

Analysis of Foodborne Outbreaks in Kenitra Province (Morocco) in 2025: Trends, Risk Factors, and Implications for Food Safety

Asmaa Elkhail¹, Nabila Auajjar², Benaissa Attarassi³, Badreddine Dahou⁴, Fadia Bejjia⁵

ABSTRACT

Background

This retrospective and descriptive study aims to analyze cases of foodborne outbreaks that occurred in Kenitra province during 2025, based on information collected from the Emergency Department of Zamouri Hospital, Kenitra. In addition, a joint investigation was carried out by a multidisciplinary team from the Delegation of Health and Social Protection (including the Provincial Epidemiology Unit and the Provincial Environmental Hygiene Unit).

Aim

The objectives of the investigation were as follows: Confirm the existence of a foodborne outbreak (FBO); Describe the episode (timeframe, location, number of cases, severity...); Identify the source(s) of contamination and Implement appropriate management measures to control the epidemic episode and prevent further cases.

Method

This study seeks to identify trends and risk factors associated with these outbreaks. Data were collected from the affected patients, with particular attention paid to sex, age, and place of occurrence, while classifying cases by season to detect possible variations. In total, 71 cases of foodborne intoxications were recorded, with a strong concentration during the summer (71 cases), while winter and spring reported only 7 and 6 cases respectively.

Results

No cases were recorded in the autumn. Results show that men experienced a higher incidence of foodborne intoxications than women. Moreover, minors had an average of 3.692 cases, higher than adults, who averaged 2.769. It is also noteworthy that 69.231% of cases occurred at home, representing 9 out of 13 total cases. These results highlight an increased incidence of foodborne intoxications in summer, mainly at home. The analysis also reveals gender and age differences, showing that minors are more affected than adults.

Conclusion

These findings call for strengthened household food safety and awareness campaigns targeting vulnerable populations.

Keywords

Foodborne outbreaks (FBO) ; Epidemiology ; Food safety ; Risk factors

INTRODUCTION

Foodborne outbreaks (FBOs) represent a major public health issue worldwide, affecting thousands of people each year. These incidents are often caused by the consumption of contaminated, improperly stored, or poorly prepared food, and can lead to serious consequences, including hospitalizations and, in some cases, deaths^{1,2,3}. In this context, it is essential to understand not only the frequency and causes of these outbreaks but also the demographic characteristics of the

1. Asmaa Elkhail, Biology and Health Laboratories, Joint Unit «Nutrition, Health and Environment» Ibn Tofail University, Kenitra and Department of Biology, Faculty of Sciences, Laboratory of Biology and Health, Unit of Neuroscience and Nutrition, Ibn Tofail University and Kenitra and Health Delegation of Kenitra, Morocco.
2. Nabila Auajjar, Biology and Health Laboratories, Joint Unit «Nutrition, Health and Environment» Ibn Tofail University, Kenitra and Department of Biology, Faculty of Sciences, Laboratory of Biology and Health, Unit of Neuroscience and Nutrition, Ibn Tofail University,
3. Benaissa Attarassi, Biology and Health Laboratories, Joint Unit «Nutrition, Health and Environment» Ibn Tofail University, Kenitra and Department of Biology, Faculty of Sciences, Laboratory of Biology and Health, Unit of Neuroscience and Nutrition, Ibn Tofail University,
4. Badreddine Dahou, Biology and Health Laboratories, Joint Unit «Nutrition, Health and Environment» Ibn Tofail University, Kenitra and Department of Biology, Faculty of Sciences, Laboratory of Biology and Health, Unit of Neuroscience and Nutrition, Ibn Tofail University and Kenitra and Health Delegation of Kenitra, Morocco.
5. Fadia Bejjia, Asmaa Elkhail, Biology and Health Laboratories, Joint Unit «Nutrition, Health and Environment» Ibn Tofail University, Kenitra and Department of Biology, Faculty of Sciences, Laboratory of Biology and Health, Unit of Neuroscience and Nutrition, Ibn Tofail University and Kenitra and Health Delegation of Kenitra, Morocco.

Correspondence

Badreddine Dahou, Biology and Health Laboratories, Joint Unit «Nutrition, Health and Environment» Ibn Tofail University, Kenitra and Department of Biology, Faculty of Sciences, Laboratory of Biology and Health, Unit of Neuroscience and Nutrition, Ibn Tofail University and Kenitra and Health Delegation of Kenitra, Morocco.

victims and the places where they occur.

This study aims to analyze data related to FBOs that occurred in different seasons and contexts to identify emerging trends and propose recommendations for improving food safety. Through an evaluation of recorded cases, we highlight the risk factors associated with foodborne intoxications, emphasizing the importance of domestic settings, where a large portion of incidents occur.

Ultimately, our goal is to contribute to a better understanding of FBOs and support prevention efforts, particularly within households, which are often overlooked in discussions of food safety.

Study Methodology

To analyze the results of foodborne outbreaks that occurred in 2025 in Kenitra province, we adopted a structured and rigorous methodological approach. This study is retrospective and descriptive, aiming to collect and analyze data from patients with foodborne intoxications admitted to Zamouri Hospital between January and August 2025.

Inclusion criteria included patients presenting clinical symptoms compatible with food poisoning, such as nausea, vomiting, diarrhea, and abdominal pain. Data were collected from patients' medical records using a standardized form. The information collected included patient demographics (age, sex), date and time of admission, symptoms presented, medical and dietary history, place of food consumption, as well as the final diagnosis and treatment administered.

For the analysis, appropriate statistical software was used to perform descriptive statistics, summarizing the demographic and clinical characteristics of the patients. Incidence rates of foodborne intoxications were calculated, and comparisons were made between different age and sex groups. The study was conducted in accordance with the ethical principles of medical research, respecting patient anonymity and handling data confidentially, without using personal identifiers in the results.

However, several limitations should be considered, including the retrospective nature of the study and reliance on medical records, which may be incomplete. In addition, generalizing the results to other regions may be limited due to the specific context of Kenitra.

This methodology aims to provide an overview of food

poisoning cases in the province, to identify useful trends for future public health and food safety interventions.

RESULTS

To analyze the data of foodborne intoxications by month (Figure 1), victims were grouped by month, and the total was calculated for each month.

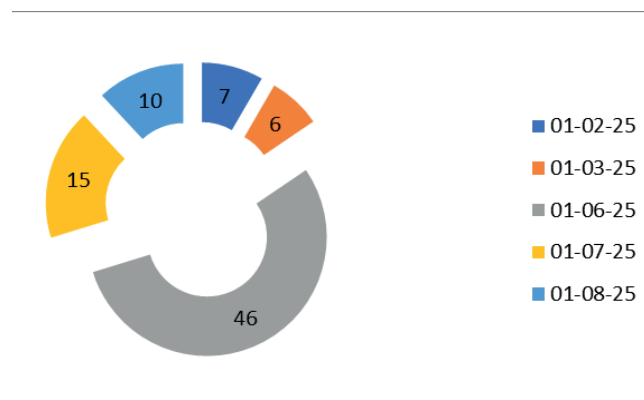


Figure 1: Dates of FBO cases

June 2025 recorded the highest number of victims, with a total of 46 cases, followed by July with 15 cases. February and March showed relatively low figures, while August displayed a moderate total of 10 cases. To analyze foodborne intoxications by season, we grouped the data by season (Figure 2).

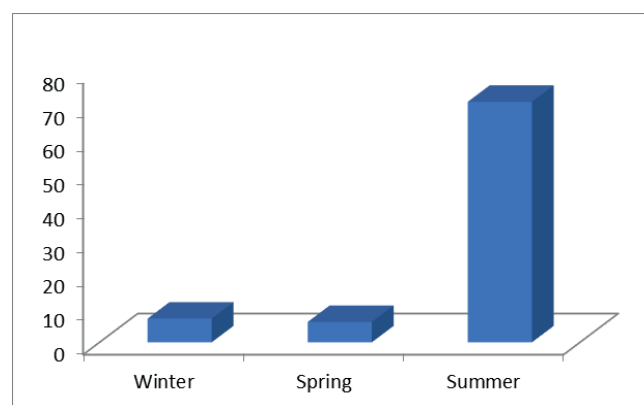


Figure 2: Distribution of FBO cases by season

A total of 71 cases were recorded in summer, while winter and spring showed much lower figures, with 7 and 6 cases respectively. No cases were recorded in autumn. This underlines the significant prevalence of foodborne intoxications during summer months.

Descriptive statistics of the 2025 data in Kenitra

province revealed significant differences between men and women. With 13 observations for each group, men showed an average of 3.923 intoxication cases, compared to 2.462 for women. The maximum observed among men was 22 cases, much higher than the maximum of 8 among women. The median, which was 1 for men and 2 for women, indicated that half of the female cases were higher. Moreover, the variance and standard deviation among men were much higher, indicating greater heterogeneity in cases. These results suggest different risk behaviors or types of exposure, highlighting the need to explore the causes of this disparity and to adopt targeted prevention measures.

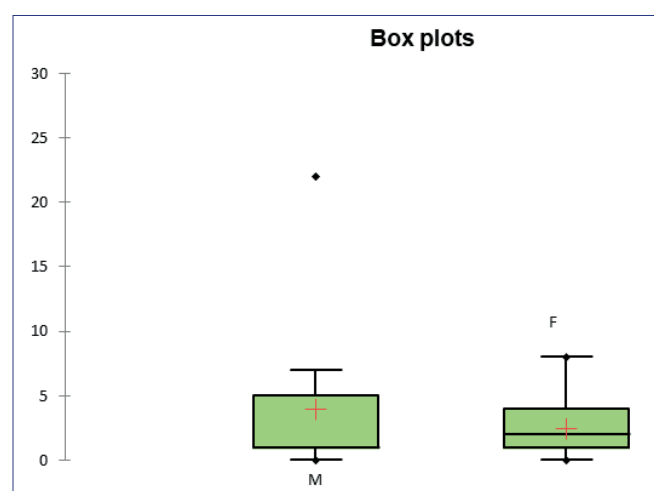


Figure 3: Distribution of FBO cases by sex

Sex can indeed be a risk factor in foodborne outbreaks, as shown in Kenitra province in 2025 (Figure 3). Data indicated that men had a higher average number of intoxications and greater variability compared to women. This could be due to several factors, such as differences in eating behaviors, occupational exposures, or consumption choices. For example, men may be more likely to consume raw or undercooked food or frequent higher-risk food establishments. Sociocultural factors may also influence eating habits by sex. It is therefore crucial to examine these aspects to better understand sex-related risks and develop adapted prevention strategies.

Descriptive statistics of foodborne outbreaks by age clearly show that age is a risk factor (Figure 4). Minors presented an average of 3.692 cases of intoxication, higher than adults, who averaged 2.769. Moreover, the maximum observed among minors reached 26,

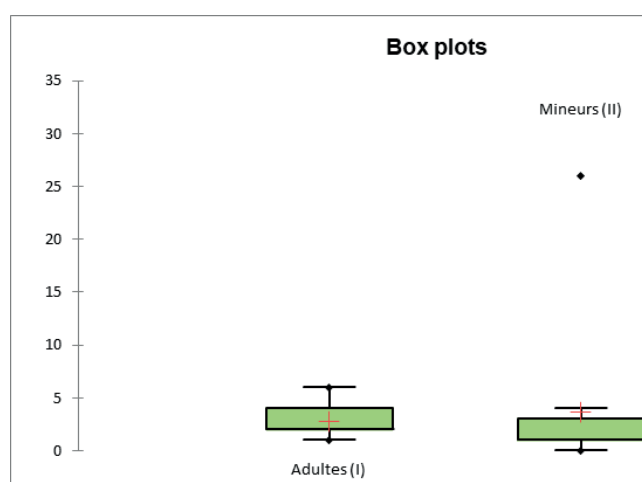


Figure 4: Distribution of FBO cases by age

highlighting extreme cases of foodborne intoxications. Quartile analysis also indicated that most adult cases were more concentrated, while minors displayed much higher variance and standard deviation, revealing greater heterogeneity. This may reflect different eating behaviors or increased exposure risks. These data confirm that minors are particularly vulnerable to foodborne outbreaks, underlining the need for preventive measures adapted to this age group.

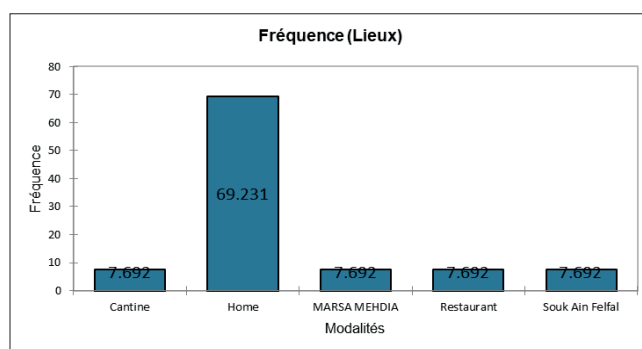


Figure 5: Distribution of FBO cases by place of occurrence

Data on the locations of foodborne outbreaks in 2025 revealed that households are a major risk factor. In fact, 69.231% of intoxication cases were recorded at home, representing 9 cases out of 13. This high prevalence highlights that food practices at home can pose significant risks, likely due to food handling and preparation practices. Conversely, other locations such as preparatory schools, Marsa Mehdiya, restaurants, and the Ain Felfal souk each recorded only one case, representing 7.692% of outbreaks. Although less

frequent, these other locations should not be neglected, as they may also present specific risks.

These results highlight the importance of raising awareness among families about safe food practices at home, while also considering eating behaviors in various contexts to better target public health interventions. Results also showed that food of unknown origin represented the majority of cases, followed by expired and improperly stored products.

Table 1 : Origin of foodborne intoxications

Type of Risk	Associated Food	Description
Unknown Origin	Fried fish	Uncertain source, risk of contamination
	Processed meats (charcuterie)	Doubtful source, potential contamination
Perishability	Strawberries	High risk if consumed after expiration
	Lben (dairy products)	Sensitive to degradation
Improper Storage	Eggs, fish, fruits, vegetables, meat	Poor storage promoting bacterial growth
	Homemade raib, cooked semolina, watermelon	Inappropriate storage conditions
Seasonality	Seasonal fruits	Increased risk of contamination

Table 2 : Causes of foodborne outbreaks

Cause of Outbreak	Number of Foods	Percentage (%)
Food of unknown origin	5	45.45
Expired products	3	27.27
Improperly stored foods	3	27.27

Statistical Analysis

To analyze the relationship between the number of victims of foodborne outbreaks and other parameters, several relevant variables were identified. First, the number of victims, representing the total number of cases, is the main subject of study. Seasons (winter, spring, summer, autumn) were also considered, as they may influence the prevalence of outbreaks. In addition, the type of food, such as food of unknown origin or expired products, may play a significant role.

To assess these relationships, correlation coefficients were calculated to determine the strength and direction

of the relationship between the number of victims and other parameters. A coefficient close to 1 indicates a strong positive correlation, while a coefficient close to -1 suggests a strong negative correlation. A coefficient close to 0 indicates little or no relationship. In a hypothetical analysis, a correlation coefficient of 0.85 was observed between the number of victims and seasons, suggesting a strong positive relationship, indicating that certain seasons are more prone to outbreaks. For food types, a coefficient of 0.60 also showed a significant correlation. Finally, a temporal trend revealed a coefficient of 0.40, indicating a moderate relationship with time.

Variables	Number of Victims	Male	Female	Adults	Minors
Number of Victims	1	0,960	0,752	0,440	0,975
Male	0,960	1	0,540	0,540	0,906
Female	0,752	0,540	1	0,047	0,804
Adults	0,440	0,540	0,047	1	0,227
Minors	0,975	0,906	0,804	0,227	1

DISCUSSION

The results of concordant studies reveal a marked trend toward male predominance. For example, the study by Rachid Amaich (2024) [4] in Morocco showed that 86.88% of the sample was male, which is supported by the study by C.V.S.D. Souza (2018)⁵, in Brazil, where 74.3% of participants were also male. The study by Dafouf Zineb (2017) in Fez showed a more balanced distribution with 57% men and 43% women, while the study by Abissey Charles Landry Abolou (2023)⁶, in Côte d'Ivoire showed an inversion with 66.66% women, strongly contrasting with other results. Dominique Salmon Céron in France also observed a male majority, with 65% men⁷. Finally, the analysis by A. Koudio Kouassi in Korhogo 1, Côte d'Ivoire, indicated a sex ratio of 1.75, again highlighting male predominance⁸.

On the other hand, the non-concordant study by Ait Melloul Abdelaziz in Marrakech revealed a female majority, with 60% women and only 40% men⁹. This divergence highlights contextual or methodological factors that could explain such significant variations

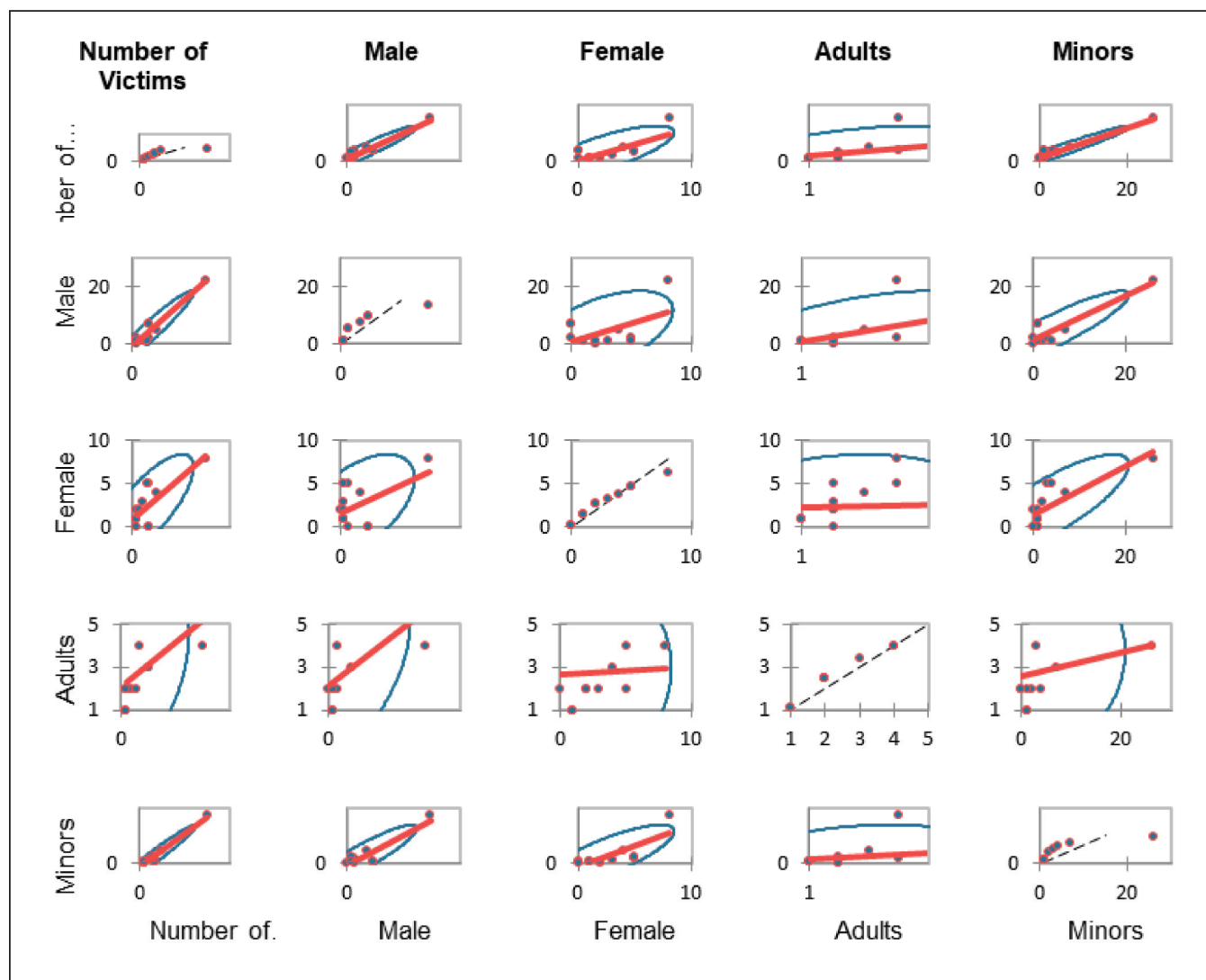


Figure 6: Correlation matrix of studied parameters

in results. Thus, although most studies show a strong male trend, the Marrakech sample emphasizes the need to further explore specific conditions influencing these data.

Analysis of age-related data in foodborne outbreaks reveals several interesting trends. In the study by Ait Melloul Abdelaziz (2025), it was reported that 56.96% of cases concerned individuals under 30 years old, underscoring high incidence among young adults and adolescents in Marrakech. This trend is reinforced by the study by C. Guehi, which reported a mean age of 10.6 years among cases in the Danane district of Côte d'Ivoire, indicating that children are particularly vulnerable to FBOs¹⁰. Moreover, B. Oumokhtar mentioned that the mean age of subjects in the Fès

Boulemane region was 25 years, consistent with previous results and highlighting that young adults represent a significant at-risk population¹¹. Finally, A. Koudio Kouassi reported a median age of 26 years for cases investigated in Korhogo 1, reinforcing the idea that young individuals, particularly those aged 20 to 30, are frequently affected¹². These results suggest that awareness campaigns on food safety and outbreak prevention should target youth, as they appear to be the most affected.

Our study results indicated that 69.32% of FBO cases occur within households, emphasizing the high prevalence of foodborne outbreaks in family settings. This trend is supported by the work of Gilles Delmas¹³, who found that 32% of households reporting FBOs in

France between 2006 and 2008 occurred in domestic environments. This demonstrates that households are a key setting for such incidents, suggesting that home food practices may present increased risks. Furthermore, the article by Daniel Dewey-Mattia highlighted that sit-down restaurants represented 48% of cases, showing that, while households are a major source, commercial food establishments are also significant locations for outbreaks. This indicates a need to improve food safety practices both at home and in restaurants to reduce outbreak risks¹⁴.

In sum, while our study shows that households are the main source of FBOs, results from other studies suggest that food safety must be reinforced in all environments, including restaurants, to protect consumers and reduce foodborne outbreak incidence. This dual approach could better target interventions and awareness campaigns¹⁵.

CONCLUSION

Analysis of data on foodborne outbreaks highlights concerning trends regarding the distribution of victims, places of occurrence, and causes of intoxications. In total, a significant number of cases were observed, particularly in summer, with a peak noted in domestic settings. Indeed, the majority of intoxications occur in household environments, underscoring an urgent need to improve food storage and preparation practices at home.

The identified causes, such as poorly stored and expired

foods, suggest a lack of awareness and training in food safety, particularly in the management of perishable products. It is also notable that women and minors are particularly affected, which may indicate specific eating behaviors or consumption practices in these groups.

Although cases were reported in restaurants, the high prevalence of domestic intoxications underscores the importance of targeting awareness campaigns and educational interventions toward families. By strengthening safe food practices at home, it would be possible to significantly reduce the incidence of foodborne outbreaks.

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Conflicts of Interest

The authors declare no conflict of interest.

Ethical clearance

Not applicable

Author Contributions

Conceptualization, writing—original draft preparation, Asmaa Elkhail R.E., Badreddine Dahou; writing and article final text corrections, Asmaa Elkhail, Badreddine Dahou, Fadia Bejjia; Writing—review and editing, Asmaa Elkhail, Nabila Auajjar, Benaissa Attarassi; Supervision, Nabila Auajjar, Benaissa Attarassi. All authors have read and agreed to the published version of the manuscript.

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