Cohort study of an outbreak of viral gastroenteritis in a nursing home for elderly, Majorca, Spain, February 2008

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An outbreak of acute gastroenteritis occurred in a nursing home for elderly in Majorca between 4 and 23 February 2008. To know its aetiology and mechanism of transmission a retrospective cohort study was conducted with a fixed cohort including 146 people (96 residents and 50 employees). The data were collected from clinical histories and through a survey by questionnaire. In total 71 cases were identified (53 residents, 18 employees), corresponding to an overall attack rate (AR) of 48.6%. The consumption of tap water, adjusted by age, sex and consumption of meals provided at the nursing home, presented a relative risk (RR) of 4.03 (95%CI, 1.4-11.4). The microbiological analyses confirmed the presence of norovirus and/or rotavirus in five of the seven stool samples submitted. The slow appearance of cases at the beginning of the outbreak is characteristic of a person to person transmission, while the sudden peak in the middle of the month suggests a common source such as the tap water. We therefore concluded that the outbreak likely originated from two sources: an infected employee of the nursing home and the tap water. The high number of dependent residents most probably facilitated the spread of the outbreak.

Introduction

The progressive aging of the Spanish population increases the demand for residential services. The resulting increase of the numbers of nursing homes and their residents has favoured the emergence of acute gastroenteritis outbreaks in these institutions over the past years [1]. Given the risk characteristics of this particular population, these outbreaks are characterised by high morbidity with high attack rates and long duration [2].

Enteropathogenic viruses, including caliciviruses, are the most common causal agents in these outbreaks [3-5]. Rotaviruses are also responsible for severe diarrhoea, but mainly in children [6,7]. Nevertheless, outbreaks of acute gastroenteritis in nursing homes for elderly caused by rotavirus have been described in the literature [8-10].

In Spain, little information is available on morbidity and mortality associated with norovirus infection, its distribution among the population, and many of its epidemiological characteristics. This is primarily due to the fact that sample collection and laboratory screening for noroviruses is not done routinely [11]. Compared to other EU countries, not many studies of gastroenteritis outbreaks caused by norovirus are described in general and in nursing homes in Spain in particular [4, 12-15].

It is estimated that norovirus is the most common cause of acute gastroenteritis in some European Union countries, with 6% and 11% of all intestinal infectious diseases attributed to norovirus in the United Kingdom and the Netherlands, respectively [16,17].

Noroviruses are transmitted primarily through the faecal-oral route, either by direct person-to-person spread or by faecally contaminated food or water. Secondary and tertiary cases appear quickly through a person-to-person transmission. Noroviruses can also spread via a droplet route from vomits [18,19].

In healthcare facilities, transmission can additionally occur through hand transfer of the virus to the oral mucosa via contact with materials, fomites, and environmental surfaces that have been contaminated with either faeces or vomits. These circumstances make it extremely difficult to control outbreaks in institutional settings [20,21].

Between 4 and 23 February an outbreak of acute gastroenteritis occurred in an elderly nursing home in Majorca, Spain. The outbreak was characterised by a slow start followed by an explosive increase in the number of cases which may be linked to a common source. To contain the outbreak, between 9 and 11 February, the nursing home authorities implemented the following control measures: enteric isolation, cleaning of areas contaminated by vomit, restriction of visitors, suspension of the consumption of tap water, distribution of bottled water, cleaning and chlorination of the water cistern, and stool sampling. The notification of a suspected gastroenteritis outbreak was sent to the health authorities of the Balearic Islands on 13 February. In view of the microbiological confirmation of a mixed viral aetiology (norovirus and rotavirus) and the high attack rate, an epidemiological investigation to determine the causes and transmission routes of the outbreak was launched on 5 March.

Methods

Study design

A retrospective cohort study was conducted including all residents and employees (health workers, cleaning, laundry and maintenance service and administration) who were present in the nursing home in February. The observation period covered 29 days, from 1 to 29 February 2008. Persons who were admitted to or began employment in the nursing home after 29 February or those who were not present for the entire period of 29 days were excluded from the study.

A case of gastroenteritis was defined as any person working or residing in the nursing home during the month of February 2008 who had an episode of acute diarrhoea (defined as three or more liquid stools in 24 hours) or vomiting, or two or more of the following signs: fever, abdominal pain, malaise and nausea.

Data source and epidemiological survey

Two data sources were used. The first one was a computerised database with the medical history of all residents of the nursing home. Information on the employees was obtained through an epidemiological self-administered survey. The questionnaire collected data on the employment position, working shifts and location within the nursing home (ground- or first floor, module A, B or C), as well as consumption of meals and drinking of tap water at the workplace during the month of February and on days 8, 9 and 10 of the same month (these dates were chosen taking into consideration the peak in case numbers on 13 February and the 72-hour incubation period). Finally, questions concerning symptoms experienced during the month of February, history of the disease and information on family members affected.

Microbiological analysis

Stool samples were collected by the medical doctor of the nursing home and sent for routine bacteriological testing to the reference laboratory in the Balearic Islands. Subsequently, as viral origin was suspected in this outbreak, the health authorities of the Balearic Islands sent the available samples to the laboratory of the National Centre of Microbiology in Majadahonda near Madrid where polymerase chain reaction (PCR) was used for identifying norovirus and Elisa test for the identification of rotavirus.

Samples of drinking water could not be taken by the outbreak investigation team because on 26 February cleaning and chlorination of the water cistern of the residence was carried out. Food samples from different meals were collected during the week between 11 and 17 February, i.e. before the arrival of the outbreak investigation team, and were tested for bacteria only.

Statistical analysis:

Common statistical methods were used for describing the variables related to personal data and place of work or residence within the nursing home. A univariate descriptive analysis was done to study the risk factors of employees and residents. The attack rate, the incidence densities, incidence density ratios (IDR) and the aetiological fractions due to exposure were calculated with their respective 95% confidence interval. The incidence densities were expressed in person-days. The differences of rates were analysed through the Fisher's Exact Test [22]. Finally, multivariate analyses using Cox regression with explanatory purpose were done to test the foodborne and the waterborne hypotheses, adjusted for age and sex. The overall significance of the model was verified through a maximum likelihood ratio test and the individual significance using p value of $\chi 2$ (chi square) by Wald's test. The resulting model relative risks (RR) were expressed with their respective 95% CI. The verification of the hypothesis of proportionality of risks was carried out using the graphic method of logarithmic survival curves: $Ln(-Ln\hat{S}(t))$. The study of outliers and influential values was done through the analysis of the residuals. EPIDAT v.3.1 was used for the data collection and Stata v.10 for the data analysis.

Results

The study population consisted of 168 persons, 96 of them were residents and 72 employees of the nursing home. Information was obtained from 146 people; 100% (n= 96) of the residents and 69% (n=50) of the employees. Among the 50 employees included in the study, 38 (76%) were health workers. Among the 22 employees who did not respond to the questionnaire, nine worked in administration, management or services (laundry, cleaning and cooking) and 13 were health workers.

Descriptive analysis of the residents

The sex ratio (males to females) among residents was 0.2 and the median age was 82 years, with an interquartile range (IQR) of 12. Over 60% of the residents needed help to perform activities of daily living. Dementia was present in 54% and 41% were incontinent. Among the residents, 53 (55%) fulfilled the case definition. The most common symptom was diarrhoea, present in 98% of the cases. All residents ate the meals provided by the nursing home and drank the tap water of the nursing home until distribution and consumption of bottled water was ordered by the director on 11 February.

Descriptive analysis of the employees

Among the employees, the sex ratio (males to females) was 0.06. The median age was 37.7 years (IQR: 17). The median time at workplace was six months. Five (10%) employees drank tap water

FIGURE 1

Epidemic curve of cases, by date of onset of symptoms, outbreak of gastroenteritis in a nursing home for elderly, Majorca, February 2008 (n=71)

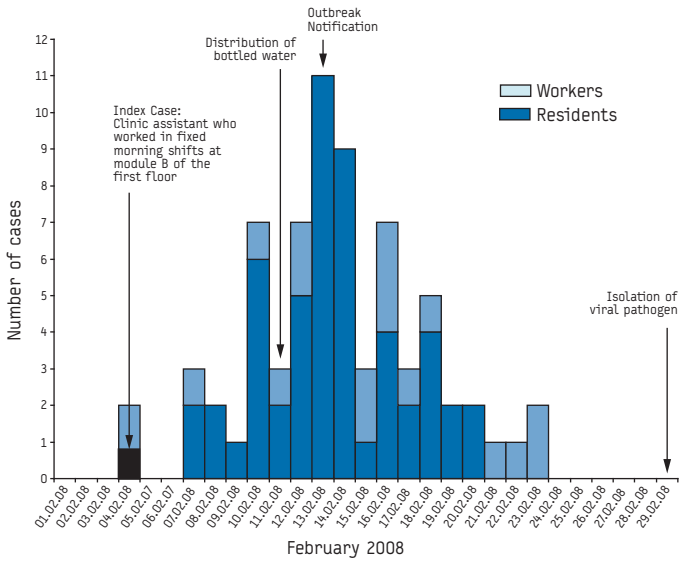

Table 1

Attack rates and incidence densities in the cohort, by residents, employees, consumption of meals and drinking of tap water; outbreak of gastroenteritis in a nursing home for elderly, Majorca, February 2008 (n=146)

Variables	Cohort	Cases	Attack rate (%) (95% CI)	Incidence density* (95% CI)	P value**
	146	71	48.6 (38.5-61.3)	2.3 (1.8-2.8)	
Cohort					0.02
Residents	96	53	55.2 (42.1-72.2)	2.7 (2.1-3.6)	
Employees	50	18	36.0 (22.6-57.1)	1.5 (0.9-2.4)	
Employees					0.13
Health workers	37	16	42.1 (25.7-68.7)	1.8 (1.1-2.9)	
Others***	13	2	16.6 (4.2-66.6)	0.6 (0.1-2.5)	
Sex					0.39
Male	23	13	48.7 (37.5-63.2)	2.2 (1.7-2.9)	
Female	123	58	56.5 (32.3-97.3)	2.8 (1.6-4.8)	
Drinking of the nursing home tap water					< 0.05
Yes	102	58	56.8 (43.9-73.5)	2.8 (2.2-3.7)	
No	44	13	29.5 (17.1-50.8)	1.1 (0.6-1.9)	
Diet					0.09
Standard	59	32	54.2 (38.3-76.7)	2.6 (1.9-3.7)	
Diabetic	19	12	63.1 (35.8-111.2)	3.3 (1.8-5.7)	
Soft	13	8	61.5 (30.7-123.0)	3.5 (1.7-6.9)	
Pureed	14	4	28.5 (10.7-76.1)	1.2 (0.4-3.1)	
Do not eat meals at the nursing home	41	15	36.5 (22.0-60.6)	1.5 (0.9-2.5)	

* Incidence density per 100 people and day
** P value of χ^2 of Fisher's exact test
*** Cleaning, laundry and maintenance service and administration

Table 2

Univariate analyses of gastroenteritis cases in residents of the nursing home, outbreak in Majorca, February 2008 (n=96)

Variables	Cohort of residents	Cases	Attack rate (%) (95%CI)	Incidence density* (95%CI)	Incidence density ratio (95%CI)	Attributable fraction (exposed) (95%CI)
Sex						**
Female	76	41	53.9 (39.7-73.2)	2.6 (1.9-3.5)	1	
Male	20	12	60.0 (34.0-105.6)	3.1 (1.7-5.4)	1.2 (0.5-2.2)	15.2 ([-7.7]-5.6)
Age in years						**
≤ 80 years	43	25	58.1 (39.2-86.0)	2.9 (2.0-4.4)	1.2 (0.6-2.1)	15.6 ([-5.1]-52.6)
≥ 81 years	53	28	52.8 (36.4-76.5)	2.5 (1.7-3.6)	1	
Independent in the activities of daily living						**
Yes	38	21	55.1 (39.2-78.0)	2.6 (1.7-4.0)	1	
No	58	32	55.2 (36.0-84.7)	2.8 (1.9-3.9)	1.1 (0.6-1.9)	5.7 ([-6.8]-48.3)
Physical disability* **						**
Yes	36	18	50.0 (31.5-79.3)	2.4 (1.5-3.8)	1	
No	59	35	59.3 (42.5-82.6)	2.9 (2.1-4.1)	1.22 (0.7-2.3)	18.2 ([-48.2]-56.4)
Dementia						**
Yes	52	26	50.0 (34.0-73.4)	2.4 (1.6-3.6)	1	
No	44	27	61.3 (47.1-89.4)	3.0 (2.1-4.5)	1.2 (0.7-2.2)	21.0 ([-40.5]-55.7)
Control sphincters						**
Yes	56	28	50.0 (34.5-72.4)	2.4 (1.7-3.6)	1	
No	40	25	62.5 (42.2-92.4)	3.1 (2.1-4.6)	1.3 (0.7-2.2)	20.0 ([-43.0]-55.0)
Diet						**
Standard	50	29	58.0 (40.3-83.4)	28.8 (20.0-41.5)	2.4 (0.8-9.5)	59.1 ([-16.3]-89.5)
Diabetic	19	12	63.1 (35.8-1112)	32.6 (18.5-57.4)	2.7 (0.8-11.7)	63.8 ([-19.3]-91.4)
Soft	13	8	61.5 (30.7-123.0)	34.6 (17.3-69.2)	2.9 (0.8-13.3)	65.9 ([-27.1]-92.5)
Pureed	14	4	28.5 (10.7-76.1)	11.8 (4.4-31.4)	1	
Type of room						**
Simple	46	23	50.0 (36.1-63.8)	2.3 (1.5-3.5)	1	
Double	50	30	60.0 (46.1-72.4)	3.1(2.1-4.4)	1.3 (0.7-2.7)	24.1 ([-30.6]-55.9)
Floor						**
Ground floor	24	11	45.8 (25.3-82.7)	1.9 (1.0-3.5)	1	
Second floor	72	42	58.3 (43.1-48.0)	3.0 (2.2-4.1)	1.5 (0.8-3.3)	35.8 ([-26.7]-70.2)

* Incidence density per 100 people and day
** P value > 0.05 of χ^2 of Fisher's exact test
*** Information on physical disability was available for 95 of the 96 residents in the cohort (one missing)

Figure 2

Survival function of the tap water adjusted by age, sex and consumption of meals at the nursing home, outbreak of gastroenteritis in Majorca, February 2008 (n=146, 48.6% cases)

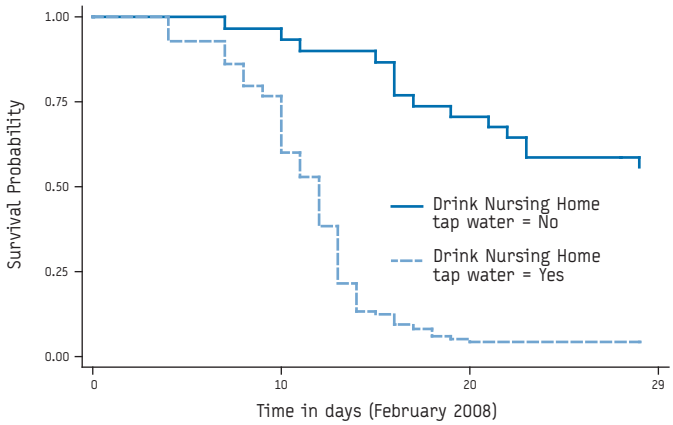

Figure 3

Verification of the hypothesis of proportional risks assumption, logarithmic survival curves, Ln(-LnŜ (t)), outbreak of gastroenteritis in a nursing home for elderly, Majorca, February 2008

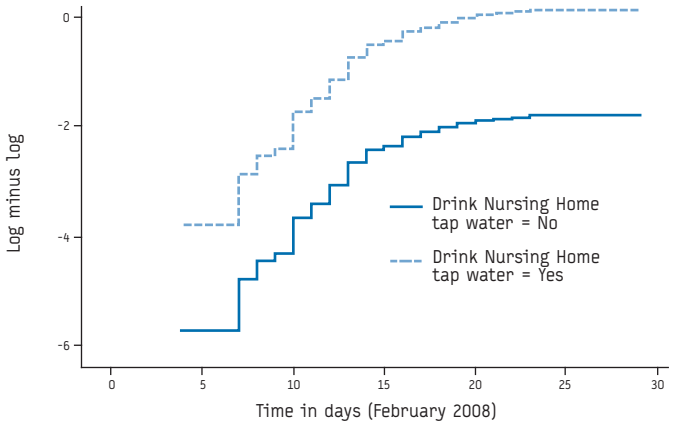

Table 3

Univariate analyses of gastroenteritis cases in employees of the nursing home, outbreak in Majorca, February 2008 (n=50)

Variables	Cohort of employees	Cases	Attack rate (%) (95% CI)	Incidence density* (95% CI)	Incidence density ratio (95% CI)	Attributable fraction (exposed) (95% CI)
Sex						**
Female	47	17	36.1 (22.4-58.1)	1.5 (0.9-2.3)	1.1 (0.2-48.5)	13.9 ([-4.5]-97.9)
Male	3	1	33.3 (4.7-23.6)	1.2 (0.2-9.2)	1	
Age in years* **						
≤ 24	8	3	37.5 (12.116.2)	1.5 (0.5-4.8)	1.5 (0.2-1.7)	36.3 ([-37.5]-91.4)
25-34	12	3	25.0 (8.0-77.5)	0.9 (0.3-3.0)	1	
35-44	12	6	50.0 (22.4-111.2)	2.1 (0.9-4.8)	2.1 (0.4-13.5)	54.2 ([-11.4]-92.6)
≥ 45	15	6	40.0 (17.9-89.0)	1.7 (0.7-3.8)	1.7 (0.4-6.9)	43.2 ([-12.2]-85.5)
Job position						
Health workers	38	16	42.1 (25.7-68.7)	1.8 (1.1-2.9)	2.9 (0.7-2.6)	65.7 ([-45.6]-96.1)
Others****	12	2	16.6 (4.1-66.6)	0.6 (0.1-2.4)	1	
Working hours						
Day shift	16	8	50.0 (25.0-99.9)	2.2 (1.1-4.4)	2.3 (0.5-13.4)	56.5 ([-81.2]-92.5)
Afternoon shift	8	3	37.5 (12.0-116.2)	1.6 (0.5-5.0)	1.6 (0.2-12.5)	40.5 ([-34.3]-92.0)
All shifts	3	1	33.3 (4.6-23.6)	1.4 (0.2-10.1)	1.5 (0.1-18.6)	33.0 ([-342.2]-94.6)
Day/night shift	11	3	27.2 (8.7-84.5)	1.1 (0.3-3.4)	1.1 (0.1-8.6)	13.1 ([-54.8]-88.3)
Day/Afternoon shift	12	3	25.0 (8.0-77.5)	0.9 (0.3-2.9)	1	
Length of employment in months						**
11-14 months	10	5	50.0 (20.8-120.1)	2.3 (9.9-57.4)	2.6 (0.5-13.2)	61.2 ([-76.9]-92.4)
7-10 months	11	5	45.4 (18.9-109.2)	2.0 (8.5-49.4)	2.2 (0.5-11.3)	55.7 ([-105.7]-91.2)
4-6 months	12	4	33.3 (12.5-88.8)	1.2 (4.8-34.0)	1.4 (0.3-7.35)	28.7 ([-282.7]-86.7)
0-3 months	17	4	23.5 (8.8-62.6)	0.9 (3.4-24.2)	1	
Location at the workplace (floor and module) in February						**
Ground floor	10	3	30.0 (9.6-93.0)	1.1 (0.3-3.5)	1.4 (0.2-8.2)	28.0 ([-391.7]-87.8)
Second floor, module A	7	2	28.5 (7.1-114.2)	1.1 (0.2-4.3)	1.3 (0.1-9.1)	23.7 ([-743.3]-89.0)
Second floor, module B	6	4	66.6 (25.0-117.6)	4.5 (1.7-12.1)	5.5 (1.0-29.6)	81.8 (2.5-96.6)
Second floor, module C	8	5	62.5 (26.0-150.1)	2.7 (1.1-6.5)	3.3 (0.7-16.6)	69.6 ([-41.0]-93.9)
Both floors	19	4	21.0 (7.9-56.0)	0.8 (0.3-2.1)	1	
Consumption of the nursing home meals in February						**
Yes	9	3	33.3 (10.7-103.3)	1.4 (0.4-4.3)	1	
No	41	15	36.5 (22.0-60.6)	1.5 (0.9-2.5)	1.1 (0.3-5.8)	7.4 ([-227.0]-82.8)
Drinking of the nursing home tap water in February						**0.01**
Yes	5	4	80.0 (30.0-213.1)	6.5 (2.4-17.4)	**5.3 (1.2-17.0)**	**81.3 (0.2-94.1)**
No	45	14	31.1 (18.4-52.5)	1.2 (7.2-20.7)	1	

*Incidence density per 100 people and day
** P value > 0.05 of χ^2 of Fisher's exact test
*** Information on age was available for 47 of the 50 employees in the cohort (three missing)
**** Cleaning, laundry and maintenance service and administration; (working in administration was not reported by any case)

from the cistern of the nursing home during the month of February, and nine (18%) ate the standard menu during the same time. 18 cases (36%) were identified among the employees. The most common symptom reported by employees was diarrhoea, followed by abdominal discomfort.

Descriptive temporal analysis

The outbreak began on 4 February and lasted until 23 February. The first two cases with onset of symptoms on 4 February were employees of the centre. Both were included in the study but only one provided detailed answers to all questions in the questionnaire. This index case was a nursing assistant who during the month of February worked in fixed morning shifts in the module B on the first floor. This person was diagnosed with acute gastroenteritis by a physician. The relatives of the index case were also affected and began to show symptoms on 6 February (Figure 1).

The outbreak peaked on 13 and 14 February (11 and 9 cases, respectively). The latest reported date of onset of symptoms was 23 February (two cases).

Attack rates, incidence densities

The overall attack rate (AR) was 48.6% (95% confidence interval, CI, 38.5-61.3). The AR among the employees (n=50) was 36% (95%CI, 22.6-57.1). The AR among the residents (n= 96) was 55.2% (95%CI, 42.1-72.2).

There were no significant differences between attack rates and the incidence densities according to sex and consumption of the menu. However, the risk of illness following consumption of tap water from the nursing home was significantly higher among those who drank it compared to those who did not (Table 1).

Univariate analysis

Among residents, women of any age and people of both sexes below 80 years of age were most affected. Being resident of the first floor in a double room, incontinent and dependent on the staff to handle the basic activities of daily living, posed a greater risk of infection. The risk of residents of double rooms was 30% higher (IDR: 1.3 CI95% [0.7-2.2]) than those of single rooms. There were no significant differences between risks related to different diets (i.e. standard, diabetic, pureed, etc.) within the meals consumed in the nursing home (chi square of Fisher's exact test for unequal rates, p= 0.098) (Table 2).

Among employees, health workers between 34 to 44 years of age, with fixed morning shifts attached to the module B of the first floor and more than 10 months at the workplace had a higher risk of acute gastroenteritis. The consumption of tap water during the month of February is the highest risk factor associated with the acute gastroenteritis (Table 3).

Multivariate analysis

The consumption of tap water during the month of February is a clear risk factor for gastroenteritis within employees and residents. The unadjusted risk ratio for drinking tap water was 2.5 95% CI (1.3-4.5). Regardless of age, sex and consumption of the menu, individuals from the cohort, who drank water, were four times more at risk of acute gastroenteritis than those that did not consume (Table 4, Figures 2 and 3).

Laboratory results

On 29 February the results of laboratory analysis of samples taken during the outbreak confirmed the isolation of viral enteropathogenic agents in five of the seven samples submitted: norovirus in three of them, rotavirus in one and both norovirus and rotavirus in the fifth one. The food samples tested during the outbreak were negative for bacteria.

Discussion

The description and the epidemiological analysis of the outbreak allow us to reconstruct the possible source and subsequent transmission of infection in the nursing home. The index case of 4 February was a clinic assistant who worked in fixed morning shifts at module B of the first floor. In this module, where the outbreak began among residents, it is likely that the index case introduced the virus into the residence. This hypothesis is also supported by the fact that the washing and changing clothes of residents is done during the morning shift, the workload is bigger than in the other shifts and the contact between employees and residents is closer.

Regarding the transmission of the outbreak, the epidemic curve with mild start and slow spread until 9 February would support the hypothesis of introduction of rotavirus from outside through the index case. However, on 13 and 14 February an explosive peak, lasting two-days, occurred affecting only residents. Knowing the pathogenesis of norovirus, its epidemiological characteristics and the fact that calicivirus outbreaks have been associated with a common water source [23-27], it is likely that this peak was due to consumption of tap water from the nursing home. All residents and five (10%) of employees in the centre drank tap water until 11 February, when distribution of bottled water was imposed due to the suspicion of an acute gastroenteritis outbreak. Within 72 hours after the closure of the cistern the highest case load per day were reported. In addition, all these cases had drunk tap water before. If we take into consideration the incubation period of these viral agents, the epidemic peak of day 14 and 15 corresponds well to the prohibition to consume tap water and the provision of bottled drinking water. This assumption is further supported by the results of the statistical analysis. The risk of gastroenteritis was four times higher in those individuals of the cohort who had consumed tap water regardless of age, sex and consumption of the nursing home meals. From the qualitative information obtained from staff interviews, we understood that days before the start of the outbreak there were complaints from residents of a bad taste of the tap water.

Table 4

Multivariate analyses by Cox regression model of gastroenteritis cases categorised by age, sex and consumption of meals and tap water at the nursing home, outbreak in Majorca, February 2008 (n=146)

Variables	Beta coefficient	Standard error	Relative risk (95%CI)	P value*
Age (in years)	-0.01	0.01	0.99 (0.97-1.01)	0.17
Sex (female vs male)	-0.03	0.31	1.03 (0.53-1.79)	0.93
Drinking of tap water (yes vs no)	1.39	0.53	**4.03 (1.42-11.38)**	**0.01**
Consumption of meals (yes vs no)	-0.05	0.25	0.96 (0.58-1.56)	0.85

* P value of χ^2 Wald's test

There were no differences between the risks related to different diets, so the alimentary hypothesis was rejected. The risk of acute gastroenteritis was similar for those who usually ate at the residence as for those who did not, and multivariate analysis confirmed the absence of association between the outbreak and having meals at the nursing home.

Therefore, disregarding the hypothesis of food source, we consider as very likely the coexistence of two routes the outbreak was introduced into the nursing home. The first was infection imported from outside, most likely by the index case we identified, which progressed by a person to person transmission. The second was a common source, most likely the tap water.

The outbreak took place in a closed setting which usually results in high attack rates. However, in this outbreak, the double source could also explain the high virulence and high transmissibility of infection, that affected half of the cohort and a density incidence of 2.3 (95%CI: 1.8-2.8) cases per 100 person-days. The unique dynamics in the transmission of this outbreak makes it markedly different from other outbreaks in nursing homes studied in Spain [4, 10-13].

After the peak on 13 and 14 February, the outbreak adopted a person to person transmission pattern affecting employees and residents. This hypothesis is supported by the high attack rates in both incontinent and dependent residents and health workers in fixed morning shifts of module B of the first floor. In addition, the risk of becoming ill among health workers was greater for those with fixed morning shifts, when as previously commented workers usually have more contact with residents. This phenomenon of spreading the disease by person to person is recurrent in different outbreaks described in nursing homes in Spain and in health care settings in other European countries [4,12-15, 28].

The greatest risk of becoming ill in the group of dependent residents and those with incontinent sphincter may be related to the special care they required. In this group of residents, the health worker per resident ratio is one per 12. As 60.4% of the residents needed assistance in performing activities of daily living, and 41% were incontinent, this might be a factor to take into account when trying to understand the difficulty of controlling the mechanism of person to person transmission in an outbreak in such setting.

Considering the limitations of this study, we must be prudent in interpreting the results where statistically significant associations were not found, since there is a possibility of false negative results in the statistical analyses. We should not overlook the possibility of a classification bias due to the memory at the time of completing the epidemiological questionnaire. Another limitation includes the selection bias introduced with the loss of selective information in the subgroup of employees in our cohort, linked to the non-response of the epidemiological questionnaire. This represents a 21.6% rate of non-response among employees. Therefore, apart from being cautious in extrapolating the results to the subgroup of employees, we should bear in mind that when we report the relative risks in the bivariate analysis of this group, the statistical power of our results is 22%. And finally, the impossibility to confirm by laboratory the presence of viruses in the drinking water of the cistern of the residence can subtract the attribution force of water as the causal hypothesis.

We can conclude that the studied outbreak showed a high attack rate and affected both residents and employees. The aetiology of the outbreak was mixed, with the involvement of norovirus and rotavirus. It is likely, that the high level of dependence of the residents had been a facilitating factor of the spread of the outbreak.

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