Outbreak of food borne *Salmonella* among guests of a wedding ceremony: The role of cultural factors

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**ABSTRACT**

**Objective:** In response to a large number of cases of gastroenteritis reporting to Sulyyel hospital, an outbreak investigation was conducted to identify its source, to assess its extent and to make recommendations on the prevention of such outbreaks in the future. **Material and Methods:** A case was defined as any individual who developed diarrhea with any of the following symptoms: Abdominal pain, fever or vomiting within three days of eating at the wedding ceremony. A retrospective cohort study was conducted to identify food items and circumstances responsible for this outbreak. **Results:** A total of 283 individuals were interviewed, 88 of whom developed gastroenteritis, most commonly manifested by diarrhea (100%), abdominal pain (94.3%) and fever (86.4%). The majority of persons interviewed were Saudis (89.1%) and 21.6% were males. The median incubation period was 20.6 ± 2.77 hours and the epidemic curve suggested a common point source outbreak. Out of 9 food items and drinks served at the wedding ceremony, 3 food items were significantly associated with illness: meat ranked first (RR=16.7, 95% CI=2.37-115.8), followed by rice (RR=13.6 95% CI=1.95-93.61), and restaurant made sweets (RR=1.9, 95% CI=1.35-2.58). Out of 62 stool samples collected from cases, 40 (64.5 %) grew *Salmonella* group C non-typhoid. **Conclusion:** *Salmonella* was considered the causative agent of this food-borne outbreak. Meat and rice served at the wedding party were the food items incriminated. Time, temperature misuse, inadequate heat treatment, and unhygienic handling were the most important factors causing this outbreak.

**Key words:** Food borne, outbreak, *Salmonella*, Saudi Arabia, wedding

**INTRODUCTION**

Food borne diseases including, food borne intoxication and infections, are terms applied to illnesses acquired through the consumption of contaminated food; they are frequently and inaccurately referred to as food poisoning. The incidence becomes an outbreak only if the illness occurs within a short but variable period of time after a meal during which individuals have consumed foods in common.\(^1\)

In Saudi Arabia, a national policy for reporting, notifying, and recording incidents of bacterial food poisoning was established in 1984.\(^2,3\) Since then, *Salmonella* food poisoning outbreaks have been reported from different regions all over the kingdom, exhibiting seasonal and regional variations with a rate of 211.6 cases per month.\(^4,5\)

A three-year period analysis of food poisoning cases, from 1991 to 1993, illustrated that *Salmonella* species was the second most common causative agent of food poisoning in Saudi Arabia. Chicken, meat, and rice were the most commonly incriminated food items.\(^7\)

In another review, it was observed that in the Eastern Province, *Salmonella* species was the most commonly recovered organism, responsible for 34% (45 of 134) of food poisoning outbreaks occurring over a 6-year period, from 1991 to 1996.\(^8\)

*Salmonella* species has been found responsible for many outbreaks published in the Saudi Epidemiology Bulletin.\(^9,20\) This might not be considered representative of the food poisoning outbreaks in the community, but it shows clearly the large burden of salmonellosis.

In response to a large number of patients with symptoms of gastroenteritis, including diarrhea, vomiting, abdominal...
pain and fever, presenting to Sulyyel hospital after attending a wedding party, a report was sent to the Riyadh Directorate, which in turn reported the incident to the Department of Food Borne Diseases in the Ministry of Health (MOH). Accordingly, an investigation was initiated.

The objectives of this study were to identify the source of the outbreak, to assess its extent, and to suggest recommendations to prevent the occurrence of similar outbreaks in the future.

**MATERIALS AND METHODS**

Sulyyel is a small town located 400 kilometers to the southwest of Riyadh city and 40 kilometers to the west of the Empty Quarter. It belongs administratively to the Riyadh region and the Riyadh Directorate of Health Affairs. Sulyyel's population is about 30,000. The health services are composed of one general hospital, three primary health care centers, two private clinics, and one private pharmacy.

The wedding ceremony was held on a vacant plot of land surrounded by houses in the eastern area of Sulyyel. The dinner was served in two sitting, first at 10 pm and the second at 2 am in the small hours of the next morning. In the second shift, the left-over food from the first shift was served along with what had been set aside for the second sitting.

In order to obtain a preliminary idea of the situation, develop the case definition, and design the questionnaire, the investigating team met the Director of the hospital along with the doctors, nurses, and health inspectors involved. The Emergency Department records were reviewed, the admitted patients were interviewed and some of the party guests were met. A preliminary list of patient's names, addresses, telephone numbers and names of treating health facilities was prepared and the active surveillance kept by the hospital was reviewed. In addition, the health care workers at the private clinics and pharmacy were interviewed.

The health care workers and the local team had already visited and inspected the general sanitation of the restaurants; as well as the cleanliness of the food preparation site, storage area, and utensils. They had already taken swabs randomly from different sites such as tables, utensils, and refrigerators. Stool cultures were requested for all diarrhea patients and Salmonella isolates were serogrouped at the MOH central laboratory. Rectal swabs were taken from all the nine food handlers and cultured for enteric pathogens including Salmonella at the MOH central laboratory.

Epi-Info program (version 6.04 b), and SPSS (version 10.0), were used for data entry, tabulation and analysis. Tables were constructed to compare the attack rates (AR) of gastroenteritis for persons exposed and not exposed 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**

A total of 238 guests were interviewed. Their ages ranged from two to 80 years with a mean age of 23.5 ± 15.11 years and a median age of 20 years. Of all those interviewed, 126 (52.9%) were female and 112 (47.1%) were male.

All persons interviewed ate at the wedding ceremony. Out of the number, 120 (50.42%) ate at 10 p.m., and 118 (49.58%) ate at 2 a.m. Of those who ate at 10 p.m., 12 (10%) were females, and of those who ate at 2 a.m. 114 (96.6%) were females. Of the guests, 57 (23.9%) ate left-over food, and 181 (76.1%) did not. Among those who ate the left-over food, 53 (93%) were females, and of those who did not eat the left-over food, 73 (40.3%) were females [Table 1].

Of all those interviewed, 88 (37%) persons fulfilled the case definition. Among the patients, 19 (21.6%) were males and 69 (78.4%) were females. All patients developed diarrhea,
with other common symptoms of colicky abdominal pain (94.3%), fever (86.4%), vomiting (64.8%), headache (48.9%), and nausea (30.7%). Of the 88 patients who became sick after the meal at the ceremony, 78 (88.6%) sought medical care. All patients recovered with no complication or death. The mean incubation period was 20.6 ± 2.77 hours (median = 21 hours, mode = 24, range = 3-78 hours). The epidemic curve suggested a common point source outbreak [Figure 1].

Twenty-eight of the patients (31.8%) ate at 10 p.m., and 60 (68.2%) at 2 a.m. Of those who ate at 10 p.m., 11 (39.3%) were females, while 58 of those who ate at 2 a.m. (96.7%) were females. Fifty-three of the patients (60.2%) ate left-over food, and 35 (39.8%) did not. Of those who ate the left-overs, 49 (92.5%) were females, and among those who did not eat left-overs, 20 (57.1%) were females [Table 1].

Out of nine food items and drinks served at the wedding ceremony, three food items were significantly associated with the illness; meat ranked first (RR=16.7, 95% CI=2.37-115.8) then followed by rice (RR=13.6, 95% CI=1.95-93.61) and restaurant made sweets (RR=1.9, 95% CI=1.35-2.58). [Table 2].

Of those who ate at 10 p.m., 28 (23.3%) became ill, and among those who ate at 2 a.m., 60 (50.8%) became ill (RR=2.18, 95% CI=1.51-3.15). Of those who ate left-over food, 53 (93.0%) became ill as compared to 35 (19.5%) who did not (RR=4.81, 95% CI=3.54-6.53).

As shown in the stratified analysis in Table 3, sickness rates after eating rice or meat rose substantially among those who ate at 2 a.m., as compared to those who ate these foods at 10 p.m., and same pattern was observed for the consumption of the remnants as compared to the fresh food. However, despite the obvious pattern, the presence of zeros in certain comparisons made it impossible to calculate all the relative risks.

Salmonella group C non-typhoid was isolated from 40 (64.5%) of the 62 patients from whom stool samples were collected.

None of the nine restaurant workers had a valid health certificate. All the restaurant workers had Salmonella group C non-typhoid in their stool samples. According to the health inspector's report, the food preparation room, the floor and tables were not clean; the ambient temperature was high and there was no air-conditioning. The food

### Table 1: Gender-wise distribution of eating practices and disease status among guests

| Eating practices | Females No. (%) | Males No. (%) | Total |
|------------------|-----------------|---------------|-------|
| Total number of guests | 126 (52.9) | 112 (47.1) | 238 |
| Time of eating | | | |
| 10 pm | 12 (10.0) | 108 (90.0) | 120 |
| 2 am | 114 (96.6) | 4 (3.4) | 118 |
| Ate left-overs | | | |
| Yes | 53 (93.0) | 4 (7.0) | 57 |
| No | 73 (40.3) | 108 (59.7) | 181 |
| Total number of patients | 69 (78.4) | 19 (21.6) | 88 |
| Time of eating | | | |
| 10 pm | 11 (39.3) | 17 (60.7) | 28 |
| 2 am | 58 (96.7) | 2 (3.3) | 60 |
| Ate left-overs | | | |
| Yes | 49 (92.5) | 4 (7.5) | 53 |
| No | 20 (57.1) | 15 (42.9) | 35 |

### Table 2: Attack rates and relative risk for food items served (N=238)

| Food items          | Ate the food item | Did not eat the food item | Relative risk | 95% CI |
|---------------------|-------------------|---------------------------|---------------|-------|
|                     | Ill/Total         | Attack rate               | Ill/Total     | Attack rate |           |
| Meat                | 87/200            | 43.5                      | 1/38          | 2.6         | 16.7      | 2.37-115.8 |
| Rice                | 87/206            | 42.2                      | 1/32          | 3.1         | 13.6      | 1.95-93.61 |
| Restaurant made sweets | 46/88            | 52.3                      | 42/150        | 28          | 1.9       | 1.35-2.58  |
| Home made sweets    | 13/30             | 43.3                      | 75/208        | 36.1        | 1.2       | 0.77-1.88  |
| Soft drinks         | 33/92             | 35.9                      | 55/146        | 37.7        | 0.95      | 0.68-10.34 |
| Coffee              | 15/80             | 18.7                      | 73/158        | 46.2        | 0.4       | 0.25-0.66  |
| Tea                 | 12/79             | 15.2                      | 76/159        | 47.8        | 0.3       | 0.18-0.55  |
preparation room was connected by a backdoor to a toilet at the back of the restaurant. The swabs taken from the restaurant were positive for coliforms. No food consumed during the wedding was available for sampling at the time of inspection.

Based on the interview of the restaurant staff, it was found that the preparation of the food in question started at 1 p.m., on the day of the wedding ceremony. The meat was cut up and cleaned in pots filled with warm water, using bare hands (without gloves). It was then kept in large dishes at room temperature until 4 p.m., when it was boiled in large pots for two hours. At 4 p.m., the rice was washed in deep pots filled with cold water, again using bare hands and was kept in strainers for two hours. At 6 p.m., the meat was put onto large plates, covered with aluminum foil and kept at room temperature for one hour. At the same time, the rice was mixed with rice and kept over very low heat for two hours. At 9 p.m., the food was transported to the site of the wedding in a pickup truck. At 10 p.m., the food was served onto large serving dishes and served initially to the male guests. The remaining food was kept in the large pots and/or on the dishes covered with aluminum foil until 2 a.m., when it was served in the second session along with some of the food left from first sitting, to the female guests without reheating.

**DISCUSSION**

Occurrence of *Salmonella* food-borne infections is an acknowledged phenomenon in Saudi Arabia. For example, in a three-month period, the Riyadh Health Directorate reported 153 cases of Salmonellosis every month.[6] However, isolated events turn into outbreaks when the number of consumers increase. Among the different possible scenarios, outbreaks of food poisoning that are associated with marriages and other parties are not rare events,[11,19] and have been reported even from developed countries.[21]

Although food samples were not analyzed in the outbreak reported here, the clinical, laboratory, and epidemiological data point to the *Salmonella* group C non-typhoid as the most likely causative organism of this outbreak. The clinical picture - with predominance of diarrhea in all patients and the presence of fever in 86% of patients in addition to the mean incubation period - is compatible with the clinical presentation of *Salmonellosis*.[1,22,23] The variation of incubation periods observed could be explained by the differences in doses of inoculation, the susceptibility of the individual or quality of information.

Food handlers are known to play an important role in food safety and in the transmission of food borne infections, since they may introduce pathogens into foods during production, processing and distribution.[24] As all food handlers denied any recent history of diarrhea, before or after the wedding ceremony, isolation of *Salmonella* from stool samples from all of them indicate their role as asymptomatic carriers. In fact, asymptomatic food handlers have been incriminated in many food poisoning outbreaks.[24,25]

*Salmonella* can survive on the fingertips for at least three hours. Inocula of less than 100 organisms per finger can lead to contamination of 90% of handled foods, which is sufficient to cause an explosive outbreak.[25] When

| Food items / Time of eating | Ate the food item | Did not eat the food item | Relative risk | 95% CI      |
|----------------------------|------------------|--------------------------|--------------|------------|
| Rice                       |                  |                          |              |            |
| 10 pm                      | 28/120 (23.3)    | 0/0 (NA)                 | -            | 3.17-151.9 |
| 2 am                       | 59/86 (68.6)     | 1/32 (3.13)              | 21.9         | 0.14-3.55  |
| Meat                       |                  |                          |              |            |
| 10 pm                      | 27/117 (23.1)    | 1/3 (33.3)               | 0.69         | 0.14-3.55  |
| 2 am                       | 60/83 (72.3)     | 0/35 (0)                 | Infinity     | -          |

Table 3: Risk of illness for rice and meat served, stratified for food serving time and consumption of food left over

| Food items / Left over usage | Ate left over | Did not eat left overs |
|-----------------------------|--------------|------------------------|
| Rice                        |              |                        |
| Ate left over               | 34/150 (22.6)| 1/31 (3.32)            | 7            | 1.0-49.4   |
| Did not eat left overs      | 53/56 (94.6) | 1/0 (0)                | Infinity     | -          |
| Meat                        |              |                        |
| Ate left over               | 34/144 (23.6)| 1/37 (2.7)             | 8.74         | 1.13-58.8  |
| Did not eat left overs      | 53/56 (94.6) | 1/0 (0)                | Infinity     | -          |
food is contaminated with fecal bacteria from hands, the contamination level is usually very low. *Salmonella* can multiply rapidly in temperatures ranging from 7 to 46 degrees centigrade.\(^{[23]}\) A serious hazard arises only if the bacteria are allowed to multiply to a high level, under adverse storage conditions, as it was in this outbreak.\(^{[28]}\)

The traditional way of serving food first to the males and then serving the remaining food, which was not stored properly to the females might have allowed such multiplication to occur. This led to the massive outbreak among female guests who formed the majority of the people affected. This is an example of how certain traditions can influence food handling and increase the risk of outbreaks of food borne diseases.

The most likely food items that acted as a vehicle for the transmission of *Salmonella* in this outbreak were meat and rice. A significant association was found between the consumption of meat and rice and illness. The two food items were probably contaminated during preparation, transportation, and/or serving, since both were cooked at a temperature exceeding 75°C for more than 12 minutes, conditions under which *Salmonella* do not survive.\(^{[27]}\) However, it was not possible to determine whether rice or the meat, was the source of infection, since they were eaten together.

Most outbreaks of food poisoning are associated with forms of mass catering, whether the food is eaten in situ or purchased for later consumption.\(^{[29]}\) The preparation of more than 700 meals within 24 hours in a small ill equipped restaurant is risky. The problem could have occurred as a result of the food not being kept at the proper temperature for a lengthy period. In this instance, the food handlers, with their poor food and personal hygiene, prepared, transported, served, and re-served without proper reheating about 300 meals in less than 12 hours.

It can be finally concluded that the causative organism of this food borne outbreak was *Salmonella*. The contaminated rice and meat were the vehicle for the transmission of the organism, and an asymptomatic carrier was the source of the organism. Non-adherence to temperature regulation, inadequate heating practices, and unhygienic handling were the most important factors that led to this huge outbreak.

To prevent such future outbreaks, a number of steps are suggested. Food must be kept at the proper temperatures, either above 60°C or below 7°C. Foods that require refrigeration should be stored at temperatures no higher than 7°C to avoid multiplication of pathogens and production of toxins.\(^{[20]}\) Proper training of food handlers can prevent the transmission of food borne disease.\(^{[30]}\)

A nationwide health education and training programs that emphasize the importance of proper food handling practices, personal hygiene, and food sanitation must be conducted. Food handlers who are excreting *Salmonella* in their stools should not handle food until their stools are clear of pathogens. It is strongly recommended that extreme care should be taken particularly when small restaurants cater for large numbers of people. The food should be delivered in well-equipped trucks and properly handled when being served.

Though some years have elapsed since this outbreak and study, we feel obliged to have this paper published because of its importance as an exploration of the cultural factors in an outbreak of food-borne disease and its impact on public health. In addition, the systematic approach to outbreak investigation as demonstrated in this paper will help in the daily practice of epidemiologists and the specialists in community medicine.

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