Review

Investigations of Foodborne Diseases by Food Inspection Services in The Netherlands, 1991 to 1994

E. SIMONE, M. GOOSEN,1 SERVÉ H. W. NOTERMANS,2 and MARTIEN W. BORGDORFF1*

1Department for Infectious Diseases Epidemiology and 2Laboratory for Microbiological Health Protection, National Institute of Public Health and the Environment, P.O. Box 1, 3720 BA Bèthoven, The Netherlands

(MS# 96-99: Received 22 April 1996/Accepted 23 August 1996)

ABSTRACT

Foodborne illnesses investigated in the period 1991 to 1994 by the regional Food Inspection Services in The Netherlands are summarized and evaluated. In this period 2,621 incidents were reported, involving 7,567 ill people. Types of food most commonly implicated were Chinese-Indonesian food and meat products. More than half of the incidents were reported to originate in a restaurant or snack bar. Although laboratory investigations were carried out when possible, a likely causative agent was identified in only 8.3% of the incidents. Of the incidents with a known etiological agent, 19% were attributed to Bacillus cereus, 16% to Salmonella spp., 11% to Clostridium perfringens, 10% to chemical toxins, 6% to Escherichia coli, and 5% to Staphylococcus aureus. The present system covers only a tiny proportion of all foodborne illness and does not utilize epidemiological evidence to identify the source of outbreaks. It is recommended to supplement the microbiological data collected at present with epidemiological evidence, in particular in outbreaks involving 10 people or more.

Key words: Foodborne disease, outbreak investigation, surveillance, Bacillus cereus, salmonella

Microbiological investigations of food are guided by the symptoms of patients and are usually limited to laboratory testing for Salmonella spp., Bacillus cereus, Clostridium perfringens enterotoxin, Staphylococcus aureus, and indicator organisms.

Data concerning the outbreaks investigated by Food Inspection Services are collected and analyzed annually at the National Institute of Public Health and the Environment. Reports are fed back to the Regional Food Inspection Services and sent on to the Food and Agriculture Organization and World Health Organization (FAO/WHO) Collaborating Centre for Research and Training in Food Hygiene and Zoonoses in Berlin, which collects and evaluates reports of foodborne diseases in Europe in the context of the WHO Surveillance Programme for Control of Foodborne Infections and Intoxications in Europe (7). This paper presents data on outbreaks in the period 1991 to 1994.

MATERIALS AND METHODS

For all incidents, Food Inspection Services are requested to report the following data, using a standard reporting format: number of persons ill, number of people exposed, symptoms, incubation period, suspect foods, places where suspect foods were prepared and consumed, type of food samples collected, and microbiological results. Until 1992, written reports were submitted. Beginning in 1992, data could be submitted as an Epi Info file on floppy disk (6). Since 1994, Food Inspection Services have been requested to submit data as an Epi Info file only. The contents of the standard report form and the Epi Info data entry program are identical.

Two types of incidents were distinguished: (i) an outbreak, an incident in which two or more persons became ill with similar symptoms after approximately the same incubation period and after eating the same type of food; and (ii) a single case, an incident in which one person became ill with food as the suspected cause.

Incidents were only included in the analysis when the total number of ill persons was reported. Microbiological or epidemiological evidence to support a conclusion that certain foods had been vehicles of infection was not necessarily available.

Epi Info was used for data analysis as well (6). Chi-square
TABLE 1. Microorganisms identified in incidents of foodborne disease in the period 1991 to 1994 reported by Food Inspection Services in The Netherlands

<table>
<thead>
<tr>
<th>Disease microorganism identified</th>
<th>1991, 8 Services (per service:)</th>
<th>1992, 8 Services (per service:)</th>
<th>1993, 8 Services (per service:)</th>
<th>1994, 11 Services (per service:)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>incidents</td>
<td>cases</td>
<td>incidents</td>
<td>cases</td>
</tr>
<tr>
<td>Bacillus cereus</td>
<td>(68)</td>
<td>(212)</td>
<td>(79)</td>
<td>(236)</td>
</tr>
<tr>
<td>Campylobacter spp.</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>9</td>
<td>24</td>
<td>8</td>
<td>61</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>4</td>
<td>144</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Salmonella spp.</td>
<td>2</td>
<td>34</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>5</td>
<td>39</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Others known</td>
<td>13</td>
<td>68</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>Known total</td>
<td>46</td>
<td>336</td>
<td>54</td>
<td>236</td>
</tr>
<tr>
<td>Unknown</td>
<td>497</td>
<td>1,361</td>
<td>561</td>
<td>1,649</td>
</tr>
<tr>
<td>Total</td>
<td>543</td>
<td>1,697</td>
<td>615</td>
<td>1,885</td>
</tr>
</tbody>
</table>

tests were used to test differences in proportions between groups and to analyze trends.

RESULTS

For 1991, 1992, and 1993, data were received from 8 of the 13 Food Inspection Services and for 1994 from 11 of the 13. In this period, the total number of reported incidents was 2,621 and the total number of ill persons 7,567. Diarrhea, nausea, vomiting, or abdominal cramps were reported in 97% (2,421 of 2,503) of the incidents in which symptoms were recorded.

The number of incidents and cases in each year are presented in Table 1. The average annual number of reported incidents per Food Inspection Service was 75. Overall, an increase was seen in the number of incidents per year. However, this increase may be attributable to differences in the number of reports submitted. Therefore, no clear increase or decrease was found.

The number of incidents other than single cases differed substantially between Food Inspection Services. In 3 of the 13 Food Inspection Services the proportion of single cases was lower than 5% (0 of 162, 0 of 94 and 1 of 47); the highest proportion found was 61% (100 of 163).

Microbiology

A remnant of the suspect food(s) was investigated in 27% (578 of 2,125) of the incidents (in 501 incidents from two Food Inspection Services, data on the type of sample taken were not recorded). In 242 of these 578 incidents other samples were investigated as well, such as other food or kitchen utensils. In 60% (1,287 of 2,125) of the incidents no remnants were available and therefore only other samples were investigated. The average proportion of incidents in which a pathogen was found was 8.3% (218 of 2,621). Bacillus cereus was the most frequently identified pathogen and was found in 40 incidents. Salmonella spp. were found in 31 incidents, but the average number of cases per incident was higher (Table 3). The highest average number of cases was found in incidents which were attributed to E. coli or viruses. A possible causative agent was found in a significantly higher proportion of outbreaks (9.6%, 148 of 1,534) than of single cases (5.9%, 70 of 1,087) (χ² = 8.6, df = 1, P < 0.01). Foods in which microorganisms were found are presented in Table 4. A comparison with microbiological results in the UK and USA and with earlier results in The Netherlands is presented in Table 5. In The Netherlands, Salmonella spp. were less commonly found, while Bacillus cereus was more commonly present than in the UK and USA.

Foods and locations involved

The number of incidents by suspect food category and microbiological agent is presented in Figure 1. The most
TABLE 3. Disease agents identified in incidents of foodborne disease reported by Food Inspection Services in The Netherlands 1991 to 1994

<table>
<thead>
<tr>
<th>Disease agent</th>
<th>All incidents</th>
<th>Outbreaks</th>
<th>Single cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of incidents (%)</td>
<td>Total no. of cases</td>
<td>No. of outbreaks</td>
</tr>
<tr>
<td><strong>Bacillus cereus</strong></td>
<td>40 (1.5)</td>
<td>172</td>
<td>28</td>
</tr>
<tr>
<td><strong>Campylobacter</strong></td>
<td>13 (0.5)</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td><strong>Clostridium perfringens</strong></td>
<td>18 (0.7)</td>
<td>91</td>
<td>16</td>
</tr>
<tr>
<td><strong>Escherichia coli</strong></td>
<td>10 (0.4)</td>
<td>165</td>
<td>9</td>
</tr>
<tr>
<td><strong>Salmonella</strong></td>
<td>31 (1.2)</td>
<td>290</td>
<td>23</td>
</tr>
<tr>
<td><strong>Staphylococcus aureus</strong></td>
<td>12 (0.5)</td>
<td>53</td>
<td>8</td>
</tr>
<tr>
<td>Viruses</td>
<td>4 (0.2)</td>
<td>69</td>
<td>4</td>
</tr>
<tr>
<td>Toxins (not bacterial)</td>
<td>21 (0.8)</td>
<td>84</td>
<td>15</td>
</tr>
<tr>
<td>Others</td>
<td>36 (1.4)</td>
<td>109</td>
<td>23</td>
</tr>
<tr>
<td>Two or more agents</td>
<td>32 (1.2)</td>
<td>95</td>
<td>19</td>
</tr>
<tr>
<td>Unknown</td>
<td>2403 (91.7)</td>
<td>6420</td>
<td>148</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2621 (100)</td>
<td>7567</td>
<td>1534</td>
</tr>
</tbody>
</table>

frequently reported food groups were Chinese-Indonesian food, which was suspected in 572 of 2,621 (21.8%) of the reported incidents and meat and meat products which were suspected in 272 of 2,621 (10.4%) incidents. Chinese-Indonesian food is usually prepared in restaurants offering both Chinese and Indonesian dishes.

In more than half of the incidents with a reported location, the suspect foods were consumed in a restaurant (57.7%, 1,215 of 2,106) or a snack bar (13.4%, 282 of 2,106).

TABLE 4. Foods suspected to be involved in incidents in which microorganisms were found reported by Food Inspection Services in The Netherlands, 1991 to 1994

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Foods involved (no. of incidents of disease)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bacillus cereus</strong></td>
<td>Chinese-Indonesian food (17), meat (3), dairy products (3), bakery products (2), fish and shellfish (1), other ethnic foods (1), other foods (13)</td>
</tr>
<tr>
<td><strong>Campylobacter spp.</strong></td>
<td>Meat (3), poultry and eggs (3), other ethnic foods (2), dairy products (1), other foods (4)</td>
</tr>
<tr>
<td><strong>Clostridium perfringens</strong></td>
<td>Chinese-Indonesian food (11), poultry and eggs (1), other ethnic foods (1), other foods (5)</td>
</tr>
<tr>
<td><strong>Escherichia coli</strong></td>
<td>Drinks (2), dairy products (1), bakery products (1), Chinese-Indonesian food (1), other foods (5)</td>
</tr>
<tr>
<td><strong>Salmonella spp.</strong></td>
<td>Meat (5), Chinese-Indonesian food (5), poultry and eggs (4), dairy products (2), fish and shellfish (1), bakery products (1), fruit and vegetables (1), other foods (11)</td>
</tr>
<tr>
<td><strong>Staphylococcus aureus</strong></td>
<td>Chinese-Indonesian food (4), meat (2), fish and shellfish (1), poultry and eggs (1), other ethnic foods (1), other foods (2)</td>
</tr>
</tbody>
</table>

* Other than Chinese-Indonesian food.
* Other than the food groups mentioned in the table.

TABLE 5. Relative frequency of identification of etiological agents in outbreaks in The Netherlands, UK, and USA, among outbreaks with a known etiological agent

<table>
<thead>
<tr>
<th>Etiologic agent</th>
<th>The Netherlands</th>
<th>England/Wales</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bacillus cereus</strong></td>
<td>18.9% (n = 148)</td>
<td>19% (n = 248)</td>
<td>2.5% (n = 403)</td>
</tr>
<tr>
<td><strong>Campylobacter spp.</strong></td>
<td>2.0% (n = 148)</td>
<td>10% (n = 248)</td>
<td>2% (n = 403)</td>
</tr>
<tr>
<td><strong>Clostridium perfringens</strong></td>
<td>10.8% (n = 148)</td>
<td>13% (n = 248)</td>
<td>16.9% (n = 403)</td>
</tr>
<tr>
<td><strong>Escherichia coli</strong></td>
<td>6.1% (n = 148)</td>
<td>&lt;1% (n = 248)</td>
<td>0.2% (n = 403)</td>
</tr>
<tr>
<td><strong>Salmonella spp.</strong></td>
<td>15.5% (n = 148)</td>
<td>27% (n = 248)</td>
<td>67.5% (n = 403)</td>
</tr>
<tr>
<td><strong>Staphylococcus aureus</strong></td>
<td>5.4% (n = 148)</td>
<td>10% (n = 248)</td>
<td>20% (n = 403)</td>
</tr>
<tr>
<td>Viruses</td>
<td>2.7% (n = 148)</td>
<td>&lt;1% (n = 248)</td>
<td>6.0% (n = 403)</td>
</tr>
<tr>
<td>Parasites</td>
<td>–d (n = 148)</td>
<td>&lt;1% (n = 248)</td>
<td>– (n = 403)</td>
</tr>
<tr>
<td>Chemical toxins</td>
<td>10.1% (n = 148)</td>
<td>&lt;1% (n = 248)</td>
<td>0.7% (n = 403)</td>
</tr>
<tr>
<td>Others</td>
<td>28.4% (n = 148)</td>
<td>19% (n = 248)</td>
<td>– (n = 403)</td>
</tr>
</tbody>
</table>

a Sources: present paper, references (4, 5, 10).

b Type 0157.
c Small round-structured viruses (SRSV).
d Indicates not determined.
DISCUSSION

Gastrointestinal complaints suspected to be due to contaminated food were reported more frequently to the Food Inspection Services in the period 1991 to 1994 than in the years before: 2,621 incidents involving 7,567 ill people were reported. In comparison with the period 1983 to 1990, the annual number of reported incidents had quadrupled from 165 to 655 (11). It seems plausible that this increase is a consequence of the introduction of the free phone number in 1991 by which incidents can be reported. Another factor may be more comprehensive reporting by the Services themselves.

The most commonly identified microorganisms were B. cereus and Salmonella spp., in 40 and 31 incidents, respectively. The types of food most commonly implicated were Chinese food and meat products. More than half of the incidents were reported to originate in a restaurant or snack bar. The mean size of outbreaks was largest in institutions, with an average number of 20.8 cases.

The data have several limitations. Large differences were found between the regional Food Inspection Services regarding number of reported incidents, distribution of the number of cases per incident, and proportion of incidents in which a microorganism was identified. Factors contributing to these differences need to be identified. The aim should be to standardize investigation and reporting of incidents of foodborne illness among the different regional offices.

From the present data it is not clear for which microorganisms food is examined in particular incidents. Some examinations, such as culture for Salmonella spp., may be performed routinely, whereas others, such as the identification of small round-structured viruses (SRSV) in faecal samples from patients may be done only in special circumstances, for instance in the case of large outbreaks in which no bacterial agent is identified. This might explain the high average number of cases in outbreaks caused by viruses. Similarly, differences between data from the UK, the USA, and The Netherlands, presented in Table 5, need to be interpreted with caution, as they may partly reflect different methods of outbreak investigation and also differences in routine testing in the laboratories.

Data from outbreaks provide limited information on the number of people affected by foodborne infections. For instance, Salmonella and Campylobacter infections are largely attributable to consumption of eggs, chicken, and pork, and only a small proportion is attributable to other routes of transmission such as food handling. The present study shows that in the period 1991 to 1994, in incidents of foodborne infection, 18 infected people were found in outbreaks attributed to Campylobacter spp., and 290 in outbreaks attributed to Salmonella spp. In laboratory surveillance approximately 3,000 cases of salmonellosis are found annually. In general practice over 17,000 cases of campylobacteriosis are seen annually, and over 5,000 cases of salmonellosis (9). On the basis of a population study, the annual number of cases of campylobacteriosis and salmonellosis is estimated at 300,000 and 100,000, respectively (7). Obviously, only a tiny fraction of these are detected by the current system of the Food Inspection Services. The fraction detected is likely to have a selection bias towards incidents arising in restaurants or snackbars, as people are less likely to call the Food Inspection Service for incidents arising at home (4).

The identification of a microorganism in food or in a kitchen does not prove that the organism was the cause of the outbreak. More convincing evidence is obtained when suspect food is implicated epidemiologically as well (5). Epidemiological evidence is obtained by comparing food histories in cases with and controls without gastroenteritis, or by comparing attack rates of gastroenteritis among people having or not having eaten particular food items. In outbreaks with more than 10 or 15 ill people, it should be possible to obtain such epidemiological evidence. The extra workload for the Food Inspection Service and Public Health Services would probably be limited, as in the period 1991 to
1994 only 66 incidents involved 15 people or more, and 107 incidents involved 10 people or more. The additional information would be very valuable, as hard evidence on food as a source of infection can contribute to control and prevention of foodborne outbreaks of gastroenteritis.

ACKNOWLEDGMENTS

We are grateful to the staff of the Regional Food Inspection Services for their collaboration and support. We gratefully acknowledge critical comments of Dr. M. J. W. Sprenger on an earlier version of this paper.

REFERENCES