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Effective factors on outbreaks of food and water borne diseases in Iran: a trend analysis

Factores efectivos sobre los brotes de enfermedades transmitidas por los alimentos y el agua en Irán: un análisis de tendencias

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ABSTRACT:

Waterborne and foodborne diseases are a major global public health concern. This study was conducted to identify affecting factors on waterborne and food borne outbreaks and analyzing its trend in Iran. A descriptive cross-sectional study was carried out using waterborne and foodborne disease national surveillance system data from 2015-2016, which have been reported by all provincial health centers to the Center for Communicable Disease Control of the ministry of health. Collected data were analyzed using SPSS version 16 software. A total of 5, 500 water and food borne outbreaks reported in Iran. Analyzed data showed that the outbreak rate was 4.14/100000 in 2015 to 2.7/100000 population in 2016 in Iran. According to laboratory results, the most frequent microbial pathogens which were sources of outbreaks included *Escherichia Coli*, *Shigella*, *Entamoeba Histolytica*, *Salmonella*, *Hepatitis A virus* and *Vibrio NAG* (Non Agglutinating Groups). The highest frequency of outbreak occurred in rural areas (56.1%). The most commonly reported symptoms were abdominal pain, vomiting and diarrhea. Qazvin, Zanzan and Kermanshah were three provinces that reported more outbreaks than nationally outbreak incidence rate during 2015 -2016. Trend analysis of reported Waterborne and foodborne diseases in Iran showed a seasonal pattern, particularly increased in autumn. Occurrence of this outbreaks in many provinces with higher incidence need to root cause analysis and interventions subsequently. These interventions should be carried out both at the level of health policy-makers to set appropriate, evidence-based priorities in the area of water and food safety and at the community level. Using syndromic surveillance data for outbreak detection, active case-finding, timely diagnosis, accurate treatment, patients monitoring along with public health education are highly recommended. Rational use and prescription of drugs inhibits antibiotic resistance and can reduce the cost of therapeutic of these diseases.

KEYWORDS: Foodborne diseases, Outbreak, Surveillance system, Water borne diseases.

RESUMEN:

Las enfermedades transmitidas por el agua y por los alimentos son una de las principales preocupaciones mundiales de salud pública. Este estudio se realizó para identificar los factores que afectan los brotes transmitidos por el agua y por los alimentos y analizar su tendencia en Irán. Se llevó a cabo un estudio transversal descriptivo utilizando los datos del sistema de vigilancia nacional de enfermedades transmitidas por el agua y transmitidas por los alimentos de 2015-2016, que todos los centros de salud provinciales informaron al Centro para el Control de Enfermedades Transmisibles del Ministerio de Salud. Los datos recolectados

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se analizaron utilizando el software SPSS versión 16. Un total de 5, 500 brotes de agua y alimentos reportados en Irán. Los datos analizados mostraron que la tasa de brotes fue de 4.14 / 100000 en 2015 a 2.7 / 100000 de la población en 2016 en Irán. Según los resultados de laboratorio, los patógenos microbianos más frecuentes que fueron fuentes de brotes fueron *Escherichia Coli*, *Shigella*, *Entamoeba Histolytica*, *Salmonella*, virus de la Hepatitis A y *Vibrio* NAG (Grupos No Aglutinantes). La mayor frecuencia de brotes se produjo en las zonas rurales (56,1%). Los síntomas más comúnmente reportados fueron dolor abdominal, vómitos y diarrea. Qazvin, Zanjan y Kermanshah fueron tres provincias que reportaron más brotes que la tasa de incidencia de brotes a nivel nacional durante 2015-2016. El análisis de tendencias de las enfermedades transmitidas por el agua y por los alimentos reportadas en Irán mostró un patrón estacional, particularmente mayor en otoño. La ocurrencia de estos brotes en muchas provincias con mayor incidencia necesita un análisis de la causa raíz e intervenciones posteriores. Estas intervenciones deben llevarse a cabo tanto a nivel de los formuladores de políticas de salud para establecer prioridades apropiadas basadas en evidencia en el área de la seguridad del agua y los alimentos y en el nivel de la comunidad. Se recomienda encarecidamente el uso de datos de vigilancia sindrómica para la detección de brotes, la búsqueda activa de casos, el diagnóstico oportuno, el tratamiento preciso, el seguimiento de los pacientes y la educación de salud pública. El uso racional y la prescripción de medicamentos inhibe la resistencia a los antibióticos y puede reducir el costo terapéutico de estas enfermedades.

PALABRAS CLAVE: enfermedades transmitidas por los alimentos, brote, sistema de vigilancia, enfermedades transmitidas por el agua.

INTRODUCTION:

Water and foodborne diseases are one of the most important public health problems, Which cause a significant number of mortality in people every year¹. The outbreak of waterborne and foodborne diseases imposes enormous social and economic burden on health systems, So the safety and security of food and water is important². Foodborne or waterborne diseases are caused by consuming contaminated foods or beverages. A food or water outbreak is an incident in which two or more persons experience a similar illness after ingestion or drinking of a common food or water source with the same clinical symptoms, and epidemiologic analysis implicates the food or water as the source of the illness. Foodborne diseases have been an issue for all societies since the beginning of humanity. The types, severity and impacts of these illnesses have changed through the ages and are still diverse across regions, countries and communities⁴.

Waterborne disease is a global burden which is estimated to cause more than 2.2 million deaths pear year^{5,6}. About 1.4 millions of these deaths are children⁵. It is suggested that waterborne diseases have an economic cost associated of 12 billion dollars annually in the World⁷.

Monitoring and trend analysis of the outbreaks of waterborne and foodborne disease are necessary to prevent and control of them. This study was conducted to identify affecting factors on water and food borne outbreaks and analyzing its trend in Iran.

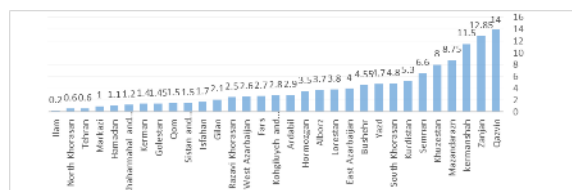
MATERIALS AND METHODS:

This descriptive cross-sectional study was carried out using waterborne and foodborne disease national surveillance system data from 2015-2016, which have been reported by all provincial health centers to the Center for Communicable Disease Control of the ministry of health. The data of waterborne and foodborne diseases' outbreaks were extracted from reports of surveillance system related to Center of Disease Control of the Ministry of Health in Iran. The data collected for each outbreak include the date of outbreak, the place of outbreak, the number of inpatient and outpatients, the agent of disease, age, gender, disease symptoms, outcomes of the disease (death or recovery), type of food consumed, type of sample used for testing, reference laboratory approval, treatment, period of outbreak, population at risk and transmission route. The validity and reliability of data collection tools has been confirmed through previous studies. The data collected for this study was approved by surveillance system related to CDC of Ministry of Health in Iran. The country's guide to the foodborne disease surveillance system was announced in 2006 by Ministry of Health to all

provinces. Data were analyzed by using descriptive and analytical statistics with SPSS software (version 16). descriptive statistics used to percentage of frequency and the Chi-square test used to show the distribution of the outbreak variables relationship between outbreak and other variables.

RESULTS:

A total of 5,500 water and food borne outbreaks reported in Iran. Analyzed data showed that the outbreak rate was 4.14/100000 in 2015 to 2.7/100000 population in 2016 in Iran.



GRAPH 1.

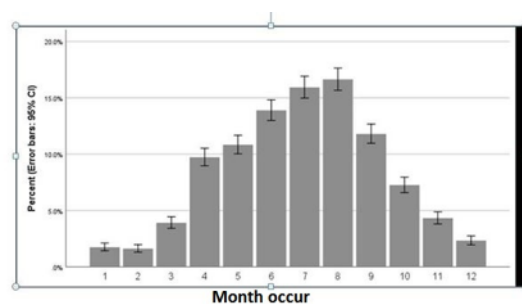
Incidence rate of foodborne disease outbreaks by provinces in Iran/100000

Qazvin, Zanjan, Kermanshah and Mazandaran were three provinces that reported more outbreaks than nationally outbreak incidence rate during 2015 -2016.

Incidence of foodborne disease outbreaks by provinces were shown in graph 1. the most frequent microbial pathogens which were sources of outbreaks included *Escherichia Coli*, *Shigella*, *Entamoeba Histolytica*, *Salmonella*, *Hepatitis A virus* and *Vibrio NAG*. The most frequent pathogen outbreak was reported by clinical diagnosis without testing of microbial pathogen included *Staphylococcus Toxin*, *Rotaviruses*, *Hepatitis A virus*, *Adenovirus* and non-microbial factors included heavy metals, chemical pesticides and alcohol.

The highest frequency of outbreak occurred in rural areas (56.1%) and urban areas (43.9%). There is a statistically significant relationship between the incidence rate of outbreaks of water and foodborne diseases and the regions of the country ($P < 0/0001$).

The most frequent of the outbreaks occurred from late summer to early winter (Graph 2). There is a statistically significant relationship between the incidence rate of outbreaks of water and foodborne diseases and the months of the year ($P < 0/0001$).

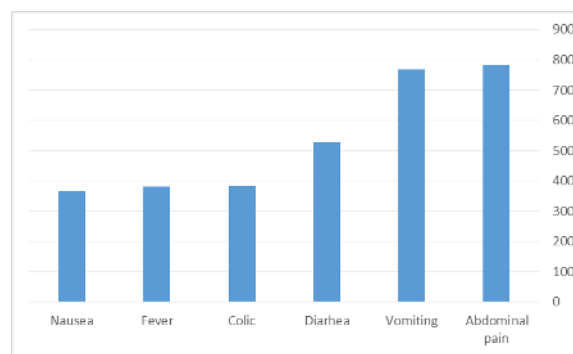


GRAPH 2.

Frequency of outbreaks by months of the year

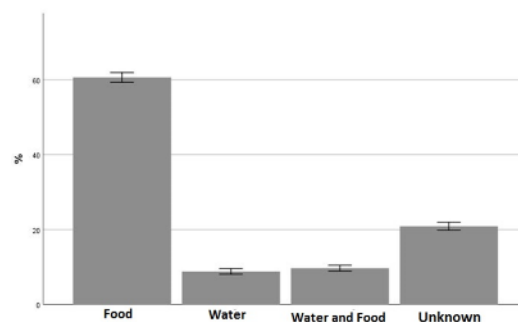
60.3% of the outbreaks occurred in 2015 and 39.7% of them occurred in 2016. The incidence rate of outbreak in the year 2016 was approximately 1.5 times lower compared to 2015. During the 5500 cases of outbreaks, 1173924 people were at risk, 2911 people were ill, 528 people were hospitalized and 4 people died.

The most common reported clinical symptoms were abdominal pain, vomiting and diarrhea (Graph 3).



GRAPH 3
Incidence of clinical symptoms

The most common way of pathogens transmission were reported through the food (60.6%), 9% of the cases were transmitted through the water, and the others (31%) did not indicate the way of transmission(Graph 4).



GRAPH 4.
Frequency of transmission route in the patients

Among 4083 cases of water samples that has been tested just 3293 (80%) samples were reported positive microbial contamination. The most prevalent microbial contamination in water was related to the Coliform, Escherichia Coli, Vibrio NAG, Rotavirus and Adenoviruses. 13.8% of the water samples cases showed the amount of Chlorine residual in water consumption was zero and in 26.4% of the cases, amount of Chlorine residual in water consumption was reported between 0.5 and 0.8 mg / liter (Table 1).

TABLE 1
The amount of residual Chlorine in water (mg / liter)

mg / liter	Frequency (Percent)
0	757(13.8)
0-0.5	1044 (19)
0.5-0.8	1452(26.4)
0.8-1	414 (7.5)
Not Measure	320 (5/8)

3833 human samples tested, only 3497 cases (90%) of the samples were positive for microbial pathogens. 640 food samples tested, only 499 cases (78%) were positive for microbial pathogens.

A total of 5, 500 water and food borne outbreaks reported in Iran. Analyzed data showed that the outbreak rate was 4.14/100000 in 2015 to 2.7/100000 population in 2016 in Iran.

DISCUSSION:

With the expansion of laboratories and identification equipment, the number of outbreaks increases but this is not necessarily due to the worsening of the health status of the community. It actually provides more accurate information about the health status of the community⁸. For example, in a country like Nigeria with 170 million population, only 90,000 cases of water and foodborne diseases are reported per year, while in a developed country with 24 million population, such as Australia, 5,200,000 cases of these diseases are registered per year. Which in fact represents an effective monitoring system in developed countries⁹.

Water and foodborne disease are as a global problem which is estimated more than 2.2 million mortality per year and more people to become ill, including diarrhea, digestive and systemic diseases¹⁰. About 1,4 million cases (63%) of these mortality About 1,4 million cases (63%) of these deaths are attributable to children due to the weakness of the immune system and the lack of familiarity with health issues, they are usually more affected by this diseases. It is estimated that the burden of these diseases is about \$ 12 billion in the world annually.. Between 2007 and 2009, 134 outbreaks of water and foodborne diseases were reported in the United States that 64% of outbreaks were caused by parasites, 21% by bacteria and 4.8% by viruses. The leading etiologic pathogen was *Cryptosporidium*, *Escherichia Coli*, *Shigella sonnei* *Pseudomonas* and *Legionella*¹¹.

Between 2015 and 2016, a total 5,500 outbreaks of water and foodborne diseases were registered in Iran. In this study, 5500 outbreaks of water and foodborne diseases the leading etiologic pathogens were *Escherichia Coli*, *Schigella*, *Entamoeba Histolytica*, *Hepatitis A virus* and *Salmonella*.

Outbreak of water and foodborne diseases happened in European Union countries especially Germany in 2011 with *Escherichia coli* with the origin of raw fruits, vegetables and beans sprouts was one of the most important foodborne outbreaks¹¹.

in the United States, The most common pathogens of Foodborne diseases outbreak were *Salmonella* (50%), *Escherichia Coli* (33%) and *Shigella* (17%)^{12,13}.

The main symptoms of disease in these outbreaks were gastrointestinal symptoms, which included Abdominal pain, Vomiting, Diarrhea, Fever, Colic, and Nausea. Abdominal pain, Diarrhea and Vomiting was identified as the most common symptom of poisoning or foodborne infections in Australia¹⁴.

Masoumi Asl et al. 38% of the outbreaks were in urban areas and 62% in rural areas (our study was 43.9% in urban areas and 56.1% in rural areas) and the highest seasons of outbreak occurred in summer (our study in autumn)¹⁵.

In this study, the main way of Transmission of diseases was reported through contaminated food. 60.6% of all cases were due to the use of contaminated food. 9% of the cases were infected through contaminated water, and in 20% of cases, was not identified the way of transmission. The most frequent of outbreaks occurred in the late summer to early winter. However, the rate of outbreaks has decreased in 2016 compared with 2015. The most common clinical diagnosis of diseases included *Staphylococcal Toxin* poisoning, *Rotavirus* Diarrhea, *Chemical Toxicity* and *Hepatitis A virus*, although in many cases, The pathogen was not detected.

The results of this survey showed that 56.1% of the outbreaks were in rural areas and 43.9% in urban areas. Which will double the necessary attention to rural areas. Although one of the reasons for this figure in rural areas is probably a more accurate registration system in rural areas than urban areas.

Growth and survival of foodborne pathogens is associated with several environmental factors such as temperature, pH, water availability, climate change, and natural disasters¹⁶. inadequate water purification, such as inadequate surface water filtration or inadequate groundwater disinfection, can lead to outbreak of waterborne disease. Between 2001 and 2002, the cause of 14% of the outbreaks of water borne diseases were due to inadequate water purification¹⁷.

About 780 million people do not have access to safe drinking water, and about 2.5 billion people do not have access to proper water treatment systems in the world. It is estimated that 2.3% of all deaths around the world are due to unsafe water caused by poor sanitation and hygiene. According to the WHO, the improvement of drinking water quality could reduce by almost 4% the global burden of the disease. Despite the significant decline in outbreaks of waterborne diseases since the 1900s, the global burden of these diseases is still significant¹⁸. In addition, the number of these outbreak is less than actual ones¹⁹.

The amount of residual chlorine in the water after half an hour contact time is 0.5 to 0.8 mg / liter in the normal conditions at the end of the water transfer network. Regarding PH and emergencies situation, epidemic of intestinal diseases and natural disasters is 1mg / liter¹⁹. In our study, the residual chlorine in water was less than 0.5mg/liter in approximately 33% of cases and it was in the range of 0.5 to 0.8mg / liter in 26.4% of cases. This indicates that the amount of residual chlorine should be carefully monitored in water to ensure complete disinfection of pathogenic agents in the water. The most commonly pathogens detected in water specimens were *Escherichia Coli*, Coliform, *Vibrio NAG*, Adenoviruses and Rotaviruses²⁰.

CONCLUSION:

Trend analysis showed the incidence of Water and foodborne diseases occurred in all seasons, especially in autumn. Occurrence of this outbreaks are indicated that the provinces with higher incidence may need to interventions. This interventions should be carried out both at the community level and health surveillance system. Active case-finding, timely diagnosis, accurate treatment, patients monitoring are highly recommended. Rational use and prescription of drugs inhibits antibiotic resistance and can reduce the cost of therapeutic of these diseases.

It is recommended that, while monitoring and controlling health at the supply level, the importance and training of the basic principles of prevention and surveillance system of foodborne diseases for producers, providers and consumers of food will be informed through various public communication channels. Considering the high incidence of water and foodborne outbreaks, preparedness, sensitivity and the importance of these diseases is one of the priorities in Iran.

Conflict of interests: None

Ethical clearance: Ethical matters e.g. plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been totally observed by the authors.

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