AN OUTBREAK OF FOODBORNE DIARRHEAL ILLNESS AMONG SOLDIERS IN MINA DURING HAJJ: THE ROLE OF CONSUMER FOOD HANDLING BEHAVIORS

Abdulla S. Al-Joudi, MD, MSc (Epidemiology)
Department of Family and Community Medicine, College of Medicine, King Faisal University, Dammam, Saudi Arabia

Objective: An investigation of the outbreak was initiated as a result of the number of cases of gastroenteritis reporting to a general hospital in Mina during the pilgrimage to Makkah (HAJJ). This study was conducted to identify the source of the outbreak, assess its extent, and make recommendations to prevent similar outbreaks in the future.

Methodology: A case was defined as any individual who developed diarrhea with or without abdominal pain after eating at the camp in Mina on 3rd January 2006. A retrospective cohort study was conducted to identify food items and circumstances responsible for this outbreak. Laboratory tests included stool cultures of all diarrhea patients, and rectal swabs from all food handlers were cultured for enteric pathogens.

Results: A total of 50 Saudi Male Soldiers were interviewed. Out of these, 16 (39%) had developed gastroenteritis, most commonly manifested by diarrhea (100%), and abdominal colic (87.5%). The mean incubation period was 12.6 ± 4.9 hours and the epidemic curve suggested a common point source outbreak. Out of three served meals, lunch was found to have a statistically significant association with illness (p=0.0230). Out of five food items served, rice was the only food item found to have a statistically significant association with illness (p=0.0230). No food remnants were found for sampling. All results of stool cultures of all diarrhea patients, and rectal swabs from all food handlers were inconclusive.

Conclusions: This outbreak was most likely caused by eating contaminated rice served at lunch on 3rd January. The most likely organisms were Bacillus cereus, and/or Clostridium perfringens. Consuming food that was kept at an unsafe temperature without being reheated was the most probable important factor leading to this outbreak.

Key Words: Foodborne Outbreak, Saudi Arabia, Hajj, Consumer behaviors.

Correspondence to:
Dr. Abdullah S. Al-Joudi, P.O. Box 31987, Al-Khobar, Saudi Arabia
E-mail: draljoudi@yahoo.com
INTRODUCTION
Foodborne disease outbreaks (FBDO) are recognized by the illness of individuals usually within a short but variable period of time after a common meal.¹ A national policy for reporting, notifying, and recording incidents of bacterial food poisoning in Saudi Arabia was established in 1984.²³ Since then, food poisoning outbreaks exhibiting seasonal and regional variations have been reported from different regions of the Kingdom.²⁴ Food poisoning outbreaks associated with mass catering are not rare, and have been reported even from developed countries.⁶

A high number of outbreaks is reported in the Hajj period (the pilgrimage to Makkah) in Saudi Arabia. The number of food poisoning incidents in the Hajj season for the last 12 years ranges from 44 to 132.⁷ These incidents are the result of too many factors. The influx of people from all over the world with different cultures, beliefs, and behavior, present the problem of food handling, especially when food hygiene standards are compromised and some people are not accustomed to foodborne pathogens.⁸⁹

Food handlers are known to play an important role in food safety and in the transmission of foodborne infections since they are likely to introduce pathogens into foods during production, processing and distribution.¹⁰ In fact, asymptomatic food handlers have been incriminated in many food poisoning outbreaks.¹⁰⁻¹²

Background
On ⁴ᵗʰ January 2006, a number of soldiers with gastroenteritis symptoms, including diarrhea, and abdominal cramp, presented to Emergency Department of a General Hospital in Mina after consuming a meal provided at their camp on ³ʳᵈ January 2006. The hospital reported the incident to Makkah Directorate of Health Affairs which in turn reported it to the Hajj Preventive Medicine Committee. On ⁵ᵗʰ January the author was requested to investigate this outbreak.

Objectives
This study was conducted to identify the source of the outbreak of gastroenteritis, to assess its extent, and to make recommendations for the prevention of similar outbreaks.

METHODOLOGY
Study area and population
Mina is a holy place where pilgrims settle for a few days to perform their rituals. All the cases came from one tent occupied by 50 soldiers located in a government camp in Mina. The camp was served by a catering company that prepared and distributed three meals daily (breakfast, lunch, and dinner).

Source of information
In order to make a preliminary assessment of the situation, to develop the case definition and generate a hypothesis, and design the questionnaire, the investigator met the doctors, nurses, and health inspectors who dealt with the situation. The Emergency Department records were reviewed, and a preliminary list of the names of patient’s was obtained.

Case definition
For the purpose of this investigation, a case of food poisoning was defined as “any individual who developed diarrhea with or without abdominal pain, and vomiting after eating at the specified tent in the specified camp in Mina on ³ʳᵈ January 2005.”

Study design
Since the outbreak occurred very rapidly, in a small well-defined population, it was decided that a retrospective cohort study¹³ to identify food items and other factors responsible for the outbreak be conducted.

Data collection
The soldiers were personally interviewed, using a structured questionnaire that enquired about demographic data, symptoms of gastroenteritis, date and time of meal, date and time of onset of symptoms, food items eaten, and history of hospitalization and any recent history of diarrheal illness.

An open-ended interview was conducted with the food handlers from the catering company. Information on the list of food items prepared, ingredients, preparation techniques, method of preservation of each food item and the job description of each food handler were obtained. The food-handlers were then examined for their level of personal hygiene, external injuries, presence of skin infections, and validity of health certificate. The municipal team visited and inspected the food preparation site for general sanitation. Laboratory tests included stool cultures of all diarrhea patients, and rectal swabs from all food handlers. All specimens were
Statistical analysis
Epi-Info program for windows, (version 3.2.2), was used for data entry, tabulation and analysis. Tables were constructed to compare the attack rates (AR) of gastroenteritis for persons exposed and unexposed to each food item, followed by a calculation of relative risks (RR) as a measure of association. Statistical significance of an association was taken as <0.05 and 95% confidence intervals (95% CI) were estimated.

RESULTS
All soldiers, all of whom were Saudis, from the suspected tent participated in the study. Their ages ranged from 21 to 48 years with a mean age of 33.9 ± 7.4 years. All participants shared the same suspected meals.

Sixteen (39%) out of the 50 participants met the case definition. Apart from diarrhea (100%), other common symptoms included abdominal colic (87.5%), nausea (25%), headache (18.8%), and vomiting (6.3%).

Out of 16 patients, 10 (62.5%) sought medical care, but none of them required hospitalization. All patients recovered with no complications or death. The mean incubation period was 12.6 ± 4.9 hours (median = 12.3 hours, range = 3 to 22.5 hours). The epidemic curve suggested a common point source outbreak (Figure 1).

Table 1 shows that out of the three meals served on 3rd January 2005, lunch was the only meal that had a statistically significant positive association with the illness (RR= infinity, $X^2 = 5.16$, $p = 0.023$). All those who developed symptoms had eaten lunch. None of the soldiers who had skipped lunch that day reported any symptoms.

Table 2 shows that out of the five food items served at lunch, rice was the only food item that had a statistically significant positive association with the illness (RR= infinity, $X^2 = 5.16$, $p=0.023$).

Based on the interview with the cases, lunch was served at 12 o’clock. A few minutes after that, soldiers were asked to carry out an urgent assignment. The assignment was terminated about an hour late. The food left in the tent without any air conditioning for a period ranging from 1 to 4 hours, with a mean of 2.8 ± 1.8 hours, was consumed without being reheated.

According to the Municipal health inspectors report, the food preparation hall, the floor and tables were clean. No food remnants were available for sampling at the time of inspection. The interview with the restaurant staff revealed that they were well-trained and had valid health certificates. The preparation of the meal in question and food items was proper. The rice and meat were cooked separately but served in the same dish. The laboratory results of stool samples of patients and food handlers were inconclusive.

Figure 1: Epidemic curve of gastroenteritis cases in the Mina camp in Makkah, Hajj season 3rd January 2006 (N=16)
Table 1: Attack rates and relative risk for meals served in the Mina camp in Makkah on 3rd January 2005 (N=50)

| Food items | Ate | Did not eat | X² | RR | 95% CI  | p-value |
|------------|-----|-------------|----|----|---------|---------|
|            | Ill/total | AR (%) | Ill/total | AR (%) |         |         |
| Breakfast  | 7/23 | 30.4 | 9/27 | 33.3 | 0.95 | 0.91 | 0.40-2.07 | 0.8266 |
| Lunch      | 16/41 | 39.0 | 0/9 | 0 | 5.16 | Infinity | - | 0.0230 |
| Dinner     | 3/11 | 27.3 | 13/39 | 33.3 | 0.14 | 0.82 | 0.28-2.37 | 0.7035 |

Table 2: Attack rates and relative risk for food items served in lunch in Mina camp in Makkah on 3rd January 2005 (N=50)

| Food items | Ate | Did not eat | X² | RR | 95% CI  | p-value |
|------------|-----|-------------|----|----|---------|---------|
|            | Ill (total) | AR (%) | Ill (total) | AR (%) |         |         |
| Rice       | 16/41 | 39 | 0/9 | 0 | 5.16 | Infinity | - | 0.0230 |
| Meat       | 15/40 | 37.5 | 1/10 | 10 | 2.78 | 3.75 | 0.56-25.12 | 0.0954 |
| Dessert    | 6/12 | 50 | 10/38 | 26.3 | 2.35 | 1.90 | 0.87-4.13 | 0.1252 |
| Beans      | 5/11 | 45.5 | 11/39 | 28.2 | 1.17 | 1.61 | 0.71-3.65 | 0.2787 |
| Jew's mallow | 3/7 | 42.9 | 13/43 | 30.2 | 0.44 | 1.42 | 0.54-3.73 | 0.5066 |

DISCUSSION

Although the food samples were not analyzed and the laboratory results were inconclusive, clinical and epidemiological evidence suggests that *Bacillus cereus*, and/or *Clostridium perfringens* were the most likely causative organisms. The mean incubation period and clinical picture that indicated the absence of fever and predominance of diarrhea, and the presence of abdominal colic were compatible with the clinical presentation of *Bacillus cereus*, and/or *Clostridium perfringens*. The variation in the incubation periods could be explained by the variation in doses of inoculation, the susceptibility of the individual or quality of information.

The most likely food item that acted as a vehicle for the transmission in this outbreak was rice served at lunch on 3rd January. A statistically significant association was found between eating lunch and illness and between eating rice and illness. Rice was probably contaminated when it was kept at ambient temperature for a prolonged period of time permitting the multiplication of the causative organism. Rice is more associated with *Bacillus cereus*, while meat is more associated with *Clostridium perfringens*. However, it was not possible to discriminate between rice and meat, as the vehicle of transmission in this scenario since they were mostly eaten together. The lack of a statistically significant association between meat and illness does not rule out the possibility of cross contamination of meat with rice because they were served together on the same dish, though cooked separately.

Hillers et al reviewed the consumer food handling behaviors associated with the prevention of 13 foodborne illnesses. They found that behavior related to keeping foods at safe temperatures is of primary importance in preventing illness caused by *Bacillus cereus* and *Clostridium perfringens* and of secondary importance in preventing illness caused by *Staphylococcus aureus*. In this incident, patients, who were all male, reported that they had consumed the food that was kept at an unsafe temperature without being reheaet. This behavior according to a recently published Meta-analysis was found to be a major risk factor for developing a foodborne diarrheal illness among males.

The lack of food samples, inconclusiveness of laboratory results, and the possibility of recall bias are among the limitations of this study.

CONCLUSION

It can be concluded that contaminated rice eaten on 3rd January was the vehicle for this foodborne outbreak and the most likely organisms were *Bacillus cereus*, and *Clostridium perfringens*. Consuming food that was kept at an unsafe temperature without being reheated was the most important factor that probably led to this outbreak.

RECOMMENDATION

An improvement in consumer food-handling behavior through effective health education programs is likely to reduce the risk and incidence of foodborne disease. To prevent future outbreaks, a number of steps were suggested. Food must be kept at temperature above 60°C if it is to be served within a few hours. Those requiring refrigeration should be stored at temperatures no higher than 7°C to avoid the multiplication of pathogens. Proper training...
of food handlers for this can prevent foodborne disease transmission.\textsuperscript{19,20} Hajj related health education and training programs that emphasize the importance of proper food handling practices, personal hygiene, and food sanitation need to be conducted. Strict hygienic conditions during food preparation for large numbers of people, proper food delivery, and hygienic handling as well as temperature control during serving are strongly recommended.

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