Investigating outbreaks caused by foodborne diseases and determining common bacterial agents that cause them in Kurdistan province

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ABSTRACT

Foodborne diseases are a global problem that is spreading day by day. These diseases are one of the most common causes of death in children and the elderly. This study was conducted to investigate the prevalence of water and foodborne diseases in Kurdistan province for six months from April to September 2022. Stool samples from patients were collected in the laboratory in a special container containing 10% formalin preservative. 134 stool samples from 28 food outbreaks from Kurdistan province were analyzed for the type of infected bacteria. The research results were analyzed in SPSS-19 software. Among the 28 outbreaks in Kurdistan province during the two seasons of spring and summer, the highest number of outbreaks was in the summer season with 20 and then in the spring season with 8 outbreaks. The dominant age group was children under 10 years (%21) old and people between 20-30 years old, and the dominant gender group was men. The most common clinical symptoms were nausea, vomiting, abdominal cramps, bloody diarrhea and non-bloody diarrhea. It is important to know the type of bacteria that cause water and foodborne diseases in reducing outbreaks and treatment costs and applying necessary measures for control and prevention.

1. Introduction

Food can always be exposed to contamination and carry many pathogenic agents as a carrier and provide the conditions for growth and reproduction and finally cause disease by consuming contaminated food. Due to many reasons, food-borne diseases are spreading in the world today, and every year they cause a significant number of people to suffer and die, even in industrialized countries, more than 30% of people are infected with food-borne diseases every year [1-4]. The phenomenon of globalization and the increase in travel and the development of tourism, as well as the increase in the consumption of food outside the home in different societies, have raised food-borne diseases as a global health problem [5-8]. The Centers for Disease Control and Prevention (CDC) defines foodborne outbreaks as If two or more people share a common source of food or drink and have similar symptoms, Food outbreaks occur. An outbreak is an unexpected and unjustifiable increase in the number of patients that occurs within a certain population at a certain time and place [9].

Public health authorities are usually concerned about outbreaks that are widespread, international, or related to restaurants, or cause severe illness that leads

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to hospitalization or death [10]. The average number of cases and prevalence between 2015 and 2020 has increased significantly, from 1.1 cases per 1 million to 28.6 cases per 1 million reported by previous research [11]. In a study, on all outbreaks caused by food in Semnan Province, it has shown that the prevalence rate was higher in women than in children and men (46%). The frequency of outbreaks in 24–44 years was observed more than in other groups (31.57%) [12-17].

Factors in the food industry have changed so that foods cross geographical boundaries more than before, and today food can be a combination of different products from different countries. In America and many other countries, food imports from other parts of the world have increased significantly. A US study found that retail food service establishments accounted for more *Salmonella enterica* outbreaks than any other food preparation location [18]. Important bacteria are the most important cause of food-borne diseases and are responsible for the occurrence of a large part of poisoning because they are microscopic organisms that live in water, soil, and air inside and on the surface of living organisms and spread everywhere [19].

Food can always be exposed to contamination and, as a transfer agent, it carries many pathogenic agents and provides the conditions for growth and reproduction, and finally causes disease by consuming contaminated food [20-24].

In addition to diseases caused by foodborne pathogens, other factors such as Salmonellosis and Shigellosis are effective in the spread of foodborne diseases. Such diseases are more severe and dangerous in high-risk people such as children and infants, pregnant women and their fetuses, and people with weak immune systems [25]. Nowadays, due to the preparation and distribution of food outside the home, such as restaurants and centers that are mainly involved in the supply of ready-made food, and the increasing use of foods such as fast food that do not require long-term cooking and high heat, it causes an increase in the number of people suffering from such diseases has been [26].

Other reasons such as evolution in food technology, change in lifestyle, buying food in large volumes, long-term use of food stored in the refrigerator, and lack of sufficient information in the field of food hygiene to how to store and cook them cause an increasing number of cases. Outbreaks caused by food products have become such problems that have been raised as a global challenge, and countries are trying to come up with informed investigations to identify the factors and control and prevent them, and by preventing the occurrence of these outbreaks, they can save money. In medical expenses and to provide for the health of society by observing food hygiene [27].

The purpose of this research was to investigate the outbreaks caused by foodborne diseases in Kurdistan province and to determine the common bacterial factors that cause them.

2. Materials and Methods

This study was conducted for six months from April to September 2022 on 28 cases and 134 stool samples sent from Kurdistan province that had outbreaks caused by water and food. Patients with clinical symptoms such as diarrhea, vomiting, nausea, abdominal cramps, fever and headache due to infection or food poisoning. All patients recover after treatment.

Of the two stool swaps sent to the Microbiology Laboratory of Tehran University of Medical Sciences, one was placed in Selenite F Broth medium (Merck) for *Salmonella* enrichment for 12 to 16 hours at a temperature of 37°C and the next day it was cultured on Hektoen Agar medium, the second swap was directly on the medium Hektoen enteric agar (Merck) was cultured to isolate E.coli and Shigella and incubated for 24 hours at 37 C temperature.

On the second day, the cultivation environments were examined. To check the growth of E.coli on Hektoen Enteric Agar (Merck) medium for Yellow colonies, for green or bluish-green *Salmonella* with or without SH2, and on the differential, culture media such as TSI, SIM, Urea, Simon's Citrate, LDC, MRVP (Merck) was transferred and

cultured and incubated for 24 hours in C-37 and the next day the relevant reactions were checked and compared with the diagnostic tables of Enterobacteriaceae. To isolate *Staphylococcus aureus*, it was cultured on Chapman's medium (Merck) and the next day the usual biochemical tests of gram staining, catalase, mannitol fermentation, VP, DNase, coagulase, and sensitivity to novobiocin and polymyxin B were performed for the yellow colonies of *Staphylococcus aureus* [28, 29].

3. Results

In this study, among the 28 outbreaks that occurred with 134 diarrhea samples, most outbreaks were related to Sanandaj City and the least outbreaks belonged to Gorveh City (Table 1). Out of all the outbreaks, 27 cases with 130 samples (96%) were related to the city and only 1 outbreak (4%) with 4 samples was related to the Dehgalan district.

Table 1. Distribution of the frequency of floods according to the cities of Kurdistan province

ROW	Cities	Number of Samples	number of outbreaks	Percentage of outbreaks
1	Sanandaj	78	16	57%
2	Marivan	22	4	14%
3	Saqqez	17	4	14%
4	Bijar	11	2	7%
5	Qorveh	4	1	4%
6	Dehgolan	4	1	4%

In this study, it was found that out of 134 rectal swap samples, 75 samples (56%) were male and 59 samples (44%) were female. The statistical results show that there is no significant relationship between the incidence of foodborne diseases and gender (P>0.005).

Also, in this survey, it was found that the most common cause of food outbreaks in Kurdistan province was the consumption of contaminated water and vegetables with 39 samples (29%) and 36 samples (27%) respectively (Fig. 1).

This study also showed that people in the age range of 12-25 years showed the highest number of contamination cases with 42 samples (30%), followed by children between 1-7 years with 29 samples (21%), and the lowest the rate related to people aged 35-45 years with 11 samples (8%) was (Fig. 2).
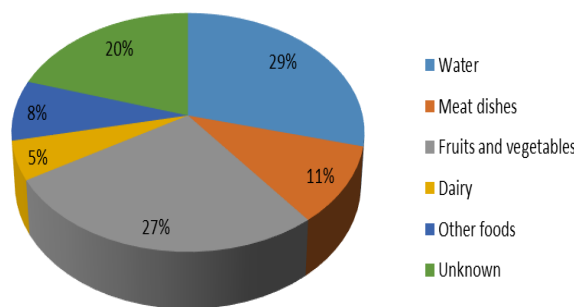

Fig. 1. The relative frequency of the type of substance that causes outbreaks
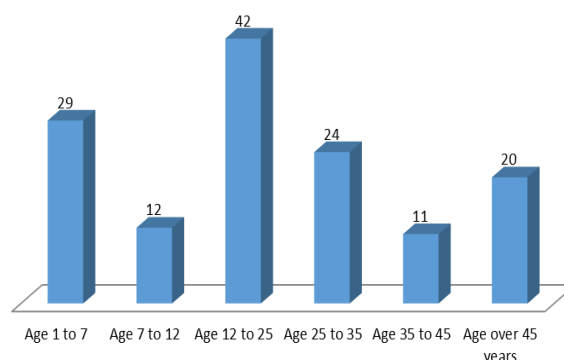

Fig. 2. Distribution of samples based on age groups

In this study, it was shown that among the clinical symptoms resulting from the outbreaks, the highest number of symptoms related to non-bloody diarrhea, vomiting, and nausea each with 25 samples (19%) and other clinical symptoms were in the next stage (Table 2).

Table 2. The frequency of clinical symptoms resulting from outbreaks

Clinical Features	non-bloody diarrhoea	bloody diarrhea	Nausea	Abdominal cramps	Vomit	Fever	Headache
Number of persons	25	12	25	18	25	15	**14**
%	19	9	19	13	19	11	**10**

The most isolates from food outbreaks in Kurdistan were Escherichia coli with 60 cases (45%), Salmonella 1 case (0.75%) and Shigella with 4 cases (3%) (Fig. 3).
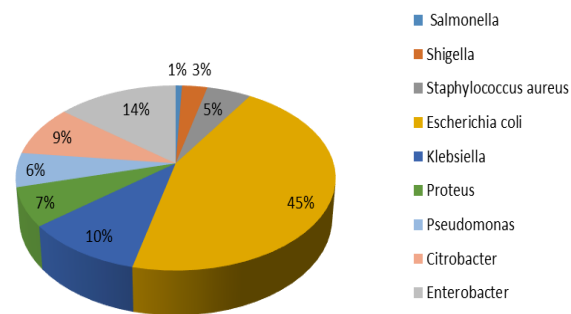
Fig. 3. Frequency of strains isolated from patient samples

4. Discussion

Today, for many reasons, diseases transmitted by water and food and the outbreaks caused by them are spreading in the world, and every year they cause the illness and death of a significant number of people, even in industrialized countries, more than 30% of people die every year. Foodborne diseases are contracted [30]. Foodborne diseases are one of the most important problems, especially in developing countries, and they are one of the main factors in morbidity and mortality all over the world. Food is an important carrier in the transmission of microorganisms to humans, and among these microorganisms, *Salmonella* is still the main cause of foodborne diseases in the pathogenesis of humans throughout the world [13-15, 31].

In our investigation in Kurdistan province, there were 28 outbreaks and 134 people were infected, and it showed that outbreaks occurred in the city (96%) more than in the district. or the village and one of the main factors in the increase in the occurrence of floods is the increase in urbanization and the change in people's lifestyles. The dominant gender in the outbreaks occurred the male gender (56%) more than the female gender, which is consistent with previous studies by Soltan Dallal [25].

In a study, during the year (2015), among the 73 food outbreaks examined, Shigella (6.9%) and *Salmonella* (1.6%) were among gram-negative intestinal bacteria. were isolated from the most common factors. In terms of gender, men were more dominant (61.8%) than women (38.2%). The percentage of outbreaks caused by foodborne

diseases and the location of the city or the countryside, the rate of occurrence was 57 in the city and 57 in the village. 16 out of 73 outbreaks were reported [25].

In terms of the type of food consumed, Kozak and his colleagues showed that Canada, having the highest consumption of fresh vegetables and fruits, has the highest statistics related to the most common causes of outbreaks caused by foodborne diseases, among which *Salmonella* with 50 % has the highest incidence of this disease, which is somewhat consistent with our studies [32].

The most clinical symptoms are non-bloody diarrhea in 25 people (19%), nausea in 25 people (19%), and vomiting in 25 people (19%), followed by abdominal cramps in 18 people (13%), fever in 15 people (11%), Headache in 14 people (10%), and finally bloody diarrhea with 12 people (9%) were the lowest clinical symptoms observed in people. In all the studies conducted and examining the clinical symptoms of patients, the same symptoms have been observed in the development of such diseases [27, 33]. In our study, the most common problem is preventing food contamination by pathogens. Because pathogens are found everywhere and some can survive and multiply in harsh conditions, cold, or low-oxygen environments. Even in some cases, a small amount of the pathogen is capable of causing disease, all of which indicate the risks involved in dealing with these pathogens. Therefore, to reduce the spread of food-borne diseases, control from farm to table and encouraging all factors in the food production chain can improve health conditions, as well as using the Hazard Analysis and Critical Control Points (HACCP) program can be effective. This program may include the destruction and inactivation of bacteria or their spores through the use of heat treatment (such as pasteurization and canning), dehydration, freezing, refrigeration, special packaging, or the use of compounds. The antimicrobial preservative has been confirmed [34, 35].

Food manufacturing factories and distributors use necessary control strategies to ensure the safety of food because if any contamination occurs at the beginning of the

production chain, it causes the creation of various carriers of pathogens and the spread of contamination over a longer period will be. For this reason, any contamination in a primary product can lead to successive contaminations [36-39].

The present study was conducted for six months on 28 foodborne outbreaks, which included 134 stool swap samples, to isolate the most common bacterial agents, especially Salmonella and Shigella. (31%) and among the different cities of Kurdistan province that sent samples, Sanandaj city with 16 outbreaks (57%) had the highest number of reports of foodborne outbreaks. Studies have shown that one of the main factors in the increase of floods is the increase in urbanization and the change in the lifestyle of people because, in this study, the ratio of floods in cities was 96% compared to 4% in villages, which showed a noticeable difference (P<0.05).

5. Conclusion

The results of this study showed that the prevalence of *Salmonella* is lower compared to previous studies conducted in Iran. It confirmed the association of foodborne diseases with many factors such as demographic characteristics, community type, disease-causative species, and climate change that can affect the survival rate of infectious agents.

Conflict of Interest

The authors hereby declare that they have no conflict of interest.

Author's contributions

All authors equally participated in designing experiment analysis and interpretation of data. All authors read and approved the final manuscript.

Ethics approval and consent to participate

No human or animals were used in the present research.

Consent for publications

All authors have read and approved the final manuscript for publication.

Availability of data and material

The authors have embedded all data in the manuscript.

Informed Consent

The authors declare not used any patients in this research.

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