

A Sustained Epidemic of Shigellosis in Isfahan Province, 2015

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Abstract

Introduction: Shigellosis is a contagious disease with acute symptoms. Delay in detecting the disease transmission way would lead to rapid spread among the community, like what happened in Isfahan Province in April 2015. The study aimed at evaluating the Shigella bacteria transmission medium in the outbreak that occurred in Isfahan Province, Iran.

Methods: Due to evidences reported by the university health deputy, the beginning of the Isfahan shigellosis outbreak was on April 17th, and the first records of all 8600 cases were reported on April 18th. Through the interviews with Shahreza's hospitalized cases, a wedding ceremony held on April 16th with 67 guests, most of whom were affected by diarrhea. Therefore, a cross-sectional study was designed to report, overall, the Epidemic of Shigellosis and a historical cohort in order to investigate the causes of the diarrhea based on wedding ceremony data. The guest list and their phone numbers were collected from the ceremony host. Data were collected through a phone call interview. Data analyses were done by STATA13. The relative risk was calculated with 95% confidence interval using logistic regression.

Results: The response rate of the guests following up was 72% (48 of 67 guests), with 33 individuals suffering from diarrhea and 30 having eaten vegetables. Patients were from both sexes and all age groups. The relative risk of diarrhea for vegetable consumers was 4.1 (95% CI: 1.5 – 11.3, p=0.006).

Conclusion: Findings have provided strong evidences against Shigella contaminated vegetables as a risk factor and transmission agent for individuals who got diarrhea in Shigellosis outbreak of Isfahan Province in April 2015.

developed in the left eye. Two patients had no family history suspicious for keratoconus.

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Introduction

Shigella is a kind of gram negative bacillus which belongs to the Enterobacteriaceae family. Although this bacterium is a facultative organism, its best growth would occur under aerobic condition. There are four Shigella species including: *S. dysenteriae*, *S. flexneri*, *S. sonnei*, and *S. boydii*, of which the first three are glucose fermenters, and *S. sonnei* is the only one that can ferment lactose. Such fermentation feature leads to their recognition of differential environment (1). In other words, potential prebiotics are typically tested using in-vitro batch fermentation models inoculated with human fecal matter to mimic the human digestive tract environment. Such studies allow in-vitro modeling of how the composition of the human gut microbiota changes in response to prebiotic nutrients. In comparison with other pathogens, a low number of Shigella (10-100) is enough for pathogenicity.

Shigella infection is restricted to the digestive tract, and circulatory system invasion would rarely occur. Their attack on the intestine mucosal epithelial cells' cytoplasm is their main damage process (1, 2). Such intestinal bacteria cause illness in humans and other primates. The disease, which develops diarrhea and other digestive signs such as: nausea, vomiting, presence of blood, mucosa, or pus in stool sample, and muscle aches, is called Shigellosis, (3).

Some of Shigellosis transmission ways are being in touch with contaminated water, food, stool, or flies with Shigella bacteria and direct or indirect transmission through oral-fecal route. Although recovery period for healthy people who are infected by Shigella would last about five days, others who are suffering from immune system deficiencies like children younger than 5, the elderly, and individuals suffering from

chronic illnesses such as HIV and cancer would face severe symptoms or even death (4).

Among bacterial gastroenteritis factors after Salmonella and Campylobacter, Shigella infection is the third in the Unites States. Shigellosis world burden is estimated to be about 165 million patients per year, of which 163 million are from developing countries. In such countries, Shigellosis infection leads to more than one million deaths each year (5, 6). Based on an assessment in the USA, this infection causes 300,000 illnesses and 600 deaths yearly (7). Another evaluation claims that Shigella contaminates 450,000 Americans per year, which brings about 6,200 hospitalizations and 70 deaths (8).

Generally, Shigella is one of the most contagious bacteria which cause diarrhea (9). Although all people are subject to shigellosis, incidence rate in specific groups, especially under-five-year-old children and those who have HIV, is higher (10). Because the infectious dose of Shigella is low, it can be transmitted by person-to-person contact more easily than other bacteria. It also can spread out amongst people through contaminated water and food as it grows in the human intestine (1).

This research aimed to detect ways of Shigellosis transmission in the spring 2015 epidemic in Isfahan Province, Iran, which, in turn, led to providing recommendations for health centers about taking drastic measures to control and overcome such epidemics of Shigella.

Methods

Based on the report by the health deputy of Isfahan University of Medical Sciences, the beginning of the outbreak was likely on April 16th 2015 in Isfahan. First records of

overall 8600, were reported on April 20th. Through the interviews with Shahreza hospitalized cases, done by the epidemic assessment team, a wedding ceremony held on April 16th with 67 guests, most of whom were affected by diarrhea, was identified. As a result, a cross-sectional study was designed to report, overall, the Epidemic of Shigellosis and a historical cohort in order to recognize the risk factors and causes of diarrhea for the individuals who attended the wedding ceremony. The list of guest names and their phone numbers were collected from the ceremony's host. The study population in this retrospective cohort study was the people who participated in the wedding ceremony which was held on April 16th.

Data were collected through a phone call interview, and a few of the main questions were: 1. what did you eat in the ceremony? 2. Have you suffered from diarrhea and been hospitalized? Individuals' age and sex were also recorded. Finally, it was made sure that none of ceremony participants were suffering from diarrhea before the party.

To make sure of the Shigellosis outcome, hospital records of each patient was evaluated. At the hospital, stool test was used to diagnose Shigellosis outcome during the 24 hours after the wedding party for those who had faced Shigellosis clinical signs and sought care which led to hospitalization.

As a result of patients' interview (wedding guests and host) consumption of vegetables served in along with the dinner meal was known as the probable transmission factor of Shigellosis. The host said that he had bought the vegetables on 15th April 2015. Interviewing the host led the researchers to a

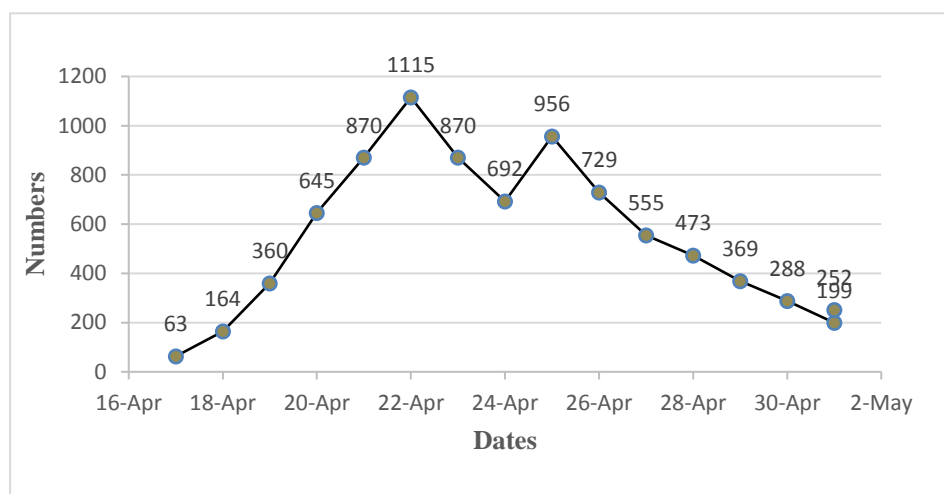
greengrocery location in Shahreza fruit and vegetable market. The information taken from the greengrocer revealed that the vegetables sold on April 15 had come from Isfahan's main fruit and vegetable market.

The province health department experts sampled remaining vegetables of Isfahan fruit and vegetable market and sent them to the laboratory. The test analysis of sampled vegetables confirmed contamination of vegetables with *S. flexneri*. Based on the evidence, the vegetables were defined as an exposure factor in this study. Since, consumption of sewage-contaminated water could be another shigellosis risk (transmission) factor, the Public Health School research team analyzed several water samples from the research zone.

Data analysis was done by STATA13. Relative risk was calculated with 95% confidence interval using logistic regression.

Results

The total number of patients suffering from diarrhea in Isfahan from 17/4/2015 to 26/4/2015 were 8600 (internal report from Isfahan Health Centre). Figure 1 illustrates the trend over the above-mentioned period with in modes. The first mode on April 21st, was an explanatory of people's direct exposure with pathogen (consumption of contaminated vegetable) and the latter, on April 25, showed bacteria transmission from patients to healthy people. The short period of outbreak could be due to the existence of just one exposure factor, which was removed over the period in figure 1.



Figur 1. Diarrhea outbreak trend in Isfahan Province, April 2014

The response rate of guests following up was 72% (48 of 67 guests), of which 33 suffered from diarrhea and 30 had eaten vegetables. Patients were from both sexes and all age groups. The relative risk of diarrhea for vegetable consumers was estimated as 4.1 (95% CI: 1.5 – 11.3, $P=0.006$) (Table 1) which was a strong evidence for the vegetable's role in *Shigella* bacteria transmission. Among the 48 wedding ceremony attendees, 23 (48%) were female, of which 18 (78.3%) were affected by diarrhea, and among 25 males, 15 (60%) developed diarrhea. Multiple logistic regression model included consumption of vegetable, gender and age. The consumption of vegetable was the only significant predictor of diarrhea. ; therefore, the univariate model was only reported (Table 1).

It should be mentioned that all water samples analysis results were negative, and, hence, drinking water could not be considered as a mode of *Shigella* bacteria transmission for this outbreak.

Table 1. Percent of patients with diarrhea in terms of vegetable consumption in Shahreza wedding ceremony on April 27, 2015

Diarrhea			
Vegetable	Suffered	Not suffered	Total
Consumed	30 (88.2)	4 (11.8)	34 (70.8)
Not consumed	3 (21.4)	11 (78.6)	14 (29.2)
Total	33 (69.7)	15 (31.3)	48

Relative Risk (RR) = 4.1 (95% CI: 1.5 – 11.3)

Discussion

Our findings showed individuals who ate vegetables were more than 3 times at diarrhea risk (RR=4.1, 95% CI: 1.5 – 11.3, $p = 0.006$). Drinking water tests were negative, and our hypothesis that contaminated vegetables irrigated with wastewater were the main mode of *Shigella* bacteria transmission in the outbreak was confirmed. Through this cohort study, we found that the contaminated vegetables irrigated with wastewater, were distributed on 14th and 15th of April in Isfahan and Shahreza fruit and vegetable markets. People including participants of the wedding ceremony, (which was held a day after the distribution of contaminated vegetables) had eaten contaminated vegetables.. Furthermore,

no other risk factor has been found. Therefore, contaminated vegetable was introduced as a risk factor in Shigella bacteria transmission.

Our findings were supported by several studies including a report which discussed Shigellosis outbreaks in those Nordic countries. Their indication was in connection with imported fruit and vegetables which were contaminated and consumed raw or half cooked. Such food stuffs were contaminated with Shigella bacteria through being in touch with infected people who were responsible for food packaging or being irrigated with sewage contaminated water (11, 12).

In 2009, a second report from Norway's (11) extensive outbreak was released. Cohort study results represented the contamination of raw materials of pesto sausage in a deli and the consumption of this sausage by a banquet's participants as this Shigellosis outbreak's agent. Shigella Sonnei was the pathogenic agent in this outbreak.

In another outbreak, which happened in 1994 in Portland (13), the factor for both Shigellosis and E.coli O157 was the drinking of fecal-contaminated water. In fact, the case group involved those who swam longer than controls who came to the same park on picnic.

In this study, we could only follow up wedding ceremony guests who were not suffering from Shigellosis before the party. Despite the strength points of this research in following up ceremony guests, we had pitfalls of inability to interview all 67 attendees of the wedding ceremony, which led to the 70% response rate and the inability to measure the precise age due to the telephone interview. Another weakness was the

inability to study all incidence cases of the epidemic; in case that were possible, we could have studied many more exposed and unexposed individuals and may have had a more precise estimation of the relative risk of developing diarrhea. The reason of this pitfall was the delay in the action of the health care surveillance system, which did not react in time, when early cases were diagnosed and hospitalized, to notify the outbreak. This led to the increase in the number of secondary patients. Therefore, the separation between primary and secondary cases, those who got ill because of direct contact with bacteria through consuming vegetables and those who were infected through person-to-person contact, was impossible.

Conclusion

The findings of this study have provided strong evidences that vegetables played a role of transmission medium for individuals who got diarrhea in the Shigellosis outbreak of Isfahan Province in April 2015.

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