.79)	1.0
Total	450	43	3.2 (2.61,3.73)	3.0	2.0 (1.91, 2.09)	1.0

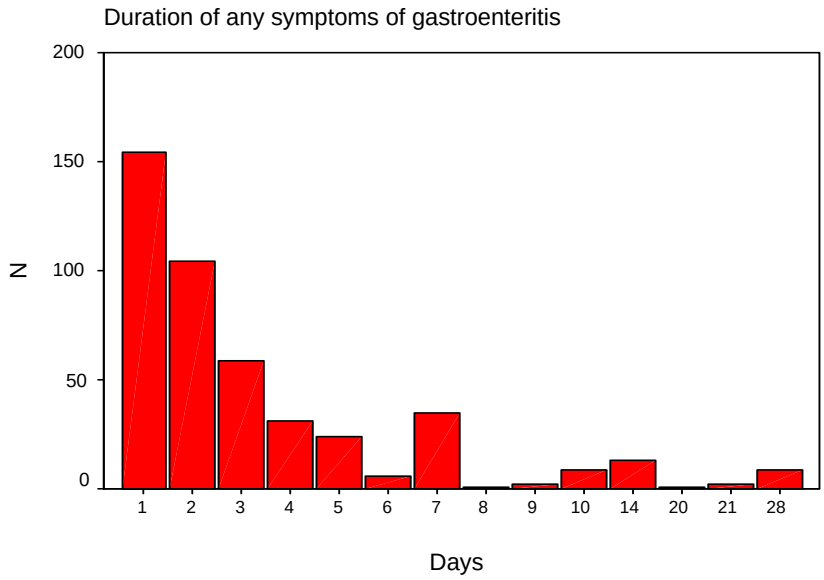
[1] Kaplan-Meier survival analysis in all cases whether finished episode of gastroenteritis or not.
[2]Gastroenteritis definition:non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3 . Weighted by state/age/sex/household size.

Duration of any symptoms

[Symptoms: Diarrhoea, Vomiting, Aches, Appetite lost, Blood in stool, Cramps, Diarrhoea, Fever, Headache, Nausea, Stiff neck, Respiratory symptoms (cough, sneeze, runny nose, sore throat)]

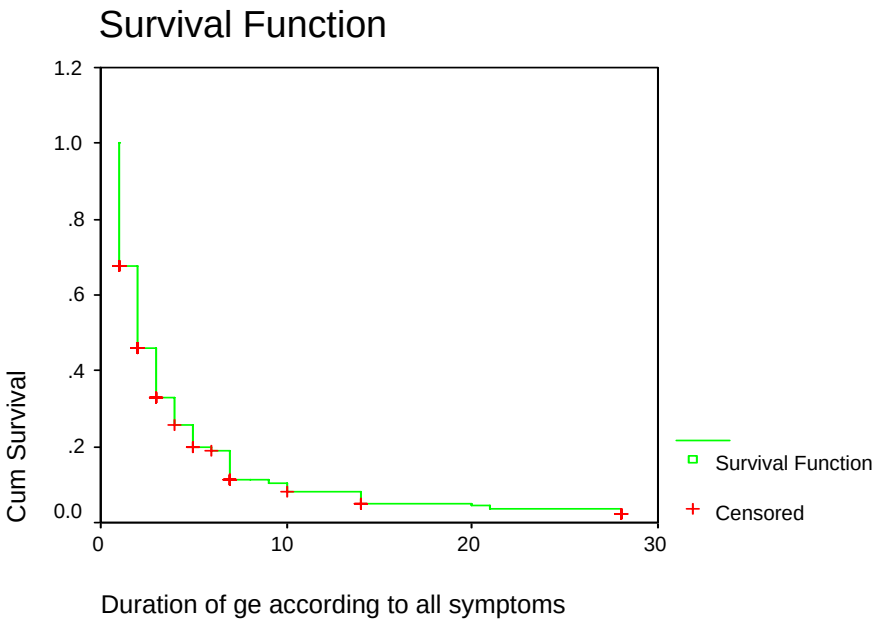
The raw data of the duration of any symptoms among cases meeting the primary definition of gastroenteritis is shown in Figure 11. This shows that the majority of cases have symptom(s) lasting one or two days, but 23% have at least one symptom lasting over four days.

Figure 11 Duration of any symptoms (raw data in days)



Using survival analysis, the median duration is 2 days and mean duration is 4.4 days. The survival curve for all ages is shown in Figure 12 .

Figure 12 Duration of any symptoms: All ages



The mean and median duration of any symptoms by age group are shown in Table 13.

Table 13 Duration[1] of any symptoms among all those with gastroenteritis[2], by age group

Age group	N	N not finished	Mean and 95%CI	Percentile 25	50 Median and 95% CI	75
0-4yrs	42	3	3.9 (2.90,4.93)	4.0	3.0 (2.25, 3.75)	2.0
5-14yrs	48	1	3.1 (2.21, 3.91)	3.0	2.0 (1.45, 2.55)	1.0
15-24yrs	56	5	5.3 (3.42, 7.12)	6.0	3.0 (2.31, 3.69)	1.0
25-44yrs	153	20	5.0 (3.77, 6.19)	5.0	2.0 (1.54, 2.46)	1.0
45-64yrs	114	9	3.4 (2.42, 4.33)	3.0	2.0 (1.70, 2.30)	1.0
65yrs+	37	5	6.1 (3.79, 8.41)	7.0	3.0 (0.74, 5.26)	1.0
Total	450	43	4.4 (3.78, 4.92)	5.0	2.00 (1.73,2.27)	1.0

[1]Kaplan-Meier survival analysis in all cases whether finished episode of gastroenteritis or not.
[2]Gastroenteritis definition:non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3 . Weighted by state/age/sex/household size.

Comparing duration of 'vomiting/diarrhoea' with duration of 'any symptoms'

The survival analysis indicates that the median duration of 'any symptom(s)' is the same as the median duration of 'vomiting/diarrhoea' (both two days). However, considerably more cases last a 'long time' when duration is taken according to duration of 'any symptom' rather than duration of 'vomiting/diarrhoea'. The 25th percentile for duration of 'any/all symptoms' is five days compared with only three days for 'vomiting/diarrhoea'; this indicates that 25% of cases have at least one symptom lasting five or more days, while 25% of cases have diarrhoea/vomiting lasting three or more days . The mean also indicates that there are more cases with a long duration of 'any symptoms' (mean 4.4 days) compared with duration of 'vomiting/diarrhoea' (mean 3.2 days).

By both vomiting/diarrhoea and all/any symptoms, duration is longest among older people over 65 years of age.

Maximum number of loose stools and vomits in 24 hours

The average and median for 'the maximum number of loose stools or vomits in 24 hours' is shown in Table 14. The median number of vomits among all cases is zero, as more than half the cases did not have vomiting at all. The median number of loose stools was five.

Among those with vomiting, the median is three vomits in 24 hours and the average four vomits. Among those with diarrhoea, the median and mean number of loose stools remains at five.

Table 14 Maximum number of loose stools or vomits in 24 hours among all cases of gastroenteritis[1]

Symptom	Raw Mean	Raw Median	Weighted Mean
	Among all cases of gastroenteritis N =450		
Vomiting	1.88 (se.123)	0	1.82
Loose stools	4.86 (se.119)	5.0	4.60

[1]All cases of gastroenteritis whether finished or not.
Gastroenteritis definition:non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3 . Weighted by state/age/sex/household size.

Table 15 Maximum number of loose stools or vomits in 24 hours among cases[2] **with vomiting and cases with loose stools**

Symptom	Raw Mean	Raw Median	Weighted Mean
	Among those with symptom of vomiting n=186		
Vomiting	4.23 (se .164)	3.5	3.94
	Among those with symptom of loose stools n=381		
Loose stools	5.45 (se .107)	5.0	5.32

[2]The two categories of any vomiting and loose stools include those cases of gastroenteritis with both symptoms and with one symptom only.
Gastroenteritis definition:non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3 . Weighted by state/age/sex/household size.

If 'severe gastroenteritis' is considered to be at least 2 days of illness and at least 5 loose stools or 4 vomits in 24 hours, then 29% of cases are classified as 'severe'.

3.4.2 Health care

3.4.2.1 Visits to a health facility

More than a quarter of respondents with gastroenteritis visited a health facility to seek treatment for their illness, with some people visiting more than one facility. This equated to a weighted estimate of over 4.6 million visits in one year, of which 3.7 million were to visit a doctor.

Table 16 Number of people with gastroenteritis[1] seeking health care.

	Raw data N cases=450		Weighted[2]	
Health facility	**N visiting**	**% visiting**	**N visits**	**95% CI**
Casualty	19	4.2		
Doctor	91	20.2		
Pharmacy	38	8.4		
Other	13	2.9		
Visiting a doctor	100	22.2	3.7 million	2.6 – 4.9 million
Visiting at least one health facility	128	28.4	4.7 million	3.3 – 6.0 million

[1]non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3
[2]Weighted by state/age/sex/household size

3.4.2.2 Cases that visit doctors

The proportion of cases that visit a doctor varies by the severity of the illness, especially duration of vomiting/diarrhoea. Table 17 shows that fever, lost appetite, and vomiting were statistically significant predictors of visiting a doctor with odds ratios of three or four. Compared with illnesses with vomiting/diarrhoea lasting 1-2 days, those that last 3-4 days had an odds ratio of six, and those that lasted 5 or more days had an odds ratio of 19.

Demographic factors (age, sex, indigenous status, income) that were put into the model did not remain statistically significant when symptoms were also in the model.

Table 17 Predictors[1] of cases of gastroenteritis[2] visiting a doctor
(100 of 450 cases visited MO)

Symptom	N with symptom	% visiting MO	Multivariate[1]	
			OR	95%CI
Aches	140	27		
AppetiteLost	292	28	2.9	1.7-5.1
Blood	12	23		
Cramps	270	21		
Diarrhoea	381	21		
Fever	171	36	4.0	2.5-6.4
Headache	191	27		
Nausea	254	28		
StiffNeck	63	35		
URTI	114	34		
Vomit	201	32	2.8	1.7-4.4
Duration				
1-2 days	300	11	-	
3-4days	86	44	6.0	3.0-11.9
5days	38	63	19.3	7.3-51.1

[1]Significant ORs in final forward stepwise model initially considering all symptoms in the Table and age, sex, state, indigenous status.
[2] non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3

3.4.2.3 Stool tests for gastroenteritis

Among all cases of gastroenteritis there were some that had vomiting only. Excluding this group and considering only the cases that had diarrhoea and that visited a doctor, 22% had a stool test ordered (16/78). One case did not submit a stool test. This extrapolates to 526,177 stool tests submitted in Australia in one year 2001/2. (95% CI: 56,491 - 995,863)

Among those cases with diarrhoea there was an association between duration and having a stool test ordered, as shown in Table 18. Compared with short illness of 1-2 days, those with illness lasting 3-4 days had an odds ratio of four, and those with illness lasting 5 or more days had an odds ratio of 14.5.

Table 18 Predictors of cases of gastroenteritis[1] having stool request
(78 of 381 cases visiting MO)

Symptom	N with symptom	% stool request	Multivariate** OR	95%CI
Duration				
1-2 days	31	7	reference	
3-4days	31	19	4.0	1.1-15.0
5days	16	50	14.5	2.6-82.3

[1]non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs,
if resp symptoms then stools>= 4 OR vomit>= 3**, must have diarrhoea**

The probability of having a stool test taken among cases with diarrhoea is shown by duration in Table 19. For those with a short duration (1-2 days), only one in 142 cases of gastroenteritis have a stool sample taken. For those with mid-duration (3-4 days), one in 14 cases has a stool sample, and among those with long duration (5 or more days), one case in four has a stool sample taken.

Table 19 Probability[1] of identification of pathogen by laboratory by severity of gastroenteritis[2]

Severity	N community cases	% visit MO	% stool test in MO visits	Probability stool test in community cases[1]	**Stool Test factor**	**95%CI**
Duration						
1-2 days	282	11	7	0.007	**1in142**	**39-1111**
3-4days	71	44	19	0.085	**1in14**	**6-31**
5days+	28	57	50	0.285	**1in 4**	**2-8**

[1] unweighted due to small numbers
[2] non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3; must have diarrhoea

3.4.2.4 Medications

A large number of medications were consumed to treat gastroenteritis during the year. The raw survey data indicated that 42% of cases took at least one medication, the most common being for pain relief. This extrapolates to over seven million people with gastroenteritis taking medication in Australia in one year. About five percent of cases overall were prescribed antibiotics. This means that of the cases that went to a doctor, about one in five was prescribed an antibiotic for treatment for the gastroenteritis. This extrapolates to over 900,000 courses of antibiotics in a year.

Table 20 Medications used to treat gastroenteritis[1] N=450 cases

	Raw sample		Weighted	
Symptom to be treated	**N taking medication**	**% cases taking medication**	**N taking medication**	**95%CI**
Cramps	7	2		
Diarrhoea	57	13		
Nausea	41	9		
Pain	138	31		
Other	38	8		
Medication type				
Antibiotic	23	5	0.9 million	0.4 – 1.5 million
Any	189	42	7.0 million	5.7 – 8.2 million

[1] non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3

3.4.3 Time off work

Gastroenteritis resulted in a large number of days of missed activities, including paid work, as shown in Table 21. Of the 6.5 million lost paid work days in a year, about 60% were due to the case being ill themselves, and about 40% were due to a carer missing work to look after someone else.

Table 21 Missed paid work because of gastroenteritis[1], Australia, 1 year 2001/2

Raw data N with gastroenteritis =450 N Workers>15yrs & gastroenteritis=239	**Persons missing >0.5 day work**			**Weighted[2] data**	
	N cases	**% of all cases**	**% of all paid worker cases**	Days paid work missed	**95% CI**
Cases missed paid work themselves	85	19	36	3.8 million	2.5 – 5.2 million
Other person missed paid work to care for case	23	5	10	2.7 million	0.5 – 4.8 million
Total cases causing missed paid work	108	24	45	6.5million	4.0 – 9.0 million

[1] non-infectious excluded, stools>= 3 OR vomit>= 2 in 24 hrs, if resp symptoms then stools>= 4 OR vomit>= 3
[2]Weighted by state/age/sex/household size.

4. Discussion of the survey findings

Summary of main findings

The survey clearly demonstrates that there is a high burden of gastroenteritis in Australia, with about 17.2 million episodes in a year (95% CI: 14.5 to 19.9 million). The Northern Territory has the highest rates in both Indigenous and non-Indigenous people, and rates are highest in Summer and lowest in Autumn. This suggests that climatic variation may influence gastroenteritis in Australia.

The age groups most at risk of acquiring gastroenteritis are children under five years, and women 20-40 years of age, similar to findings in the US [1]. Older people over 60 years of age are at less risk of gastroenteritis, although the duration of gastroenteritis is longest in this group.

It is likely that the behaviour of young children may increase their exposure to pathogens via person-to-person and environmental transmission, and their increased infection load may be passed on to their female carers. In contrast, teenagers have a 'lower' level than children and young adults. There is a plausible explanation for increased levels in children and young female adults, but it is also possible that there could be respondent bias to under-report specifically in the adolescent age group. In younger teenagers up to 15 years, the questionnaire was answered by their parents, who may be ignorant about symptoms in adolescents this age. Older teenagers may be reluctant to self-report gastroenteritis.

People with lower household incomes under $50,000 per year were less likely to report gastroenteritis, a finding similar to that in the US [1]. Possibly this is due to a reporting bias, with more wealthy households more likely to perceive that they have symptoms. Alternatively this may be due to more risky behaviours in this group. This might include eating out more frequently, and eating higher risk foods such as soft cheeses and rare meat. Those without health insurance were more likely to report gastroenteritis in all income brackets. Possibly those with health insurance are more conscious about health promotion and take more care with food practices. In univariate analyses, education level showed a tendency to higher rates in more educated people, but when controlling for income and health insurance, the pattern became inconsistent.

The most common symptoms reported in over half the cases were diarrhoea, loss of appetite, cramps and nausea. Most episodes lasted 1-2 days, and the average number of maximum loose stools in 24 hours was around 5. Vomiting occurred in less than half of cases, but a small proportion of cases had vomiting only.

In one year in Australia, it is estimated that there are about 3.7 million visits to doctors for gastroenteritis and over half a million stool tests. Health Insurance Commission dataset had records of nearly half a million stool samples examined for a Medicare rebate [19], validating the estimate in the survey. However, the BEACH dataset on General Practice consultations (Bettering the Evaluation of Care of Health) has estimated that there are about one million visits to GPs each year for gastroenteritis [20]. This is less than that estimated from the gastroenteritis survey but could be influenced by the classification of 'reason for presentation'. The discrepancy warrants further investigation.

Duration of vomiting/diarrhoea was the most important predictor for visiting a doctor and having a stool sample taken. A stool test is done for about one in every 140 episodes of gastroenteritis in the country if the duration is 1-2 days, but for one in every four episodes if the duration is five or more days. About seven million people took medications to treat their illness, including close to one million courses of antibiotics. The high level of antibiotic use suggests possible over prescribing of this medication since most episodes of gastroenteritis do not require antibiotic therapy.

There were over six million days of lost paid work due to gastroenteritis, nearly half of these being due to a carer needing to look after someone else with gastroenteritis. This is obviously a very significant cost to the community.

Gastroenteritis overseas

Compared with overseas studies, Australia has rates similar to published results from the United States and Canada, and higher rates than the United Kingdom, Ireland and the Netherlands, as summarised in Table 22. [1, 21,22, 23, 24]

The different definitions of gastroenteritis of the studies summarised in the Table, and the different methodologies make comparison problematic. The UK and Netherlands gastroenteritis studies were prospective longitudinal design while cross sectional telephone interviews were used in Australia and the US. The UK study included a check component to compare the incidence based on a retrospective recall method similar to that used in the US

and Australian studies, and found that the incidence was about 0.6 cases per person per year by this methodology, compared with 0.2 cases per person per year using the prospective diary method. Whether the prospective study caused an underestimate, possibly due to participants having to supply a stool sample when they declare symptoms, or whether the recall method causes an overestimate due to 'telescoping' events into a shorter time frame is unknown and worth further investigation.

Table 22 Comparison of incidence of gastroenteritis in different developed countries

Study	Method	Definition	Cases/ person/ year
Tecumseh 1965-71 [21]	Longitudinal	Any diar/vomiting	1.0 0.8 *
Melbourne WQTS 1998 [22]	Longitudinal	2symptoms: 2vomit or 2diar or 1vomit+1other or 1diar+1other in 24hrs	0.8*
US FoodNet 1996 [1]	Phone cross-section	3diar in 24hrs AND exclude those with chronic bowel illness	1.4*
		(3diar in 24hrs AND >1day or impaired function)AND exclude those with chr bowel illness	0.75*
		(3diar in 24hrs AND >1day or impaired function)AND exclude those with chr bowel illness *AND adjust for no data on:* vomit –add% resp symptoms-deduct%	0.8
UK IID study 1993-96 [23]	Longitudinal	(Significant diar<2wks OR vomit>once+1other and<2wks) AND exclude non-infectious	0.2
Netherlands 1998/9 [24]	Longitudinal	3 symptoms in 24hrs: (3diar OR 3vomit OR 1diar+2other OR 1vomit+2other) AND exclude non-infectious	0.3*
Australia OzFoodNet 2002	Phone cross-section	(3diar OR 2vomit in 24hrs) AND exclude non-infectious. If Resp, then 4 diar or 3 vomit	0.9*
Ireland Food Safety 2002(personal communication)	Phone cross-section	3 diar in 24 hours OR bloody diar OR vomit and one other symptom (diarrhea, abdominal pain, abdominal cramps, fever) AND exclude non-infectious	?
Canada NSAGI 2002(personal communication)	Phone cross-section	?	

The definition of gastroenteritis should be the same when comparing across countries and times, as even an apparently small change in the definition can cause a large impact on the incidence. Recent collaborative work between Australia, Ireland, US and Canada shows that when the same definition of gastroenteritis was used - 3 loose stools in 24 hours - and the same retrospective telephone methodology, there was still a lower level in Ireland at around 3.6% of respondents with diarrhoea in the last four weeks (weighted for age / sex), compared with the other three countries which were all around 6-7%. This suggests that in the UK, the incidence really is lower compared with Australia, US and Canada.

However, it is also possible that the way the questions about symptoms were asked was influential as Ireland was different compared with Australia, US and Canada. The Irish study asked whether the respondent had had 3 or more loose stools, while the other studies asked about the number of loose stools and the definition of gastroenteritis was applied later during analysis. Possibly the higher response rate in Ireland (85% of eligible people contacted, personal communication Elaine Scallan) may also have been influential, with more people without gastroenteritis being willing to take part in the survey compared with the other countries where response rate was lower (Australia and Canada were about 70%).

Random selection, comparison with Census and recall bias

A number of ancillary checks were carried out as quality control measures during this Australian survey, including a check on random selection within the household by last birthday, comparison of the sample with the underlying population, and comparison of 4 week recall versus 2 week recall.

The results of the check on random selection by last birthday suggest that efforts to develop methods to reduce possible selection bias during telephone surveys in general would be beneficial. The Kish grid selection is designed to make it harder for the household or interviewer to select preferentially rather than randomly. The more detail that is collected about the household structure, the less scope there is for manipulation of random selection. However, the poorer response rate with Kish grid selection needs to be weighed against the increased scope for selection bias during random selection by last birthday.

The check on random selection in the household by last birthday suggested the possibility of bias due to handing the phone to a person in the house who had a known history of gastroenteritis; people are possibly more willing to take part if they think they have something ‘useful’ or ‘interesting’ to say. The influence of introducing the topic of

‘gastroenteritis’ to the person answering the phone might be to encourage that person to preferentially seek out the person they know has had gastroenteritis in the household. The effect of not introducing the specific health topic needs to be assessed - while it may reduce selection bias by the person answering the telephone, it is possible that this could reduce rapport and hence response rate.

The selection of one respondent per household necessarily produces a sample that has less children than in the underlying population, but the representativeness of the estimates was assured by demonstrating the similarity of the characteristics of the Census data with the sample data when weighted. The age / sex distribution of the samples of *all* household members was similar to the Census distribution except that there was a lower proportion of 20-30 year olds in the sample compared with the Census (Figure X(iii)). The reason for this is not clear. The sample was drawn from more households with landlines and perhaps more single people in this age group are on mobile phones rather than land-lines, or are more difficult to contact.

The recall period of four weeks was selected to allow international comparison with the US results, and because the longer the recall period, the greater the power available for determining statistical significance. On the down side, a longer recall period may lead to more likely bias with respondents either forgetting about their episode of gastroenteritis, or alternatively ‘telescoping’ events that occurred prior to the relevant period into the time that is being asked about. In the UK infectious diarrhoeal diseases study, the use of prospective diaries resulted in an estimate of incidence of gastroenteritis that was one third the level deduced from a check study using a four week recall period [25]. One interpretation of this is that respondents tend to telescope events that occurred more than four weeks ago into the four week period of interest.

Respondents were asked to use a calendar to try to minimise possible recall effects in this Australian study, and a parallel data collection was undertaken to assess the effect of recall of two weeks compared with four weeks. This did not show a large difference in the estimate of gastroenteritis depending on the recall period. However, the samples were too small to be conclusive and it would be very beneficial to conduct further validation studies with larger samples to compare the effects of different recall periods and data collection methods.

The future

It is likely that a repeat survey will be carried out in the future, to monitor the level of gastroenteritis compared with this benchmark in 2001/2. Any type of data collection strategy is likely to have some degree of a particular bias, making comparison across studies with different methods problematic. Standardization of methods when studies are being compared over time or place is crucial for comparison of results to be meaningful.

TECHNICAL NOTES

Technical note 1. Random selection within the household

A study was carried out as part of the pilot to ascertain the effect of using two different techniques to randomly select the respondent in the household. The two methods were

a) using a Kish grid and
b) selection by last birthday.

A Kish grid is a random selection technique based on a list of all the occupants of the household. The advantage is that there is less scope for the household to manipulate the selection of the respondent, which is determined by the interviewer using a prescribed method. This is unlike the second method of asking for the person with the next birthday, where the householder has the scope to decide who to put forward as the interviewer is ignorant of the status of those in the household. Selection by birthday is likely to be part of the reason for the increased numbers of women respondents in CATI surveys, as possibly there is a decision in the household not to put forward males in the household as respondent. The disadvantage of the Kish method is that information about the household members has to be obtained immediately the phone contact is made, which may be regarded as intrusive and could interfere in the establishment of rapport with the householder. A study of the response rate using the two techniques was carried out as part of the pilot.

The randomness of the selection of the respondent as the person with the next birthday was checked by comparing the data collected on birthdays in the household with the birthday of the person who initially identified as the respondent.

Results

Kish grid selection versus last birthday

In the pilot, a study was done to compare the response rates using the Kish method and selection by last birthday. This involved 68 Kish selections and 112 last birthday selections; there was no introductory letter in the pilot. The interviewers reported that problems arose during questioning about household members details like date of birth. The response rate is shown in the following Table.

Table TN1.1 Response rate by Kish grid and last birthday selection methods

Kish grid	Next birthday
33/68	70/112
49%	63%

The results led to the decision to select respondents by next birthday.

Birthday selection check

To check whether there could be an impact from a possible cohort effect of changing seasonality of birth, births in Australia were checked for 1975 and 1985.
The distribution of births are shown in the following Table.

Table TN1.2 Percentage of births in each month in Australia in 1975 and 1985

Month	1975	1985
Jan	8.3	8.5
Feb	7.9	7.8
Mar	8.0	8.8
Apr	9.0	8.4
May	8.8	8.6
Jun	8.2	8.0
Jul	8.8	8.5
Aug	8.2	8.5
Sep	8.2	8.4
Oct	8.8	8.7
Nov	7.5	8.0
Dec	8.0	7.9

No real difference was observed for these two cohorts or across seasons, with little variation between the months.

To check that the respondent selected was actually the person with the last birthday, the birthdays of all household members were examined. This data was collected about 10 minutes into the interview.

There were 5675 households that selected the person with the last birthday as the respondent as requested, and 412 households that did not. Of the 5675 households, there were 4,327 that had more than one occupant. After excluding single person household (where there is not room for inappropriate selection of the respondent), the proportion of respondents that were selected inappropriately are shown for different groups in the following Table and Figures.

Table TN1.3 Percentage of respondents that were selected inappropriately By sex, education level and gastroenteritis[1] status (households of size one are excluded)

Characteristic	% respondents incorrectly selected (N=412households)
Non-single person households	
(412/4739)	8.7%
Sex	
Female	8.2%
Male	9.3%
Education Level	
=<yr 10	8.5
>yr 10	8.7
Gastroenteritis*	
Yes	11.7
No	8.5

[1] Gastroenteritis defined as at least 3 loose stools or 2 vomits in 24 hours, and if respiratory symptoms present, then at least 4 loose stools or 3 vomits.

Figure TN1.1 Proportion of respondents incorrectly selected by household size (households of size one are excluded)

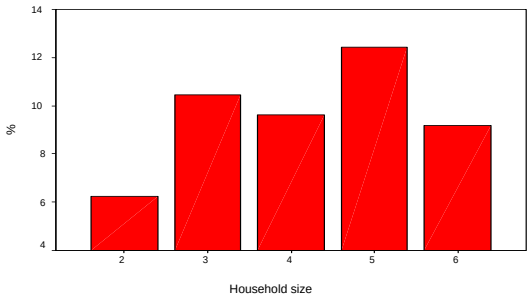
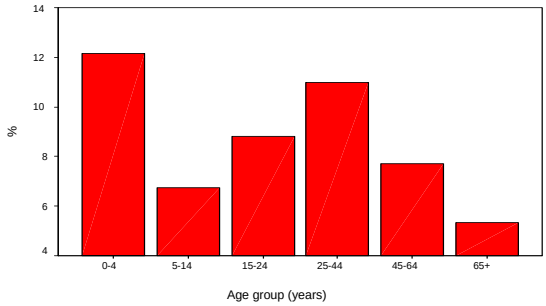


Figure TN1.2 Proportion of respondents incorrectly selected by respondent age (households of size one are excluded)



The incorrect selection of the respondent is more common in larger households and is more likely to be found in the under five years age group or the 25-44 years age group. There is no differential by sex or education status of the household.

There is a differential by gastroenteritis status, with a higher proportion of incorrectly selected respondents in the group with gastroenteritis. This suggests that there could be selection bias within the household with the phone being preferentially handed to someone who has had gastroenteritis recently.

The proportion of respondents with any diarrhoea/vomiting, and with infectious gastroenteritis, is shown separately for the group selected correctly and the group selected incorrectly in the following Table.

Table TN1.4 The proportion of respondents with gastroenteritis[1] in the last 4 weeks by selection status (including single person households)

Illness in last 4 weeks	Correctly selected	Incorrectly selected	Total
Any Diarrhoea or vomiting	619/5675 (10.9%)	64/412 (15.5%)	683/6087 (11.2%)
Gastroenteritis*	408/5675 (7.2%)	42/412 (10.2%)	450/6087 (7.4%)

[1] Gastroenteritis defined as at least 3 loose stools or 2 vomits in 24 hours, and if respiratory symptoms present, then at least 4 loose stools or 3 vomits.

The inappropriate respondent selection occurred in 412 out of 6087 households, or 7% of households. If it were assumed that the rate of gastroenteritis in the incorrectly selected respondents was supposed to really be the same as the rate in the correctly selected respondents (7.2%), then the “excess” cases of gastroenteritis were 13 out of 450 cases. The proportion with gastroenteritis overall would then have been 437/6087=7.2% instead of 450/6087=7.4%.

Technical note 2. Case definition of gastroenteritis

There is no agreed international definition of gastroenteritis based on symptoms. Some definitions from major studies around the developed world are shown in the following Table.

Table TN2.1
Definitions used in some major gastroenteritis studies in the developed world.

Study	Method	Definition
Tecumseh 1965-71 [21]	Longitudinal	Any diarrhoea or vomiting
Melbourne WQTS 2001 [22]	Longitudinal	2 or more loose stools in 24 hrs, or 2 vomits, or 1 stool with abdo pain or nausea or vomit, or one vomit with abdo pain or nausea
US FoodNet 1996 [1]	Phone cross-section	3diar AND exclude those with chronic bowel illness
[Mead 1999]		3 or more loose stools in 24 hrs lasting over one day or interfering with normal activities, adjusted to include any vomiting alone, adjusted to exclude those with Acute Respiratory Infection (ARI) symptoms
UK IID study 1993-96 [23]	Longitudinal	Loose stools or significant vomiting (more than once in 24 hrs, incapacitating or cramps or fever) and lasting under 2wks, excluding known non-infectious cause.
Netherlands 2000 [24]	Longitudinal	2 or more loose stools in 24 hrs with 2 extra symptoms, or 1 or more vomit with 2 or more extra symptoms –Extra symptoms: 2 or more loose stools in 24 hrs, vomiting, fever, abdo pain, abdo cramps, nausea, blood or mucus
Canadian water quality study (Payment 1997)		2 or more loose stools in 24 hrs, or 1 vomit, or 1 stool with abdo pain or nausea, or abdo pain with nausea

The primary objective of the current survey was to have a case definition consistent with infectious intestinal gastroenteritis. People who identified that their gastrointestinal symptoms were due to non-infectious causes were not counted as cases (pregnancy, medications, chronic illness, alcohol).

Those with respiratory symptoms as well as diarrhoea or vomiting posed the possibility that their gastrointestinal symptoms were part of a respiratory illness rather than due to a primary gastrointestinal illness. Previous studies had identified that about 29% of people with diarrhoea/vomiting also had respiratory symptoms and 11-15% of people with respiratory symptoms also had diarrhoea/vomiting as shown in the following Tables.

Table TN2.2 Proportion of illnesses with loose stools/vomiting that also had respiratory symptoms*

Tecumseh Michigan 1965-71	WQTS Melbourne 1998/9	GE survey Australia 2001/2
27%	??	28%

*cough, sore throat, sneezing, runny nose

Table TN2.3 Proportion of illnesses with respiratory symptoms that also had gastroenteritis symptoms

Tecumseh Michigan 1965-71	WQTS Melbourne 1998/9
11%	15%

Examination of other Australian data on the occurrence of respiratory illnesses suggested that independent co-infection was unlikely, as the average number of respiratory infections is about 2-3 per years shown in the following Table. The Melbourne WQTS had found the incidence of gastroenteritis to be 0.8 per person per year. The probability of having two independent infections concurrently was therefore considered low.

Table TN 2.4 Incidence of URTI in Australia

Age 0-4yrs	5-9yrs	10+yrs	All	Source
3.3	2.3	1.7	2.2	Leder 2002
				WQTS Melbourne
			2.9	NHS 1995

However, over 25% of those with gastrointestinal symptoms also had respiratory symptoms indicating that a considerable proportion of people were either prone to concurrent illnesses or that infections with primary sites in either the respiratory or gastrointestinal tract, also resulted in symptoms in the other system.

Data where a gastrointestinal pathogen had been identified showed that over 25% of this group had respiratory symptoms. Data where a respiratory pathogen had been identified showed that 15% of this group had respiratory symptoms.

Table TN2.5 Symptoms among cases with identified gastroenteritis pathogens from WQTS Melbourne 1998/9*

Pathogen found &symptoms collected N=151	**N**	**N with cold symptoms**	**% with cold symptoms**
Adeno virus	6	4	**67**
NLV	66	16	**24**
Rotavirus	7	6	**86**
Campylobacter	19	4	**21**
E Coli	31	14	**45**
Salmonella	9	4	**44**
Crypto	8	0	**0**
Giardia	5	5	**100**
Total	151	53	**29**

*Leder personal communication 2002 and Sinclair poster 2002
Pathogen found in 198 of 791 stools tested.
Info on symptoms for 151 of these cases.

Table TN2.6 Symptoms among cases with identified respiratory pathogens from Tecumseh study 1965-71[1]

Pathogen found &symptoms collected N=151	N	N with diar/vomit	% with diar/vomit
Rhinovirus	223	26	12
Parainfluenza	96	12	12
Resp syncytial	34	7	21
Influenza type A	33	12	36
Influenza type B	36	3	8
Adeno virus	26	6	23
Enterovirus	25	4	16
Group A strep	77	15	20
Total	550	85	15

[1] [21]

To reach a conservative definition rather than an over inclusive definition, we elected to exclude those with respiratory symptoms, unless the gastrointestinal symptoms were more severe.

The primary definition of gastroenteritis in the respondent:
At least 3 loose stools or 2 vomits in 24 hours, excluding cases who identified a non-infectious cause of their symptoms. If respiratory symptoms were present, then a higher level of gastrointestinal symptoms was required of at least 4 loose stools or 3 vomits.

Technical note 3. Reliability and Recall bias checks

Reliability check

The main dataset was merged with the 'reliability check dataset' which comprised 143 respondents who were re-contacted within a maximum of one week of the initial interview. The respondents were re-asked a number of questions relating to diarrhoea and vomiting and demographic characteristics. The calendar period was the same for the two interviews' that is, 'the last four weeks' for the main interview, and the same dates for the second interview.

Diarrhoea and vomiting

The results for reporting 'any diarrhoea or vomiting' are shown in the following Table.

Table TN3.1 Respondent reported Any Diarrhoea or Vomiting (N=144 Sep to May)

	Check data YES DorV	Check data NO DorV	
Main data YES DorV	**70**	**3**	73
Main data NO DorV	**3**	**67**	70
	73	70	143

The Comparability Factor for 'Yes, Any Diarrhoea or Vomiting', when the check data is compared with the main data is 1 (73/73).

The concordance for *'Yes; Any Diarrhoea or Vomiting' is 96%* (70/73).
(73 had 'Yes, Any DorV' in the main dataset and 70 were concordant in the check data, and 3 were discordant).

The concordance for *'No; Any Diarrhoea or Vomiting' is 94% (67/70).*
(70 did not have DorV in the main dataset. 67 concordant in checkset, 3 discordant).

DOB respondent

The concordance for the same date of birth was 92% (131/143)
(131 in the check data were the same as in the main data).

Sex respondent

There was no specific question for sex due to sensitivity to this question, and this may lead to some difficulty in telephone interviews, as the interviewer has to judge the sex of the respondent by their voice and first name.

The concordance for sex was 96% (137/143).

There was a discrepancy for 6 people; of the 53 males identified in the main data, 5 were called female in the check data. Of the 90 females in the main data, one was called male in the check data. This suggests that if someone is identified as female, this is almost certainly correct. If someone is identified as male, this has a low chance of being incorrect.

Others in household

When all people in the household were counted, there were 236 people in the main dataset and 226 in the check dataset. There were 220 people in both datasets, indicating that a different set of people was sometimes identified in the household at the two time points; 16 people were listed only in the main data and 6 people were listed only in the check data. This may be a factor related to real movements, such as people moving back from long stay accommodation elsewhere such as boarding school, or may be due to misunderstanding that the interviewer is not asking only about people actually in the house at the time of the phone call. It seems less likely that some people may be forgotten by the respondent or not entered by the interviewer.

Of all ‘other persons’ found on both the main and check data, 83% (183/220) had the same age in years recorded in both data sets. Most of the discrepancies were within 1-2 years of each other.

Recall bias check

The recall check sample was taken from the Hunter region between March and August 2002, and respondents were asked about vomiting and diarrhoea in the last two weeks, and then the responses were adjusted to give the equivalent amount of gastroenteritis in the last four weeks. This was then compared with the results from the sample in the main study from the same region and time where the recall period was four weeks. The samples are very small and so cannot be conclusive, but the results are similar as shown in the following Table. The data was not weighted due to the small numbers, and the definition was at least three loose stools or two vomits in 24 hours.

Table TN3.2 Comparison of proportion with gastroenteritis[1] from 2 week recall and 4 week recall

Period of recall			Proportion with gastroenteritis in 4 weeks *		
	N in sample	**N with GE**	**Proportion**	**SE**	**95% CI**
2 weeks	132	3	0.05	0.026	0-0.10
4 weeks	114	7	0.06	0.022	0.03-0.12

[1]Gastroenteritis defined as at least 3 loose stools or 2 vomits in 24 hours.
Data for 2 week recall adjusted to be for 4 weeks equivalent

APPENDICES

Appendix 1. Variables in the questionnaire

Variables in the questionnaire

Group	Item	Comments
Basic Demographics	Postcode	
	Age	
	Sex	
	Rural/urban	
	How many people in household	
	Age /sex of residents	
	Ethnic group and Aboriginal status	
	How many residential telephone numbers?	Sampling information
Incidence	Either vomiting or diarrhoea last month?	For calculation of incidence
	How many episodes of vomit/diarrhoea?	For calculation of incidence
	Either vomiting or diarrhoea last month in others in household?	For calculation of incidence
Chronic illness	Have a chronic illness or condition with symptoms of diarrhoea? Specify.	Used for definition
	Was the episode of vomiting or diarrhoea due to an illness different from chronic condition?	Used for definition
	Take any medications last month?	-Treatment of v/d -Risk factor for v/d by immunosuppression -Cause v/d (side effect) Used for definition
	Medical history of general diseases esp immunocompromised	Risk factor
	Pregnant last month?	Used for definition
Travel exposure	Travel inside or outside Australia last month?	Risk factor
	What countries?	Risk factor
	Did the illness of vomiting/diarrhoea begin before, during, or after return from travel outside Australia? Dates	Risk factor
Symptoms of diarrhoea/ vomiting	What date did the illness of vomiting/diarrhoea begin?	If more than one illness, ask about the most recent illness. Check on recall Timing re travel

	If date unknown: Did this illness of vomiting/diarrhoea begin in the last month?	Risk factor
	How many days altogether was the vomiting/diarrhoea?	Severity
	Were there the following symptoms a. Stomach cramps b. Fever c. Headache d. Sore throat e. Cough f. Nausea g. Muscle/body aches h. Stiff neck i. Runny nose j. Sneezing k. Chills l. Vomiting m. Diarrhoea n. Blood How many days of N days diarrhoea N days vomiting	Severity and clinical syndrome
	Maximum number of stools in 24 hour period?	
	Maximum number of vomit in 24 hour period?	
Health Care seeking behaviour	Go to a doctor, nurse, or other medical person?	-Health Care seeking -Severity -Costs
	Specify a. Hospital Emergency Department b. Doctor's surgery c. Nurse d. Other Number times___	-Health Care seeking -Costs
	Admitted to the hospital?	-Severity -Costs
	How many nights in hosp?	
	Asked to submit a stool?	-Investigation practices -Costs
	Provided a stool?	Client health seeking beh
	Why not provide a stool sample?	Client health seeking beh
	Medicine for this illness?	-Treat diarrhoea -Costs
Effect on work	Employed at a job in the past month?	-Severity -Costs
	Miss any time from work?	-Severity -Costs

	How many days altogether did you miss?	-Severity -Costs
	Illness prevent school, recreation, or other activities?	-Severity -Costs
	For how many days?	-Severity -Costs
Socioeconomic status	Highest level of school completed or the highest degree	Risk factor
	Income bracket	Risk factor
	Health insurance	Risk factor
Dining locations	How many meals eaten in a typical week?	Risk factor
	In a typical week How many meals prepared at.... a. A fast food chain b. A sit-down restaurant c. A cafeteria buffet line? d. A community event e. A food stall f. Other	Risk factor
	In a typical week how many meals prepared in a home?	Risk factor
Food safety perceptions		

Appendix 2. Ethics Clearance

In keeping with the NHMRC guidelines, this study was classified as multi-centre as there were investigators from different institutions and localities. The ethics committee at the Department of Health and Ageing was selected as the primary committee, and others were sent applications along with the approval letter from DoHA. All committees approved the survey. Some states were not represented as there was no appropriate committee identified by the state investigator at the time.

Committees providing clearance

Ethics Committee, Department of Health and Ageing, Canberra ACT.

Ethics Committee, Australian National University. Canberra, ACT.

Hunter Area Research Ethics Committee, Newcastle, NSW.

Research Ethics Committee, Princess Alexandra Hospital. Brisbane, Queensland.

Royal Hobart Hospital Ethics Committee, Hobart, Tasmania.

Ethics Committee, Department Human Services. Melbourne, Victoria.

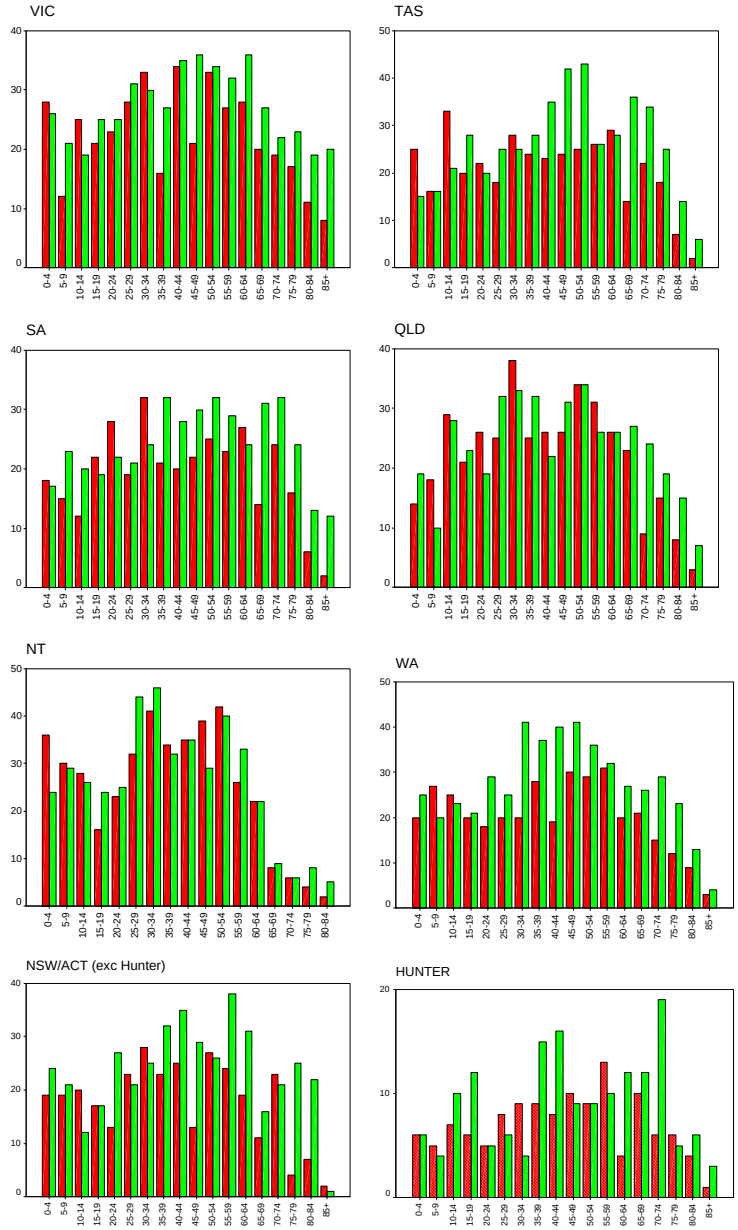
Appendix 3. Age / sex distribution of respondents in the survey sample by jurisdiction

The sample distribution in each state/territory is shown by sex in Table A3.1 and by age / sex in the graphs in Figure A3.1

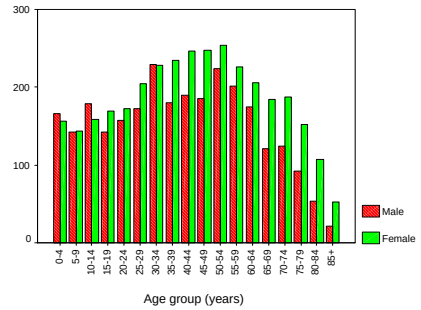
Table A3.1. Number and percentage of respondents in each state by sex.

	Male		Female		Total N
HUNTER	126	(43.6%)	163	(56.4%)	289
NSW/ACT (Exc Hunter)	317	(42.8%)	423	(57.2%)	740
NT	424	(49.2%)	437	(50.8%)	861
QLD	397	(48.2%)	427	(51.8%)	824
SA	346	(44.4%)	433	(55.6%)	779
TAS	376	(44.6%)	467	(55.4%)	843
VIC	404	(45.3%)	488	(54.7%)	892
WA	367	(42.7%)	492	(57.3%)	859
AUSTRALIA	2757	(45.3%)	3330	(54.7%)	6087

Figure A3.1 Distribution of the sample in each state, and the Hunter region, Number by sex and age group.



All Australia



Appendix 4. Distribution of the sample by month and sex by jurisdiction

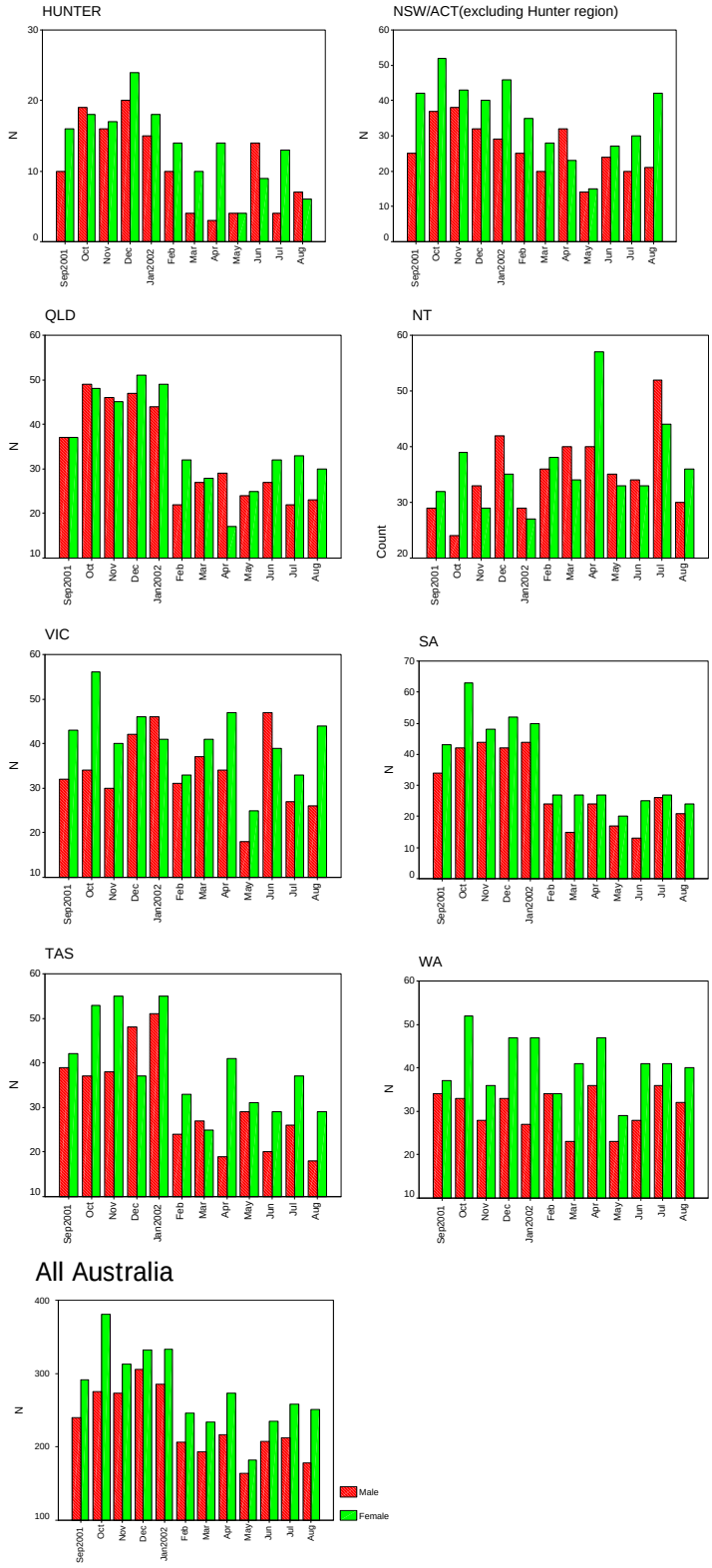
Table A4.1 Distribution of the sample by month and state

State	Month of survey												
	1 Sep 2001	2 Oct	3 Nov	4 Dec	5 Jan 2002	6 Feb	7 Mar	8 Apr	9 May	10 Jun	11 Jul	12 Aug	Total
HUNTER	26	37	33	44	33	24	14	17	8	23	17	13	289
NSW/ACT (excHunter)	67	89	81	72	75	60	48	55	29	51	50	63	740
NT	61	63	62	77	56	74	74	97	68	67	96	66	861
QLD	74	97	91	98	93	54	55	46	49	59	55	53	824
SA	77	105	92	94	94	51	42	51	37	38	53	45	779
TAS	81	90	93	85	106	57	52	60	60	49	63	47	843
VIC	75	90	70	88	87	64	78	81	43	86	60	70	892
WA	71	85	64	80	74	68	64	83	52	69	77	72	859
Total	532	656	586	638	618	452	427	490	346	442	471	429	6087

The earlier months had a higher sample size as the response to the randomly selected sample of telephone numbers was slightly higher than had been estimated from the pilot. This was adjusted in January so that the following months had lower sample sizes, to prevent overshooting the total sample size (which would have cost more.). In May 2002 there was a lower sample size; the reason for this was unknown.

The distribution in each state by month and sex shows that women accounted for a higher number of respondents consistently over the year and that the pattern in each state was generally for a higher number of responses in the earlier months. The Northern Territory had an opposite pattern with more responses later when the sampling procedure was adjusted to take account of the high number of non-usable phone numbers that were generated for the NT (mostly disconnected). The distribution was more evenly spread throughout the year for Victoria and Western Australia.

Figure A4.1 Distribution of the sample in each jurisdiction, and the Hunter region, by sex and month



Appendix 5. Some Characteristics of Households and Respondents

Household size, income, locality, health insurance, Indigenous status and education level.

Household size

Household size has similar proportions in the survey and Census. Over 50% of households are size one or two, over 30% are size 3 or 4, and about 10% are size 5 or larger.

Income

Income data was collected in the survey at the household level and about 10% of households did not answer this question, which is a non-response similar to that found in the Census. The income categories have similar proportions in the weighted survey and Census, with about 30% of households having incomes under $25,000, 50% between $25000 and $100,000, and 10% over $100,000. In the survey, excluding unknowns, the lowest income group occurs mostly in households of one or two (83% of survey households), many of which will be adult only households, including pensioners, although some will be single parent households. The other income categories had a higher proportion of households of size three or more, which are likely to be households with children. The middle income categories had 47% and 61%, and the highest category had 68% of households with household size of three or more.

Rural/urban

The overall proportion of rural households in the survey (18%) is slightly higher than in the Census(14%). This may indicate a slight bias of rural households being more prepared to answer the questionnaire. In the raw data, over half the households were classified as suburban (58% raw data), seven percent were inner city, 17% town and 17% rural/remote communities or farms. The distribution across states was similar, although Tasmania had a higher proportion of rural areas (28%).

Health Insurance

In the survey, 52% of respondents said they had health insurance. This is somewhat greater than the number recorded by the Private Health Insurance Administration Council.

Indigenous status

The overall weighted proportion in the survey (2%) is the same as the Census (2%). There were a total of 146 people who identified as Indigenous in the sample and about half were from the NT (N=66). In each state, the proportion of the raw sample that was Indigenous was around 2% except for VIC, SA and WA which were around 1%, and the NT which was 8%. Although the NT contributed the highest number of Indigenous respondents, there is still a significant shortfall compared with the underlying population of the NT which comprises 30% Indigenous people. This bias was expected as the survey was by telephone and it is likely that many Indigenous households in the NT do not have a phone.

Education

The weighted proportion of education up to year 10 in the survey respondents (41%) is slightly lower than in Census subjects (47%). This possibly indicates a slight bias towards more educated people being prepared to answer the survey questionnaire. It is interesting that in the survey, at the household level, 'highest education in the household' showed that only 13% (raw data) of households had year 10 or under as the highest level among all household members. This suggests that the vast majority of households have at least one person educated to over year 10, even though the weighted proportion of respondents and Census subjects show that over 40% of Australians over 15 years are educated to year 10 or less.

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