Journal of Disaster & Emergency Research
http://jder.ssu.ac.ir
J Disaster Emerg Res
2018; 1(1): 5-13

Surveillance of Foodborne Illnesses in Association with Ecological Conditions in Yazd Province, Iran

Mohammad Hassan Ehrampoush [1], Mohammad Mehdi Soltandallal [2, 3]
Abbas Ali Dehghani Tafti [4], Mehdi Yaseri [5], Farzaneh Aminharati [6*]

[1] *Department of Environmental Health Engineering, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran*
[2] *Department of Food Microbiology, School of Public Health, Tehran University of Medical Science, Tehran, Iran*
[3] *Food Microbiology Research Centre, Tehran University of Medical Sciences, Tehran, Iran*
[4] *Departments of Disaster and Emergency Health, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran*
[5] *Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran*
[6] *International Campus, Shahid Sadoughi University of Medical Sciences, Yazd, Iran*

ARTICLE INFO

ORIGINAL ARTICLE

Article history:
Received: 23 Des 2017
Revised: 7 Jan 2018
Accepted: 10 Feb 2018

***Corresponding author:**
Farzaneh Aminharati

Address:
International Campus, Shahid Sadoughi University of medical Sciences, Yazd, Iran

Email:
shahrood2005@yahoo.com

Tel:
+98-21-42933047

ABSTRACT

Introduction: The role of surveillance system is to support the early identification of diseases by monitoring the ecological conditions such as climatic events, natural disasters, and demographic parameters in order to access timely public health functional responses. Food and water supply quality are the essential factors in foodborne illness incidence rates that might be influenced by environmental conditions. Therefore, detecting unacceptable numbered cases suffered from foodborne illness in Yazd touristic province of Iran was considered as the main goal of this study.

Methods: The methodology of investigation was recognizing the gastrointestinal illness relationships with temporal climatic parameters in scattered parts of the Province during (2012-2016) by multilevel regression analysis model. The analyses were done using Stata software, version 14.

Results: The output of analyses indicated that relative humidity, rainfall, and dust suspended condition have been in association with the cases of foodborne illness in different cities of the Province and the highest rate of illness was in summer.

Conclusion: The ecological conditions have various roles on foodborne disease incidence rates in different cities of Yazd province. Therefore, further investigations are needed for detecting the regional climatic impacts and more important epidemiologic factors should be considered for the control of foodborne diseases.

Keywords: Climate Change, Foodborne Diseases, Epidemiology, Yazd, Iran

Introduction

The surveillance role in burden illness analyses, elimination, and eradication of the disease outbreak is fundamental to improve the national health policy that aimed at reducing public health risks. Therefore, detecting the outbreak sources and contaminant factors are essential requirements for risk management strategies, in order to ensure food control throughout the food chain (1, 2).

The associations of climatic variations with foodborne illness incidence rates are valuable evidences for future predicting models of disease outbreak patterns that can be used in

Citation: Ehrampoush MH, Soltandallal MM, Dehghani Tafti AA, Yaseri M, Aminharati F. **Surveillance of foodborne illnesses in association with ecological condition in Yazd Province, Iran**. Journal of Disaster & Emergency Research. 2018; 1(1): 5-13.

environmental event response. Moreover, one of the common ways for multi antimicrobial resistant transmissions is food chain that by timely control strategies can reduce the originated contaminants of food sources (3-5).

Climate change influences the ecological condition, so dynamics of diseases may be changed due to epidemiological changes in wildlife-associated infectious disease. Furthermore, the warmer summer can affect the lifecycle of wildlife that increase the rates of disease in hunted wildlife; therefore, the food security of rural food reliant to wildlife is decreased based on new environmental variations (6).

The influence of environmental changes on disease transmission refers to seasonal warming of sea-surface temperature which may enhance the growth and transition pathways of microorganisms. This relationship with *El Niño* was obvious in Bangladesh during 18-years period (7).

The socio-economic conditions are the important factors in ecological foodborne disease incidence rates. Therefore, the WHO launched a 20-year program in foodborne disease surveillance that was consequences of socio-economic impacts on outbreak rates (8).

The most information of foodborne disease incidence rates usually comes from surveillance data that can be collected in outbreak reports and little information is available about the sporadic case incidence rates, so many cases might be misleading than enlightening. The differences among countries in foodborne disease reports is reflected from differences in types of community food habits that can be varied over time due to immigration of populations and the differences in lab diagnostic methods by various surveillance systems (9).

Foodborne illnesses are various based on the etiological agents and ecological conditions of hosts in the world. Salmonellosis is a major zoonotic bacterial foodborne illness in the worldwide that microbial causative agent of disease isolated from food chain and transmit by farm products, raw meat, vegetables, and dairy products; therefore, it is considered as a threat to human's health (10).

The habitat wildlife living in farms like raccoons was one of the significant evidence for Zoonosis Salmonellosis in Ontario foodborne disease outbreaks during 2011–2013 (11). In addition to the ambient temperature rising that was associated with various disease outbreaks in developed countries, some of risk factors such as monthly international travels increased the none-typhoid serotype Salmonellosis in Canada during the 2010–2011 (12, 13).

Shigella spp. and Entrotoxigenic *E.coli* (*ETEC*) are the serious causes of diarrhea in children, adults and travelers of endemic regions that spread by fecal-oral, human-to-human contact, and contaminated food or water resource. High rates of mortality and morbidity related to Shigellosis reported based on different geographical ranges, case definitions, and age groups in china caused the public health necessarily needs for vaccinate decision-making (14). The annual severity flooding might play an important role in spreading shigellosis in geographical scattered parts of the world. Therefore, the first report of relationship between the El Niño–Southern Oscillation *(ENSO)* and dysentery was used in existing disease surveillance data from Shandong Province, China (15). Shigellosis, the only large-scale epidemic acute dysentery in the world, caused high rates of death in the east and center of Africa in 1992. Moreover, Shigellosis outbreaks that reported in Orthodox Jewish community of the Antwerp Belgium in the beginning of April 2008 have been associated with the endemic Shigellosis in Israel (16). Therefore, based on the latest investigations it can be concluded that *Shigella* spp. foodborne diseases are the most probable fetal agents due to patient sensitivity and private nature of specific communities (17).

Citrobacter freundii gastroenteritis is the other foodborne disease related to ecological condition that caused hemolytic uremic syndrome in 152 patients of the Germany's institutional nursery school in 1995 (18). The last research on *Citrobacter freundii* outbreaks showed that increased rates of foodborne disease during summer months in adult and child patients have been related to fecal pollution of drinking water sources and food (19, 20). Recently the transmissions of *Citrobacter* spp. had been detected as infectious agents in air-particles that can be considered as etiologic agents of current foodborne diseases (21).

The Enterotoxigenic *Escherichia coli* (*ETEC*) is the causative agent of travelers' diarrheal disease outbreaks in developing country that can be transmitted by food or water. The *ETEC* foodborne illness might be unrecognized from viral gastroenteritis, but by clinical symptoms and duration of illness as well as routine lab diagnostic methods, it can be differentiated from viral gastroenteritis or other etiologic agents of gastroenteritis illnesses (22).

Accordingly, communities may be posed to risks of new infectious diseases in new conditions of life positions by food and water sources. Therefore, surveillance systems should be prepared to new scenario of disease outbreaks by using last records of infectious causative agents (2, 23). The main objective of this study was detecting the various demographic and climatic parameters which impact foodborne illness in Yazd, a touristic Province of Iran. Therefore, multi variant information of social and environmental factors affecting risk perceptions and likelihood of exposures are utilized for future planning strategies.

Materials and Methods

Methodology of research: The present study was done in Yazd province, Iran with more than 1138533 million population and 131,575 km² area that natural geomorphologic phenomena caused climatic diversity between different parts of province levels. The province demographic information was gathered based on Iran statistical center data that classified according to age, sexuality, and type of community living (Institute and household group). Studies on patients didn't need the approval forms.

Methodology for sample collection: All gastroenteritis cases were diagnosed based on standard clinical symptoms that issued by the health ministry surveillance system of Iran. Therefore, 729 collected rectal swabs have been delivered to foodborne disease reference lab of Tehran university medical science under approved conditions with medium transport (Cary-Blair) in case of more than two hours delay.

Data collection: The relevant data have been collected instantly, based on the specific syndromes such as diarrhea, vomiting and particular infectious agents such as *Salmonella* spp, *Shigella* spp, *ETEC*, and *Citrobacter feriundii*. Therefore, the defined criteria is used to ensure that collected data were prepared based on the standardized WHO questionnaire guideline on foodborne disease outbreak by all personnel at all times, places and levels (24). Furthermore, data on foodborne diseases and their trends compared with Yazd Province gathered climatic data from National Meteorological Organization of Iran. All information such as; clinical symptoms, age, genus, and community types of each patient and metrological variables were coded in an excel sheet, version 2007.

Lab- based foodborne disease surveillance: For successful implementing of foodborne surveillance, the excellent microbiological and chemical or biochemical laboratory facilities have been used to test clinical samples. Thus, etiological agents have been detected by the information of pathogen trends at national and laboratory levels that can be analyzed by using various parameters such as age, sex, location of patients (25).

Statistical method: To quantify the magnitude extent of links between the incidence rate of foodborne illness and the potential environmental drivers such as climatic variations (temperature, humidity, and dust condition), the Poisson regression correlation was used in multilevel regression model. All statistical analyses were performed by using STATA software (Intercooled Stata 14.0; Stata Corporation, College Station, Texas) and the significance criterion was P value ≤0.05.

Results

Over a period of five years investigating on 729 cases of foodborne disease related to climatic variations in Yazd Providence, 64 cases of Salmonellosis, 68 cases of shigellosis, 91 cases of *ETEC* foodborne disease, and 57 cases of *Citrobacter freundii* foodborne disease were found in different cities of the province. Moreover the analyses outputs revealed that incidence rates of foodborne illness in 2013 and summer have been the highest rates of gastroenteritis diseases compared to other yearly seasons (**Figure 1, 2**).

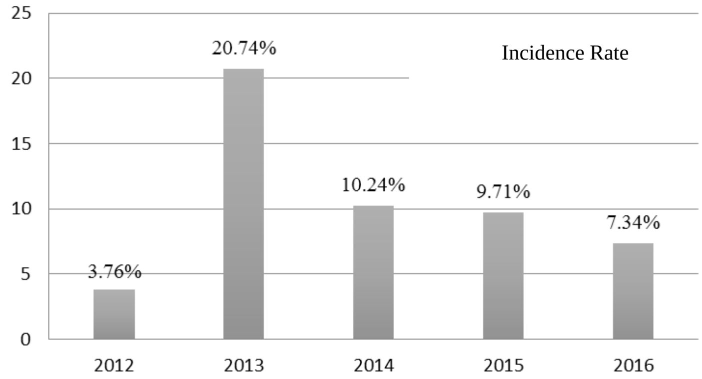

Figure 1: Incidence Rate of foodborne illness based on years

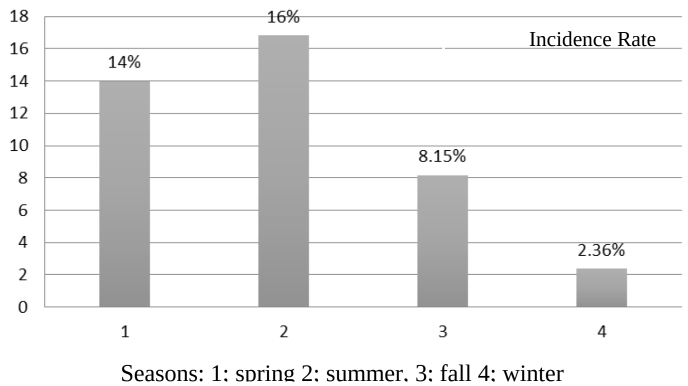

Figure 2: Incidence rate of foodborne illness based on seasons

The output of multilevel regression analyzes model determined the association between adjusted incidence rate ratio (IRR) of foodborne illness (as a depended variable) and the monthly average of climatic variables (rainfall, relative humidity, temperature, and dust conditions) as in depended variables. There was no significant relation between temperature and the IRR of foodborne illness, while the IRR of foodborne illness increased up to 4.46 by dust hovering that originated from inside of the cities and the IRR of illness increased up to 2.19 by the external originated dust compared to normal weather condition.

The analyses output revealed a considerable correlation between relative humidity and the adjusted IRR of foodborne illness. Therefore, increasing each percent of relative humidity enhanced the IRR of illness up to 1.14 times, as well as each millimeter of rainfall enhanced the IRR of foodborne disease 1.05 times in Province level (**Table1**).

Table 1: Incidence rate ratios of foodborne illness based on climatic variables

Adjusted IRR[1]	IRR	95% CI[2] Lower	Upper	P value
Air Condition				
Normal [3]	Reference			
Dust from outside [4]	2.19	1.77	2.70	<0.001
Dust from inside [5]	4.46	3.59	5.52	<0.001
Temperature	1.00	0.98	1.02	0.935
Humidity	1.14	1.10	1.19	<0.001
Rainfall	1.05	1.02	1.08	<0.001

[1] IRR: Incidence rate ratio, [2] CI: Confidence interval, Reference; [3] Normal condition of air, [4] Suspended dust that originated from outside of the cities, [5] Suspended dust that originated from inside of the cities

The temporal pattern of climatic variation showed more relationship between the geographical scattered parts of the Providence and foodborne illness. Therefore, except Mybod, Abarkooh, and Khatam, the rest of cities have been in significant correlations with IRR of foodborne illness in compared to Yazd city (**Table 2**).

Table 2: Incidence rate ratios of foodborne illness based on the different cities of Province

Cities	IRR[1]	95% CI[2] Lower	Upper	P value
Yazd	Reference			
Ashkezar	2.69	1.99	3.63	<0.001
Mehriz	2.18	1.64	2.89	<0.001
Taft	1.74	1.27	2.39	0.001
Mybod	1.09	0.81	1.45	0.569
Abarkooh	0.71	0.45	1.13	0.151
Khatam	1.37	0.93	2.03	0.114
Ardekan	1.72	1.35	2.20	<0.001
Behabad	0.04	0.01	0.17	<0.001

[1] IRR: Incidence rate ratio, [2]CI: Confidence interval

Furthermore, the scattered geographical parts of Province have been in relationships with the IR of foodborne illness that can be related to types of microbial agents and demographic factors of the different cities. Therefore, analyses consequences showed effects of age, gender, and type of communities on *Salmonella*, *Shigella*, *Citrobacter freundii*, and *Enterotoxigenic Ecoli* (*ETEC*) pathogenesis in exposed population. In most cases of foodborne illness except the *ETEC* etiological agents, the vulnerable age groups have been ≤ 5 years, and sexuality was only related to Shigellosis IRRs, while the type of community was an important risk factor only in Salmonellosis (**Table 3**).

Table 3: Incidence rate of various foodborne illnesses based on demographic parameters in Yazd Province

IR	Female	Male	Age ≤ 5	Age ≥ +60	Family Group	Social Group
Salmonella	NS	NS	8.37	0	0.31	*72.20
Shigella	1.77	1.13	15.64*	4.26	NS	NS
ETEC	NS	NS	2.95	4.78*	NS	NS
Citrobacter	NS	NS	3.06	0	NS	NS

IR: Food borne Illness Incidence Rate, NS: None Significance Relation, * Maximum Rates of Illness

Discussion

A total of 729 affiliated foodborne illnesses were reported by Yazd province's health department for 2012–2016. Most of illnesses started during the summer. One of the important reasons for this efficacy outcome might be the temperature and relative humidity rising in summer. Temperature and relative humidity can directly change the rate of pathogenic agent replications and their surviving in the environment. Since the evidence indicated a strong association between some of enteric bacteria as Salmonella proliferation species and temperature (26).

The monthly water vapor pressure means like as the other climatic factor in northeast and southern cities of china had obvious influences on foodborne outbreaks; therefore, the auto regressive integrated moving average (ARIMA) model determined the mean water vapor pressure was a high relative risk for bacillary dysentery transmissions in both regional cities (27). As a time series prediction model, the multi-level regression analysis model determined the significant correlation between relative humidity and foodborne illness IRRs in different cities of Yazd.

In Yazd Province regional scattered parts, the obvious significant correlation observed between rainfall and foodborne illness by multi-level analyses model. The other cluster analyses approach time-series Poisson regression models revealed more relationship between 10 times various degrees of floods with monthly morbidity of dysentery during 2004- 2010 in Xinxiang of China (28).

According to the study results, foodborne illness IRRs increased by dust hovering in compared to normal weather condition. The evidence of foodborne outbreaks in autumn 1931 revealed that dryness dusty summer, and dust raising winds can increase dysentery by the irritant effects of ingested dust or pathological effects of fecal wind-blown (29).

The last studies on metrological variable effects on public health in South Korea during 2011–2015 indicated that combination of temperature, relative humidity, and precipitation have been in positive correlation with foodborne disease such as Salmonellosis, Cholera, and *EHEC* O157:H7 infections, since the climatic parameters have not been always the only causative agents of foodborne infections (4). The outputs of the study showed that except the seasonal metrological variables, different regional conditions, demographic factors and various pathogens have been in close relationships with foodborne illness. So that we found the most of vulnerable groups were < 5 years and types of community or sexuality have been the effective agents on incidence rates of some foodborne illness like as Salmonellosis and Shigellosis. The *Shigella* spp. was known as common etiologic agents of diarrhea during the second year of life in South America, Africa, and Asia that most of cases have been related to infectious agent transmissions by inadequate sewage disposal (30). Furthermore, the last investigation conducted on children in the Peruvian Amazon reported an incidence of 0.34 episodes per year in children < 6 years of age groups. Therefore, the incident rate of shigellosis in children < 5 was found to be 15.64 per 100000 populations in Yazd Province levels (31, 32).

The similar studies in New Zealand and other parts of the world showed that higher rate of disease observed in males than females, while the contradicting Shigellosis rising rate observed between women and men in our study that can be related to demographic conditions and food habits of Iranian Yazd Province community (33, 34).

The county-level incidence rates of shigellosis hot spot by using geographic information system (GIS) tools determined the demographic and environmental outbreak risk factors such as (age groups, sexuality, type of community, ambient temperatures, relative humidity, distances to highways, rivers and lakes facilitated in Jiangsu Province of China (35). Furthermore, it was found that there is a significant association between some foodborne illnesses and scatter parts of Yazd Province by multilevel regression model. Therefore, the IRs of diseases have been various in different cities of Province that only shigellosis IRs in women reported higher than men and social groups have been in high risk of Salmonellosis, while the Ashkezar city was in more IRs of foodborne illness by reasons of animal husbandry.

Moreover the last study on foodborne disease surveillance in Iran during 2006-2011 reported the increased rates of foodborne disease outbreaks that rose from 0.07/100000 in 2006 to 1.38/100000 population in 2011, qua the Khuzestan, Kermanshah, and Qazvin provinces have been in high rates of outbreaks than nationally expected outbreak incidence rates in 2011. The epidemiological research during 2011 also indicated that outbreak IRs was reported more in warm months and females were more affected by foodborne illness than males (36).

Type of communities are the important efficacy factors in incidence rate of foodborne disease outbreak in last investigations and the social group that used restaurant foods can be more vulnerable to foodborne illness in compared to family groups. Many factors such as food handler carriers, and cross contaminations can contribute to increasing the risk of foodborne disease when foods are eaten in restaurants (37). Statistical analyses of the current study determined the social groups that used organized or restaurant foods have been in more IRs of salmonellosis because the healthy carriers in food handlers have known the serious reasons for salmonellosis spreading in social communities.

Conclusion

This investigation outcomes and overview on key results of the study affirmed the association of foodborne illness with many factors such as demographic features, type of community, etiologic strains of illness, location status, and climate variations that can influence the survival incubation rate of infectious agents as the impressive environmental contributor.

Acknowledgments

Particular thanks are owed to the Department of Disaster and Emergency Health, International Campus, Shahid Sadoughi University of Medical Sciences, Yazd, Iran (IR.SSU.MEDICINE. REC. 1395.127), and the Food Microbiology Research Center, Tehran University of Medical Sciences, Tehran, Iran, Contact No. 35508 for their help in conducting this study.

Funding source

This article had no financial involvement for the conduct of the research.

Conflict of interest

The authors of this study announce no conflict of interest.

Authors' contribution

All authors have contributed sufficiently in this research and are responsible for appropriate portions of the content.

References

1. World Health Organization. Manual for integrated foodborne disease surveillance in the WHO African Region. 2012. Available at [http://apps.who.int/ iris/ bitstream/ 10665/ 170262/ 1/ foodborne- disease-manual. pdf]
2. Seimenis A. Capacity building for zoonotic and foodborne diseases in the Mediterranean and Middle East regions (an intersectoral WHO/MZCP proposed strategy). International Journal of Antimicrobial Agents. 2010; 36: S75-9.

3. Sergelidis D, Angelidis AS. Methicillin-resistant Staphylococcus aureus (MRSA): A controversial food-borne pathogen. Letters in Applied Microbiology. 2017;64(6):409-418.
4. Park MS, Park KH, Bahk GJ. Combined influence of multiple climatic factors on the incidence of bacterial foodborne diseases. Science of The Total Environment. 2018; 610:10-16.
5. Griffiths E, Dooley D, Graham M, Van Domselaar G, Brinkman FS, Hsiao WW. Context Is Everything: Harmonization of Critical Food Microbiology Descriptors and Metadata for Improved Food Safety and Surveillance. Frontiers in Microbiology. 2017; 8: 1068.
6. Stephen C, Duncan C. Can wildlife surveillance contribute to public health preparedness for climate change? A Canadian perspective. Climatic Change. 2017;141(2):259-71.
7. Rose JB, Epstein PR, Lipp EK, Sherman BH, Bernard SM, Patz JA. Climate variability and change in the United States: potential impacts on water-and foodborne diseases caused by microbiologic agents. Environ Health Perspect. 2001; 109 (Suppl 2): 211.
8. Tirado C, Schmidt K. WHO surveillance programme for control of foodborne infections and intoxications: preliminary results and trends across greater Europe. J Infect. 2001;43(1):80-4.
9. Kass P H, Rieman H P. Epidemiology of foodborne diseases. In: H. P. Rieman D. O. Cliver (Eds.). Foodborne infections and intoxications, San Diego: Academic Press 2006; 3-26..
10. Xu Q, Yin Y, Liu D, Zhang J, Wu Q, Tian P, et al. Prevalence and characterization of Salmonella serovars isolated from farm products in Shanghai. Food Control. 2018;85:269-75.
11. Bondo KJ, Pearl DL, Janecko N, Boerlin P, Reid-Smith RJ, Parmley J, et al. Impact of season, demographic and environmental factors on Salmonella occurrence in raccoons (Procyon lotor) from swine farms and conservation areas in southern Ontario. PloS one. 2016; 11(9): e0161497.
12. Hoge CW, Echeverria P, Shlim D, Rajah R, Shear M, Rabold JG, et al. Epidemiology of diarrhoeal illness associated with coccidian-like organism among travellers and foreign residents in Nepal. The Lancet. 1993;341(8854):1175-9.
13. Tighe M-K, Savage R, Vrbova L, Toolan M, Whitfield Y, Varga C, et al. The epidemiology of travel-related Salmonella Enteritidis in Ontario, Canada, 2010–2011. BMC Public Health. 2012; 12(1): 310.
14. Hosangadi D, Smith PG, Giersing BK. Considerations for using ETEC and Shigella disease burden estimates to guide vaccine development strategy. Vaccine. 2017.
15. Cash BA, Rodó X, Emch M, Yunus M, Faruque AS, Pascual M. Cholera and shigellosis: different epidemiology but similar responses to climate variability. PloS one. 2014;9(9):e107223.
16. De Schrijver K, Bertrand S, Gutierrez Garitano I, Van den Branden D, Van Schaeren J. Outbreak of Shigella sonnei infections in the Orthodox Jewish community of Antwerp, Belgium, April to August 2008. Euro Surveill. 2011;16(14): 19838.
17. Curtis V, Cairncross S. Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. The Lancet Infectious Diseases. 2003;3(5):275-81.
18. Tschäpe H, Prager R, Streckel W, Fruth A, Tietze E, Böhme G. Verotoxinogenic Citrobacter freundii associated with severe gastroenteritis and cases of haemolytic uraemic syndrome in a nursery school: green butter as the infection source. Epidemiol Infect. 1995;114(03):441-50.
19. Shariatpanahi M, Anderson A. Bacterial survey of well water—Tehran, Iran. Environ Res. 1987;43(2):285-9.
20. Guarino A, Capano G, Malamisura B, Alessio M, Guandalini S, Rubino A. Production of Escherichia coli STa-like heat-stable enterotoxin by Citrobacter freundii isolated from humans. Journal of Clinical Microbiology. 1987; 25(1): 110-4.
21. Rosselli R, Fiamma M, Deligios M, Pintus G, Pellizzaro G, Canu A, et al. Microbial immigration across the Mediterranean via airborne dust. Scientific Reports. 2015;5:16306.
22. Dalton C, Mintz E, Wells J, Bopp C, Tauxe R. Outbreaks of enterotoxigenic Escherichia coli infection in American adults: a clinical and epidemiologic profile. Epidemiology and Infection. 1999;123(01):9-16.
23. Murphy HM, Prioleau MD, Borchardt MA, Hynds PD. Epidemiological evidence of groundwater contribution to global enteric disease, 1948–2015. Hydrogeology Journal. 2017; 25(4): 981-1001.
24. World Health Organization. Foodborne disease outbreaks: guidelines for investigation and control: World Health Organization; 2008.

25. Vandepitte J. Basic laboratory procedures in clinical bacteriology: World Health Organization; 2003.
26. Baird-Parker A. Foods and microbiological risks. Microbiology. 1994;140(4):687-95.
27. Li G-Z, Shao F-F, Zhang H, Zou C-P, Li H-H, Jin J. High mean water vapour pressure promotes the transmission of bacillary dysentery. PloS one. 2015; 10(5): e0124478.
28. Ni W, Ding G, Li Y, Li H, Jiang B. Impacts of floods on dysentery in Xinxiang city, China, during 2004 – 2010: a time-series Poisson analysis. Global Health Action. 2014; 7(1):23904.
29. Large D, Sankaran OK. Dysentery among Troops in Quetta. Part II D. Journal of the Royal Army Medical Corps.. 1934; 63(4). 231-237
30. Platts-Mills JA, Babji S, Bodhidatta L, Gratz J, Haque R, Havt A, et al. Pathogen-specific burdens of community diarrhoea in developing countries: a multisite birth cohort study (MAL-ED). The Lancet Global health. 2015; 3(9): e564-e75.
31. Kotloff KL, Nataro JP, Blackwelder WC, Nasrin D, Farag TH, Panchalingam S, et al. Burden and aetiology of diarrhoeal disease in infants and young children in developing countries (the Global Enteric Multicenter Study, GEMS): a prospective, case-control study. The Lancet. 2013; 382(9888): 209-22.
32. Kosek M, Yori PP, Pan WK, Olortegui MP, Gilman RH, Perez J, et al. Epidemiology of highly endemic multiply antibiotic-resistant shigellosis in children in the Peruvian Amazon. Pediatrics. 2008;122(3):e541-e9.
33. Lopez L, Carey-Smith G, Lim E, Cressey P, Pirie R. Annual Report Concerning Foodborne Disease in New Zealand. 2013. Available at [http://www.mpi.govt.nz/news-resources/publications.aspx]
34. Younus M, Wilkins MJ, Arshad MM, Rahbar MH, Saeed AM. Demographic risk factors and incidence of Salmonella enteritidis infection in Michigan. Foodbourne Pathogens & Disease. 2006; 3(3): 266-73.
35. Tang F, Cheng Y, Bao C, Hu J, Liu W, Liang Q, et al. Spatio-temporal trends and risk factors for Shigella from 2001 to 2011 in Jiangsu Province, People's Republic of China. PloS one. 2014; 9(1): e83487.
36. Asl HM, Gouya MM, Soltan-dallal MM, Aghili N. Surveillance for foodborne disease outbreaks in Iran, 2006-2011. Medical journal of the Islamic Republic of Iran. 2015; 29: 285.
37. Angulo FJ, Jones TF, Angulo FJ. Eating in restaurants: a risk factor for foodborne disease? Clinical Infectious Diseases. 2006; 43(10): 1324-8.