BRIEF REPORT

An outbreak of Salmonella Enteritidis food poisoning following consumption of chicken shawarma: A brief epidemiological investigation [version 1; peer review: awaiting peer review]

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Abstract

Background: Shawarma, a popular meat-based fast food could be a source of foodborne outbreak due to non-typhoidal Salmonella. A clustering of acute gastrointestinal (GI) illness following intake of chicken shawarma occurred primarily among the staff and students of a tertiary care hospital in southern India.

Methods: A case-control study was conducted among 348 undergraduate medical students (33 cases, 315 controls). Data was collected using direct interviews and a simple online questionnaire. Epidemiological associations of GI illness were evaluated at three levels of exposure namely - eating food from any restaurant, eating food from the implicated food outlet, eating chicken shawarma from the implicated outlet.

Results: Of 33 cases, 26 had consumed food from a particular food outlet, 4 from other outlets, and 3 did not report eating out. Consumption of food from the suspected food outlet was significantly associated with GI illness (odds ratio 121.8 [95% CI 28.4 to 522.7]; P <0.001); all the 26 cases who had eaten from the particular outlet had eaten chicken shawarma. In comparison, only one of the 315 controls had eaten this dish. Of the 27 persons (cases as well as controls) who had consumed chicken shawarma from the outlet, 26 fell ill. Culture of stool samples from 10 affected individuals and implicated food item yielded Salmonella Enteritidis.

Conclusions: Thus, it can be concluded that meat-based shawarma is a potential source of NTS infection.
Keywords
Salmonella Enteritidis, foodborne disease outbreaks, gastroenteritis

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Introduction
Shawarma is a meat-based dish of Middle Eastern origin.¹ It has become a popular food item across many countries including India. Nontyphoidal Salmonellae (NTS) are known to contaminate meat and poultry products resulting in foodborne disease outbreaks.² There have been a few recent reports of foodborne disease outbreaks related to NTS contamination of chicken shawarma.³⁻⁵ A few countries have issued guidelines for safe preparation and serving of shawarma.⁶⁻⁷ but such guidelines do not exist in many developing countries. Further, foodborne disease outbreaks are often under-reported, and the necessary epidemiological investigations are not always carried out.⁸⁻⁹ Here, we report an epidemiological investigation of a foodborne disease outbreak caused by consumption of chicken shawarma, which mainly affected the students and staff of a teaching hospital.

Methods
Setting
This brief outbreak investigation was carried out during the months of July and August 2019 at the Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, India. Since the data was collected as part of an outbreak investigation which was a mandatory public health exercise, an exemption from review was granted by the Institute’s Ethics Committee. The participating subjects were aware that their data was being collected as part of a foodborne disease outbreak investigation which was a mandatory public health exercise. However, since the decision to publish the findings was taken many months after the outbreak investigation, an informed consent for publication was not explicitly taken.

Index case
The index case was a postgraduate resident who presented to the emergency department at 4 AM on July 22nd, 2019 with abdominal pain and multiple episodes of diarrhea which started about 7.5 hours after consuming biryani (a mixed rice dish) and chicken shawarma (a Middle Eastern dish made of thinly sliced cuts of meat marinated and cooked after stacking in a vertical skewer) from a food joint near the hospital. The index case developed high grade fever and multiple episodes of vomiting after hospital admission. Subsequently over the next 2 days, 19 more cases were admitted with similar illness, of whom 16 were either students or staff of the hospital. Three of the admitted cases reported about 6 other episodes of vomiting after hospital admission. Over the next 2 days, 19 more cases were admitted with similar illness at other health facilities, thus making the total number hospitalized cases to 26. All 26 cases reported consuming chicken shawarma from the same outlet.

Evaluation of cases
Patients who were admitted in Department of Medicine with the history of acute onset fever and gastrointestinal symptoms such as diarrhea and vomiting after consumption of chicken shawarma from the suspected food outlet on the dates July 22nd -July 24th were categorized as cases. Clinical history was collected through direct interview from individuals who were still hospitalized when data collection started and through telephonic conversation from individuals who could not be directly interviewed. The clinical history of those who were treated in pediatrics department of our institution for similar gastrointestinal complaints and also a few individuals treated elsewhere were obtained from patients who were admitted in Department of Medicine and who happened to share the chicken shawarma meal.

Confirmation of cases for NTS infection
Stool samples of 14 hospitalized individuals could be submitted for the microscopic examination. Primary culture of stool samples as well as a specimen taken from shawarma which was obtained from the restaurant on the same day were carried out. Cultures were done in MacConkey, XLD, DCA, TCBS with selenite F enrichment and alkaline peptone water. Identification of the bacterial colonies were done using matrix assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF MS version 3.2, VITEK MS, Biomerieux). Stool polymerase chain reaction (PCR) was done using Eppendorf AG HAMBURG 22331 for identifying diarrheagenic E. coli and Campylobacter spp.

Case-control study
We conducted a case-control study for confirming the source of contaminated food. Since undergraduate medical students belonging to the third to ninth semesters constituted a major proportion of affected individuals, we considered them representative of the population at risk. We collected information from them by direct interview (202 individuals) which was carried out by meeting the third to ninth semester students when they assembled for scheduled theory classes. Those who could not be directly interviewed (146 individuals) were requested to fill up a web-based (Google forms) questionnaire which was circulated through the respective classes’ social media groups. The data was collected over the time period from July 25th to August 2nd, 2019. We asked three questions: 'Where did you have your dinner on July 21?‘ (the day prior to presentation of index case); ‘What did you eat?’; and ‘Did you have any gastrointestinal (GI) symptoms in the form of abdominal pain, vomiting or diarrhea during the index dates from July 22 to 24?’. We defined cases as those who presented with GI symptoms on dates July 22nd -24th irrespective of need for hospital admission. Controls were those who reported no GI symptoms. We compared the odds illness at 3 levels of exposure
among cases and controls at 3 levels. At each level the odds ratio was calculated as ratio of odds of illness in the exposed group to the odds of illness in the non-exposed group. Level 1 was eating at any place other than their hostel or home on July 21\textsuperscript{10}; Level 2 was consumption of any food item from the suspected food outlet on July 21\textsuperscript{10} among those who ate outside; and Level 3 was consumption of chicken shawarma among those who had dined at the suspected outlet. To assess the causality of the observed epidemiological association, we applied the Bradford Hill’s criteria adopted for foodborne disease outbreaks.\textsuperscript{10}

**Results**

Of the 26 individuals who sought medical attention in our hospital and elsewhere, 17 were male and 9 were female. Their median age was 22 (18–25) years. The median (IQR) incubation period of symptom onset was 9.5 (8–12) hours.

Apart from the index case and his co-diner who had taken biriyani along with chicken shawarma from the implicated restaurant, the other 24 people had consumed only chicken shawarma. All cases had greenish loose watery diarrhea. Of 26 cases, 23(88.5\%) had high grade fever and vomiting and 25(96.1\%) had abdominal pain. Of the 20 cases admitted at our center, 3 required intensive care unit admission because of severe dehydration. All admitted patients recovered completely and were discharged home.

**Stool examination**

Microscopic examination of the stool samples was done for 14 affected individuals. In 13 individuals it revealed pus cells without any ova or cysts. In 10 patients, the stool culture revealed black colonies, which were identified as subsp. enterica serovar Enteritidis. *Salmonella* Enteritidis was also isolated from the shawarma sample. Stool PCR was negative in all 14 cases.

The case-control study involving undergraduate students identified 7 more cases of GI illness (not requiring hospitalization), thus taking the total number of cases to 33. Among the 33 cases, 26 had consumed food from the particular food outlet, 4 had consumed food from other outlets, and 3 did not report eating out (Table 1). Consumption of food from the implicated outlet was significantly associated with GI illness (odds ratio 121.8 [95\% CI 28.4 to 522.7]; \(P < 0.001\)); 26 of 27 persons who had consumed chicken shawarma from that outlet developed GI illness. Applying the Bradford Hill’s criteria, the observed association was deemed to be causally linked; only the criterion of biological gradient was not fulfilled (Table 2).

**Discussion**

We found that the outbreak of gastroenteritis caused by *Salmonella* Enteritidis was epidemiologically linked to the consumption of contaminated chicken shawarma from a particular food outlet. Gastroenteritis outbreaks caused by NTS have been previously reported from India and other countries.\textsuperscript{11–13} Poultry meat contamination by NTS is also reported.\textsuperscript{14} Importantly, a study from Jordan found high rates of contamination of chicken meat used in shawarma by *Salmonella* spp.\textsuperscript{15} Previously, an NTS (*Salmonella* Thompson) outbreak caused by consumption of chicken shawarma was reported from Canada.\textsuperscript{3} Microbial contamination of shawarma can occur during the storage, cooking and serving of the meat. Generally, NTS does not survive high temperatures when the cooking process is adequate. However, the important step of

### Table 1. Association of gastrointestinal (GI) illness with varying levels of exposure among cases and controls.

|            | GI illness present | GI illness absent | Odds ratio (95\% CI) | \(P\)-value |
|------------|--------------------|------------------|----------------------|-------------|
| **Level 1**|                    |                  |                      |             |
| Ate food from outside | 30                 | 79               | 29.9 (8.9–100.6)     | <0.001      |
| Did not eat food from outside | 3             | 236              |                      |             |
| **Level 2**|                    |                  |                      |             |
| Ate food from the suspected food outlet | 26              | 4                | 121.8 (28.4–522.7)   | <0.001      |
| Did not eat food from the suspected food outlet | 4             | 75               |                      |             |
| **Level 3**|                    |                  |                      |             |
| Ate chicken shawarma from suspected food outlet | 26           | 1                | 123.7 (4.2–3665.8)   | <0.001      |
| Did not eat chicken shawarma from suspected food outlet | 0            | 3                |                      |             |
secondary cooking of cut slices of meat might be overlooked when the food outlet becomes busy. It is important that food safety authorities enforce guidelines for safe preparation and sale of shawarmas and similar products.

Two important steps helped in quick containment of the outbreak in our setting: early identification of the contaminated food source and timely intimation of food safety authorities for prohibitory action. Also, since the contaminated food sample was procured while it was still on sale, we could isolate NTS from the source. Moreover, we demonstrated the epidemiological link by performing a case-control study.

One possible limitation of our investigation was that we could not obtain specimens for microbiological testing from the food handlers and the water used for cooking could also not be tested. Notwithstanding, our report helps to highlight shawarma as a potential source of food poisoning.

**Conclusion**
In conclusion, chicken shawarma is a potential source of food poisoning due to NTS. Epidemiological investigation of foodborne outbreaks could yield important information.

**Data availability**
**Underlying data**
Figs3hare: Foodborne disease outbreak version 2. [https://doi.org/10.6084/m9.figshare.15022065.v2](https://doi.org/10.6084/m9.figshare.15022065.v2)

This project contains the following underlying data:

Data file 1. Deepanjali salmonella data (1).xlsx (Foodborne disease outbreak version 2)

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).
Consent
The data represented in the manuscript was collected as part of an outbreak investigation. An exemption from review was granted by Institute Ethics Committee.

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