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Foodborne Disease Outbreak Associated with Eating *Gaajar Halwa* at a Wedding – Palghar District, Maharashtra, India, 2018

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Abstract

Background: A foodborne disease outbreak among wedding attendees from Makunsar village, Palghar district, Maharashtra state, India, was reported on February 18, 2018.

Objectives: The outbreak investigation was conducted to find out the epidemiology of the outbreak and to identify the etiologic agent and risk factors.

Methods: A case–control study was carried out, where cases (patients), controls, and food handlers were interviewed and leftover foods were collected for culture. A case was defined as a person having vomiting or diarrhea (i.e., ≥3 loose stools within 24 h) who attended the wedding ceremony at Makunsar village, Palghar district, Maharashtra, on February 18, 2018. Attack rate and odds ratio (OR) were calculated with 95% confidence intervals (CIs).

Results: Out of 75 cases, 63% were female. Altogether, forty-two (56%) cases were hospitalized, and later on, all of them were discharged from hospital without any mortality. About 93%, 68%, 43%, and 41% of the cases reported with vomiting, nausea, abdominal pain, and diarrhea, respectively. The median incubation period was found to be 4 h (range: 2–8 h). Eating *gaajar halwa* (carrot pudding) was significantly associated with illness (OR: 12.8; 95% CI: 3.5–46).

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Conflicts of interest

There are no conflicts of interest.

Gaajar halwa is prepared with *khoa*, a perishable milk product. The *gaajar halwa* culture yielded no growth.

Conclusion: The case-patients' clinical presentation and incubation period were consistent with enterotoxin-producing *Staphylococcus aureus* as the probable etiologic agent. The epidemiologic investigation identified the probable etiologic agent and food source in a low-resource community setting. Community food handlers were educated on food preparation hygiene and safe storage measures to prevent future outbreaks.

Keywords

Foodborne diseases; gaajar halwa; India; outbreak investigation; Staphylococcus aureus; vomiting

Introduction

Foodborne diseases are a public health problem worldwide. The World Health Organization estimated that 600 million foodborne disease cases and 420,000 deaths occurred worldwide in 2010.[1] Despite vast underreporting in India, 554 acute diarrheal disease outbreaks, including 242 foodborne disease outbreaks, were reported during 2017.[2] Most foodborne outbreaks are not investigated because of a lack of resources and training, and etiologic agents and food sources are rarely identified or reported.

On February 18, 2018, the Palghar District Surveillance Unit in Maharashtra state generated an early warning signal after two primary health centers reported clusters of acute diarrheal disease cases. The district surveillance team initiated an investigation to find out the epidemiology of the foodborne diseases along with to identify the etiologic agent and risk factors.

Materials and Methods

Case finding

A case was defined as a person having vomiting or diarrhea (i.e., ≥3 loose stools within 24 h) who attended a wedding ceremony at Makunsar village, Palghar district, Maharashtra, on February 18, 2018. Records at two health facilities were also scrutinized to identify more cases in Makunsar and two nearby villages.

Case–control study

A case–control study was conducted with one control per case, to identify potential food sources for the outbreak. Controls were wedding attendees and neighbors of cases from the same village, who were not ill. Cases (patients) and controls were interviewed using a semi-structured questionnaire to collect data on sociodemographic characteristics, food consumption at the wedding, time of illness onset, clinical presentation and outcomes, and treatment history.

Environmental assessment

The host of the wedding ceremony and the relatives from Makunsar village were interviewed to explore food safety and hygiene practices during the event. Food handlers from Makunsar village were also interviewed to find out the cooking process and food storage practices during community gatherings. Food samples of *gaajar halwa,* paneer, and dal rice that remained after the wedding ceremony were collected and were sent to the state health laboratory for *Salmonella, Shigella*, *Staphylococcus aureus*, *Bacillus cereus,* and *Vibrio cholerae* testing.

Data analysis

Data were analyzed using Epi Info™ software, version 7.1 developed by Centers for Disease Control and Prevention, Atlanta, Unites States of America (USA) (available at http://www.cdc.gov/epiinfo).[3] Categorical data were expressed in proportions, while continuous data were expressed in median. Association between food items eaten and occurrence of acute illness was calculated overall and separately for different sexes. Exposure to different food items eaten and calculated odds ratios (ORs) with 95% confidence intervals (CIs) were compared between themselves. A *P* value 0.05 or less was considered as statistically significant.

Ethical considerations

The investigation was a public health response to an outbreak as part of the India Epidemic Intelligence Service Programme, undertaken with the purpose to identify the source of spread for immediate control of outbreak and intended for benefit of the community at large. Ethical approval is not applicable as part of public health response. The investigation did not involve any human laboratory sample collection for research purposes, and there were no invasive investigations or medical interventions/experiments. Ethical principles and guidelines as laid down by the Indian Council of Medical Research were maintained during the outbreak response: the investigation was aimed at achieving public good (beneficence) and collective welfare (solidarity); no harm was done to any individual (nonmaleficence); fair, honest, and transparent (accountability and transparency); and participants' data were de-identified prior to analysis (confidentiality).

Results

Descriptive study

Altogether 75 cases were identified without any mortality. About forty-seven (63%) cases (patients) were female. The median age of cases was 38 years (range: 4–85 years). All 75 cases had eaten lunch at the wedding and reported illness between 3 and 10 p.m. on the same day [Figure 1]. The wedding lunch was served from 12 to 5 p.m. on February 18. The median incubation period for illness was 4 h (range: 2–10 h). The attack rate was 13% (75/600) among the wedding guests.

Of the 75 cases, 92% (69) reported vomiting, 67% (50) reported nausea, and 43% (32) and 41% (31) cases complained of abdominal pain and diarrhea, respectively. Seventy-four (99%) cases sought medical care from two health facilities. Out of the 74 cases who

sought medical care, 57% (42) of them were admitted and all were discharged within 12 h after admission. Cases were treated with oral rehydration solution (62 [84%]), injectable antiemetics (65 [88%]), oral antibiotics (56 [76%]), and intravenous rehydration fluids (23 [31%]). No stool specimens were sent for laboratory testing.

Case–control study

Overall, 59 cases and 59 controls were enrolled in the case–control study as case: control as 1:1. Only consumption of *gaajar halwa* (carrot pudding) was found to be associated with illness (OR: 12.8) [Table 1]. In stratified analysis by sex, association of eating *gaajar halwa* with illness was found to be much higher among females (OR: 23.1) compared to males (OR: 7.7) [Table 2].

Environmental investigation

The wedding caterer cooked the food in a temporary kitchen in an open space near the wedding host's house. Raw food and water were procured from the local market. The food handlers did not practice regular handwashing after handling raw food, after using washrooms, or after touching food preparation surfaces.

The wedding caterer reported that *gaajar halwa* was prepared the evening before the wedding with raw carrots, sugar, and milk cooked together on medium heat until the milk evaporated. The carrot mixture was stored at room temperature for approximately 12 h. Before the wedding lunch, *khoa*, a perishable milk product, was added to the carrot mixture and cooked on low heat until the *khoa* melted. The *gaajar halwa* was served warm at the wedding. Five kilograms of *khoa* had been procured a day before the wedding from an unauthorized local vendor and refrigerated. No information was available about the source of the raw milk or pasteurization. The date of preparation of the *khoa* was also uncertain. We were unable to screen food handlers for illness or assess temporary kitchen operations. No pathogens (i.e., *Salmonella*, *Shigella*, *S. aureus*, *B. cereus*, and *V. cholerae*) were isolated from the food samples of *gaajar halwa,* paneer, or dal rice that were tested.

Discussion

A point-source foodborne disease outbreak was investigated at a wedding lunch that was associated with eating *gaajar halwa* (carrot pudding) prepared from *khoa,* a perishable milk product. The clinical presentation and short incubation period were consistent with heat-stable enterotoxin-producing *S. aureus* as the etiological agent. Because toxin testing for *S. aureus* is not readily available in India and many other low-resource settings, we relied on the epidemiologic findings to identify the probable etiologic agent.[4,5] The association between eating *gaajar halwa* and illness was stronger in women compared to men. In most of the community gatherings in rural India, including weddings, women eat after men. Women might have received a higher dose of enterotoxin if the *gaajar halwa* was kept for a longer duration of time after preparation or women might have eaten larger quantities of *gaajar halwa* than men. The onset of illness did not differ between women and men. *Khoa* is a perishable milk product that is widely used across the Indian subcontinent as a base for sweets. *Khoa* is conducive to bacterial growth due to the high nutritive value and

high water activity.[6] *S. aureus* can grow in *khoa* under a wide range of conditions.[6,7] In addition, higher microbial loads have been detected in milk products from local vendors compared to registered dairies in India.[8] Many unauthorized small-scale vendors sell milk products that do not meet food safety regulations for the treatment and storage of milk.[8] Foodborne diseases from locally prepared milk products, such as *khoa*, are common because milk is often not pasteurized, not refrigerated, and not prepared in hygienic conditions.[6,8] Foodborne outbreaks where *S. aureus* is implicated as the etiologic agent are usually due to food handlers; food is contaminated during preparation due to unhygienic practices. The investigation of foodborne outbreaks provides an opportunity to identify gaps in food safety controls across the food supply chain.[9,10] The district surveillance response team did not include representation from the food safety department for this outbreak investigation. They should be included and involved in future foodborne outbreak investigations to facilitate traceback of the source food through the supply chain, testing of food and environmental samples by the state laboratory, and for providing food safety education for both vendors and consumers.

The findings are subject to several limitations. Wedding guests might not have accurately recalled the lunch foods they ate when interviewed several days after the event. We could only test three foods that were left from the wedding for common foodborne pathogens; the state health laboratory did not have the capacity to test for enterotoxins. Finally, we were unable to assess food preparation practices or test the *khoa.*

Conclusion

This point-source foodborne disease outbreak associated with eating *gaajar halwa* at a wedding underscores the importance of timely epidemiologic investigations to identify the responsible food source and probable etiologic agent and to inform local public health actions. We conducted an educational session for community members and food handlers on hygiene practices and food safety measures to prevent future outbreaks.

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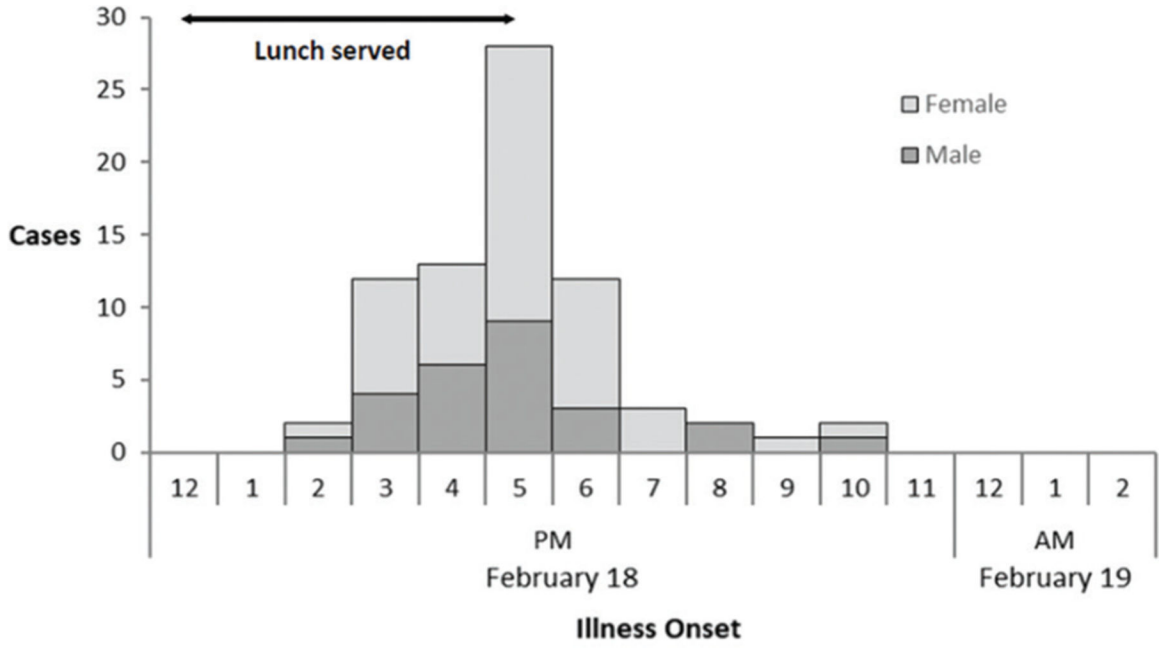

Figure 1:
Epidemic curve of 75 foodborne disease cases by time of illness onset among wedding attendees in Makunsar village, Palghar district, Maharashtra, India, on February 18–19, 2018.

Table 1:

Comparison of lunch items eaten among cases and controls during a wedding in Makunsar village, Palghar district, Maharashtra state, India, on February 18, 2018

Food or drink	Percentage of cases exposed* (*n*=59)	Percentage of controls exposed (*n*=59)	Odds ratio (95% CI)
Gaajar halwa	95	59	**12.8† (3.6–46)**
Paneer	76	68	1.5 (0.7–3.4)
Dal rice	98	90	6.5 (0.8–56)
Water	73	85	0.5 (0.2–1.2)
Papad	58	68	0.6 (0.3–1.4)
Pickle	29	34	0.8 (0.4–1.7)
Okra fry	51	65	0.6 (0.3–1.2)
Green salad	47	69	**0.4 (0.2–0.8)**
Kothimbir vadi	41	66	**0.3 (0.2–0.7)**
Poori aloo	32	61	**0.3 (0.1–0.6)**
Pineapple juice	14	34	**0.3 (0.1–0.8)**
Cabbage	7	19	0.3 (0.1–1.1)

*Persons who ate selected food or drink items.

†Bold text indicates statistical significance. CI: Confidence interval

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Table 2:

Comparison of lunch items stratified by sex among cases and controls during a wedding in Makunsar village, Palghar district, Maharashtra state, India, on February 18, 2018

Food or drink	Percentage of cases exposed* (*n*=34)	Females percentage of controls exposed (*n*=34)	Odds ratio (95% CI)	Percentage of cases exposed (*n*=25)	Males percentage of controls exposed (*n*=25)	Odds ratio (95%CI)
Gaajar halwa	97	59	**23.1† (2.8–189)**	92	60	**7.7 (1.5–40)**
Paneer	68	68	1.0 (0.4–2.8)	88	68	3.4 (0.8–15)
Dal rice	97	94	2.1 (0.2–24)	96	81	5.9 (0.6–54)
Water	71	79	0.6 (0.2–1.9)	76	92	0.3 (0.0–1.5)
Papad	59	68	0.7 (0.2–1.8)	56	68	0.6 (0.2–1.9)
Pickle	26	44	0.4 (0.2–1.2)	32	20	1.9 (0.5–6.8)
Okra fry	53	68	0.5 (0.2–1.4)	48	60	0.6 (0.2–1.8)
Green salad	35	71	**0.2 (0.1–0.6)**	64	68	0.8 (0.3–2.7)
Kothimbir vadi	32	62	**0.3 (0.1–0.7)**	52	72	0.4 (0.1–1.3)
Poori aloo	24	62	**0.2 (0.1–0.5)**	44	60	0.5 (0.1–1.6)
Pineapple juice	12	35	**0.2 (0.1–0.9)**	16	32	0.4 (0.1–1.5)
Cabbage	3	15	0.2 (0.0–1.6)	12	24	0.4 (0.1–1.2)

*Persons who ate selected food or drink items.

†Bold text indicates statistical significance. CI: Confidence interval