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Research Paper / Araştırma Makalesi

A Study of Food Poisoning Cases in Turkey from 2016 to 2020 According to the Written and Visual Media

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ABSTRACT

This study aims to examine and statistically analyze the cases of food poisoning in Turkey between 2016 and 2020, and the number of people affected by these cases. The data on food poisoning were obtained from news sources published in the written and visual media while weather temperature and relative humidity values were obtained from the Ministry of Agriculture and Forestry. Frequency distributions and Kruskal Wallis and Bonferroni non-parametric tests were used to evaluate the data. A total of 504 cases of food poisoning (100.8 cases/year, 42 cases/month) were experienced in Turkey between 2016 and 2020, and the estimated number of people affected by those cases is 27,196. Surprisingly, most cases of food poisoning occurred in autumn and winter while the lowest number of cases took place in summer. Students and employees were most affected by food poisoning. No direct correlation of food poisoning with ambient temperature and relative humidity was determined. The study is the first research conducted in Turkey in this area, and can be used to develop strategies and policies for food safety.

Keywords: Food poisoning, Climatic conditions, Seasonal change, Ambient temperature, Relative humidity, Turkey

Türkiye'de Gıda Zehirlenmesi Vakalarının İncelenmesi: 2016-2020

ÖZ

Bu çalışmanın amacı; 2016-2020 yılları arasında Türkiye'de yaşanan gıda zehirlenme vakalarını, bu vakalardan etkilenen kişi sayılarını incelemek ve istatistiksel olarak analiz etmektir. Gıda zehirlenmelerine ait veriler yazılı ve görsel medyada çıkan ve haber niteliği taşıyan kaynaklardan elde edilmiştir. Verilerin değerlendirilmesinde frekans dağılımları, nonparametrik testlerden Kruskal Wallis ve Bonferroni testi kullanılmıştır. 2016-2020 yılları arasında Türkiye'de toplam 504 gıda zehirlenme vakası (100,8 vaka sayısı/yıl, 42 vaka sayısı/ay) yaşanmış ve bu vakalardan tahmini 27 196 kişi etkilenmiştir. Şaşırtıcı bir şekilde gıda zehirlenme vakaları en çok sonbahar ve kış mevsiminde en az yaz mevsiminde gerçekleşmiştir. Gıda zehirlenmelerinden en çok öğrenciler ve çalışanlar etkilenmiştir. Hava sıcaklığı ve nispi nemin gıda zehirlenme vakalarıyla doğrudan bir ilişkisi saptanmamıştır. Çalışma bu alanda Türkiye'de yapılan ilk araştırmadır.

Anahtar Kelimeler: Gıda zehirlenmesi, İklim koşulları, Ortam sıcaklığı, Bağıl nem, Türkiye

INTRODUCTION

Foodborne diseases are a problem that has existed since the dawn of humanity and significantly threatens public health [1]. It is estimated that about 30% of infections occurring in the past 60 years have been caused by food only [2]. Foodborne diseases, which differ between countries and societies [3], are particularly common in underdeveloped countries [4]. Today, the global dimension of food production and sales increases the risk of foodborne poisoning and outbreaks worldwide. In this sense, many cases of poisoning and outbreaks resulting from Norovirus [5], *Clostridium botulinum* [6], the melamine chemical [7], Cryptosporidiosis [8], *Salmonella* [9], Hepatitis A [10], *Escherichia coli,* Shiga-toxin, Listeriosis, *Vibrio parahaemolyticus, Cyclospora* [11] etc. have been reported in different parts of the world.

The global extent of foodborne illnesses is not still fully known as many countries do not regularly record such data. However, it has a significant impact on the economy, particularly on health, tourism, agriculture, and the food industry [12, 13]. In 2010, the World Health Organization (WHO) conducted research in different regions of the world to determine the global extent of foodborne diseases, and published the results in 2015. It was reported that 31 different foodborne hazards caused by 14 parasites, 3 chemicals and toxins, 2 viruses and 12 bacteria caused nearly 600 million cases and killed 420,000 people. The report also stated that approximately 230,000 people had died due to foodborne diarrhea mainly caused by non-typhoidal *Salmonella enterica* (59,000), enteropathogenic *E.coli* (EPEC) (37,000), and Norovirus (35,000). Other foodborne (excluding diarrhea) deaths were mostly caused by *Salmonella* Typhi *(*52,000), helminth *T. solium* (28,000), the hepatitis A virus (28,000) and aflatoxin (20,000). The report also stated that 40% of the foodborne diseases occurred among children under the age of 5. WHO also evaluated foodborne diseases on the basis of regions. Accordingly, the African subregions, South-East Asian subregions, and Eastern Mediterranean subregions are places where foodborne diseases occur most while the European subregions, Western Pacific subregions, and American subregions are regions where they are experienced least [14]. Moreover, more than 1,954,336 people died because of the COVID-19 disease [15], which was claimed to emerge in a wet market in the city of Wuhan in China and was declared a global pandemic by WHO on 11 March 2020.

Foodborne diseases are often referred to food poisoning [16]. Food poisoning occurs 24 to 72 hours after foods contaminated with bacteria, viruses, parasites, toxins, or chemicals (water, soil, air, human, animal, machine, packaging, hygiene, storage conditions, cooking, etc.) are consumed [17], usually showing symptoms such as high fever, vomiting, nausea, stomach pain, stomach cramps, diarrhea, and weakness, etc. [18]. Food poisoning is usually a mild disease. But it can lead to serious consequences or even death in infants, children, the elderly, pregnant women, or individuals with poor immunity due to chronic illness [19].

The microorganisms, especially bacteria, which cause food poisoning, can multiply rapidly under certain conditions. These conditions can be divided into two as intrinsic (water activity, PH, redox potential, antimicrobial constituents, content of nutrients, such as inhibiting substances and biological structures) and extrinsic (storage temperature, oxygen availability, relative humidity, gas composition in the environment, such as the presence of other microorganisms) factors [20]. By controlling these factors, microbiological activities are limited, and food poisoning can be prevented. The number of studies examining ambient temperature, other seasonal features and the effects of climate change on microorganism development, food safety, and human health has been increasing recently [21-24].

Foodborne diseases continue to be the focus of food producers and government authorities due to the human dimension and economic dimension of food poisoning, and the increasing perceptions of consumers about quality of life in today's world [25, 26]. In this context, a dynamic period in which many long-term policies and strategies have been developed (such as GAP, GMP, HACCP, ISO 22000, BRC etc.) has started [27]. Activities related to food poisoning in Turkey are carried out under the Coordination of the Ministry of Food, Agriculture and Livestock, the Ministry of Health, and the Ministry of Justice. Food poisoning ranks second after drug poisoning in poisoning cases at emergency services in Turkey [28]. Policies to prevent food poisoning should be developed through extensive research based on aggregate data [29, 30]. However, no systematic and comprehensive study of food poisoning has been carried out in Turkey so far.

This study aims to examine and statistically analyze the food poisoning cases in Turkey between 2016 and 2020, and the number of people affected by these cases in terms of variables such as year, region, season, month, temperature, relative humidity, location, and occupation.

MATERIALS and METHODS

Statistical information on food poisoning in Turkey is limited. The data of this study on food poisoning cases that occurred between 2016 and 2020 were obtained from news sources in the written and visual media (TV, web page, written and electronic newspapers, magazines, etc.), with the support of a news agency. As a result of the filtering of the specific keyword ‘‘poison’’, a total number of 5,842 newspapers were accessed. 1,224 of which from the year 2016, 931 from 2017, 1,276 from 2018, 1,452 from 2019, and 959 from 2020, respectively. Mean weather temperature and humidity values were obtained from the Ministry of Agriculture and Forestry, General Directorate of Meteorology (MEVBIS) with the permission letter (95579059-107-E.9159). The data were transferred to the IBM SPSS Statistics 23 program (Armonk, New York U.S.*A*), and the analyses were completed. Frequency distributions and descriptive statistics were used for categorical variables and numerical variables respectively when evaluating the data. The Kolmogorov-Smirnov normality test was applied to the variable of the number of people affected by food poisoning in order to decide the analyses to be applied to the data. The test results showed that the normality assumption could not be achieved, and therefore the Kruskal Wallis and

Bonferroni tests were used for the comparisons. The findings were visualized with tables and graphics.

RESULTS and DISCUSSION

Table 1 shows the frequency distributions of the categorcial variables related to the food poisoning cases in Turkey between 2016 and 2020, and the estimated number of people affected by those cases.

Table 1. Distribution of the information about food poisoning

	Number of Food Poisoning		Number of Affected People	Mean Temperature[a]	Mean Humidity[a]
	n=504	%	27,196	Mean±SD	Mean±SD
Year					
2016	82	16.3	4,361	14.08±8.984	65.32±16.047
2017	87	17.3	3,403	14.71±7.720	62.22±18.952
2018	113	22.4	5,401	16.32±8.704	61.78±18.340
2019	128	25.4	9,976	16.64±7.745	63.75±19.180
2020	94	18.7	4,055	14.60±8.257	60.17±18.167
Month					
January	19	3.8	729	6.12±5.427	65.28±16.695
February	33	6.5	994	8.44±3.759	61.24±19.039
March	47	9.3	1,835	9.99±4.205	65.46±19.655
April	44	8.7	1,457	14.95±5.573	60.00±16.017
May	31	6.2	3,141	17.52±4.098	56.32±19.041
June	19	3.8	789	22.69±4.796	59.03±19.989
July	55	10.9	6,943	26.47±3.785	62.09±19.621
August	37	7.3	1,466	26.28±3.657	65.23±16.570
September	38	7.5	2,162	22.36±3.186	65.83±20.525
October	56	11.1	3,108	16.35±4.501	64.03±16.777
November	53	10.5	2,027	11.62±4.108	61.18±19.976
December	72	14.3	2,545	6.58±5.076	63.37±16.359
Season					
Spring	122	24.2	6,433	13.70±5.619	61.17±18.482
Summer	111	22.0	9,198	25.76±4.140	62.61±18.679
Autumn	147	29.2	7,297	16.20±5.806	63.46±18.931
Winter	124	24.6	4,268	7.01±4.862	63.10±17.067
Region					
Aegean	95	18.8	9,087	17.98±8.725	55.74±17.511
Mediterranean	50	9.9	1,882	17.74±7.604	61.27±19.969
Marmara	78	15.5	3,335	16.97±6.989	65.35±19.154
Central Anatolia	72	14.3	3,437	13.20±8.997	62.01±18.631
Black Sea	114	22.6	5,099	13.59±7.270	64.15±17.531
Southeastern Anatolia	61	12.1	2,630	15.13±8.391	67.33±14.782
Eastern Anatolia	34	6.7	1,726	12.93±9.398	65.46±19.113
Place					
House	81	16.1	1,790	16.60±8.339	65.00±17.437
Workplace	89	17.7	7,926	18.16±8.230	60.46±18.626
Restaurant	68	13.5	1,053	15.54±7.967	63.51±18.334
Mevlit	30	6.0	1,637	19.64±7.948	64.59±20.666
School	135	26.8	6,831	11.16±7.025	63.16±17.094
Dormitory	47	9.3	2,359	12.09±6.704	61.75±20.364
Other*	54	10.7	5,600	20.35±7.206	59.92±18.808

	Number of Food Poisoning		Number of Affected People	Mean Temperature[a]	Mean Humidity[a]
	n=504	%	27,196	Mean±SD	Mean±SD
Profession					
Employee	95	18.8	8,182	18.64±8.232	60.87±18.623
Student	218	43.3	10,151	11.75±6.970	62.55±17.700
Citizen	154	30.6	5,566	17.54±8.003	64.43±18.580
Other**	37	7.3	3,297	20.17±8.314	60.17±19.597
Temperature (°C)					
-10-0	15	3.0	407		
1-10	151	30.0	5,474		
11-20	181	35.9	10,012		
21-30	141	28.0	10,707		
31-40	16	3.2	596		
Relative Humidity (%)					
0-25	9	1.8	550		
26-50	129	25.6	10,908		
51-75	232	46.0	9,434		
76-100	134	26.6	6,304		

[a] The mean temperature and humidity values for the last 7 days before the food poisoning occurred. * Other: Military, Soup Kitchen, Prison, Wedding, Hospital, Iftar, Hotel. ** Other: Soldier, Prisoner, Tourist

Table 1 indicates that 82 (16.3%), 87 (17.3%), 113 (22.4%), 128 (25.3%), and 94 (18.7%) cases of food poisoning occurred in 2016, 2017, 2018, 2019, and 2020, respectively. The number of cases of food poisoning and the estimated number of people affected by those cases were the highest in 2019 (Figure 1).

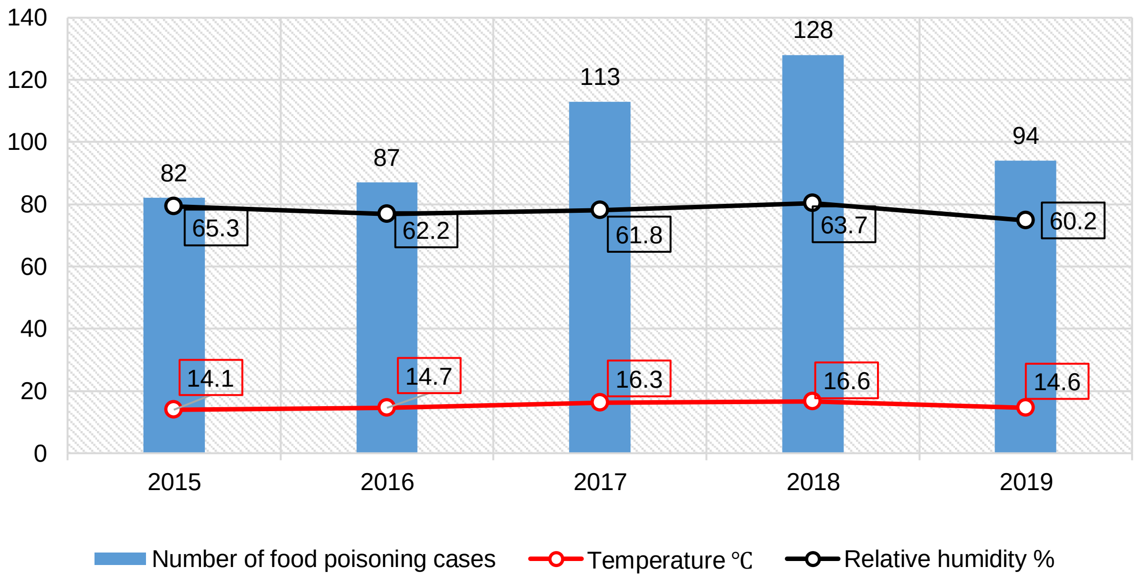

Figure 1. Number of food poisoning cases by year

The number of food poisoning cases was the lowest in January and June by 3.8% (n=19) each and the highest in December and October by 14.3% (n=72) and 11.1% (n=56), respectively. The estimated number of people affected by food poisoning was the highest in July (6,943) (Figure 2). Mun (2020) states that the frequency of only foodborne outbreaks between 2009 and 2016 were highest in May (10.2%), March (9.7%), June (9.5%), and December (9.4%), and the number of foodborne diseases was the highest in December (10.2%), April (9.7%), June (9.6%), and May (9.4%) based on the data from The National Outbreak Reporting System (NORS) [31].

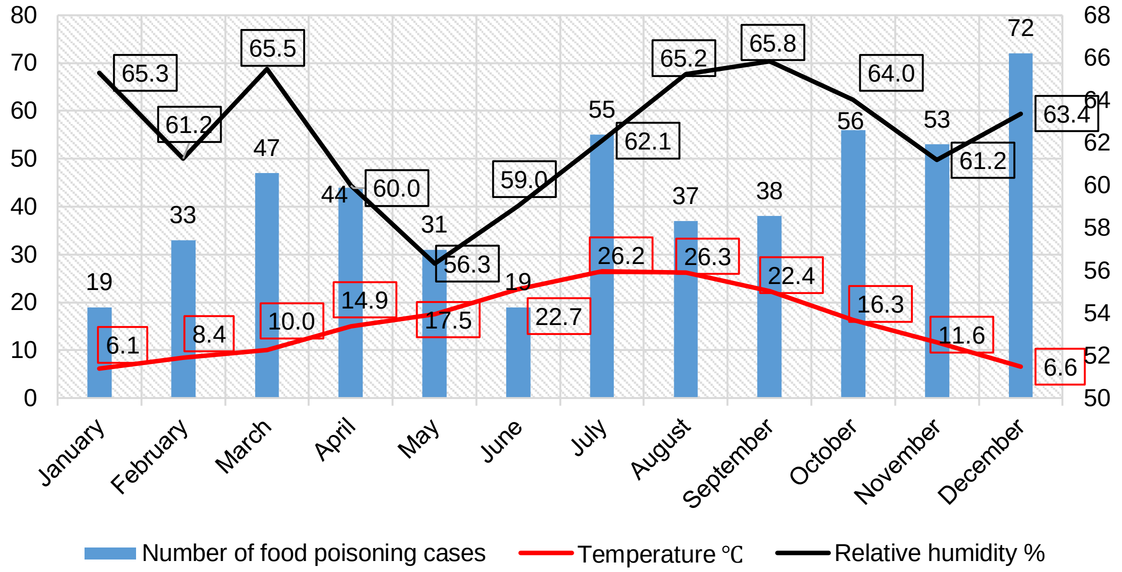

Figure 2. Number of food poisoning cases by months

The numbers of food poisoning cases by seasons are as follows in a descending order: 29.2% (n=147) in autumn, 24.6% (n=124) in winter, 24.2% (n=122) in spring and 22.0% (n=111) insummer. Although the number of food poisoning cases is the lowest in the summer season, it ranks first in terms of the number of people affected by food poisoning (9,198) (Figure 3). Various scholars (Hall et al., 2002; Yun et al., 2016) state that there is a correlation between seasonal differences and variety of food poisoning [32, 33] while others state that there may be peaks in food poisoning in different seasons, especially during the summer months [34, 35]. According to Mun (2020), NORS has clearly stated that apart from food, water and other resources, seasonality has a very strong impact on emergence of enteric diseases [31].

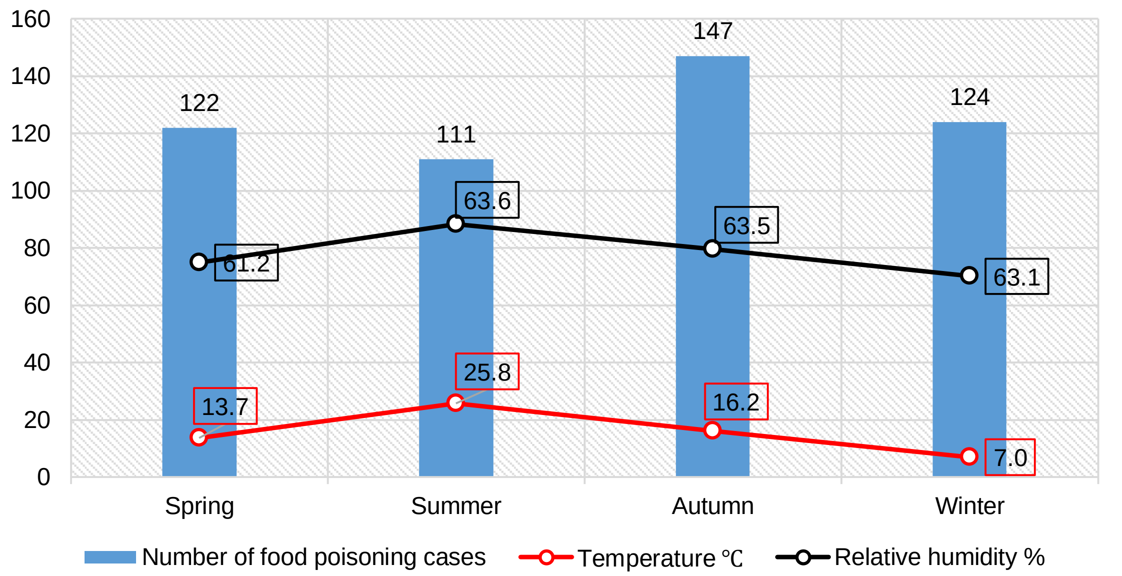

Figure 3. Number of food poisoning cases by seasons

The numbers of food poisoning cases in the seven geographical regions of Turkey are listed in a descending order as follows: 22.6% (n=114) in the Black Sea, 18.8% (n=95) in the Aegean, 15.5% (n=78) in Marmara, 14.3% (n=72) in the Central Anatolia, 12.1% (n=61) in the Southeastern Anatolia, 9.9% (n= 50) in the Mediterranean, and 6.7% (n=34) in the Eastern Anatolia region (Figure 4). The number of people affected by food poisoning was the highest in the Aegean region (9,087) and the lowest in the Eastern Anatolia (1,726) region. It is stated that regional differences in climatic conditions have the potential to affect foodborne pathogens and outbreaks, and cases of food poisoning [36, 37].

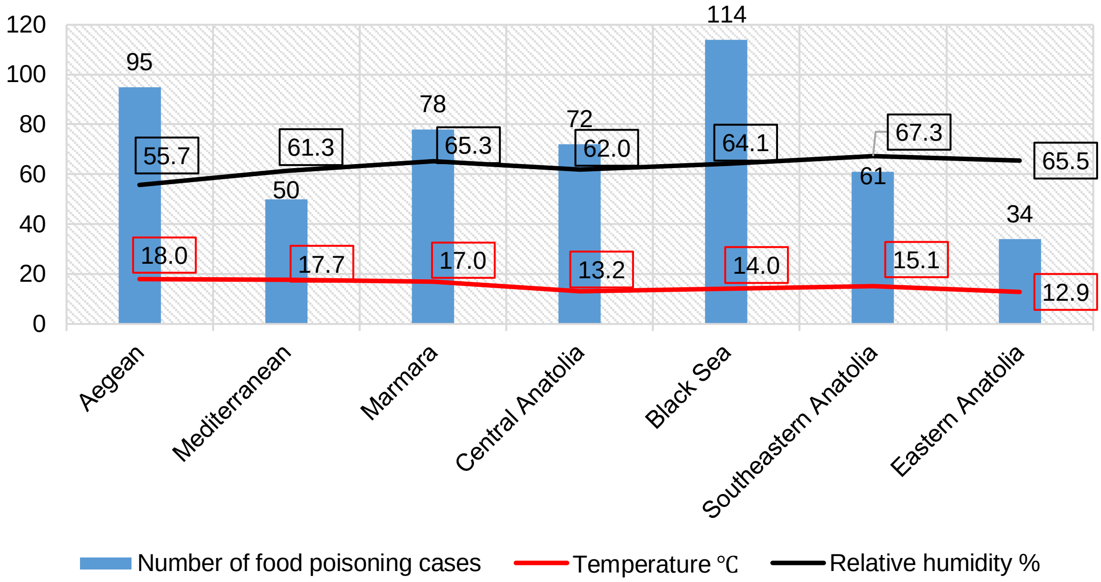

Figure 4. Number of food poisoning cases by geographical regions of Turkey

Cases of food poisoning were most common at school (n=135-26.8%), work (n=89-17.7%) and home (n=81-16.1%). As for the professional status, students and employees were most affected by food poisoning. 2,424 people in the other** group are soldiers. Dewey-Mattia et al. (Centers for Disease Control and Prevention-2018) reported that 61% (n=459) of the 839 cases of food poisoning in the United States in 2016 occurred in restaurants, 14% (n=102) in catering organizations, 10% (n=76) at homes where individuals lived, and 3% (n=21) at institutions such as schools and prisons [38].

2.4% (n=12), 29.4% (n=148), 36.5% (n=184), 28.4% (n=143), and 3.4% (n=17) of the food poisoning cases occurred at temperatures ranging from -10 to 0, 1 to 10, 11 to 20, 21 to 30, and 31 to 40, respectively. The number of people affected by food poisoning was the highest in the 21-30 temperature range (10,898) and the lowest in the -10–0 temperature range (553). 1.8% (n=9), 25.6% (n=129), 46.0% (n=232), 26.6% (n=134) of the food poisoning cases occurred at 0–25%, 26–50%, 51–75%, and 76–100% relative humidity ranges respectively. The number of people affected by food poisoning was the highest in the 26–50% relative humidity range (10,898) and the lowest in the 0–25% relative humidity range (Figure 5). Various scholars state that pathogens develop more rapidly at various points of the food chain due to increased temperature and relative humidity, causing an increase in food poisoning [21, 22, 31, 35, 39-44].

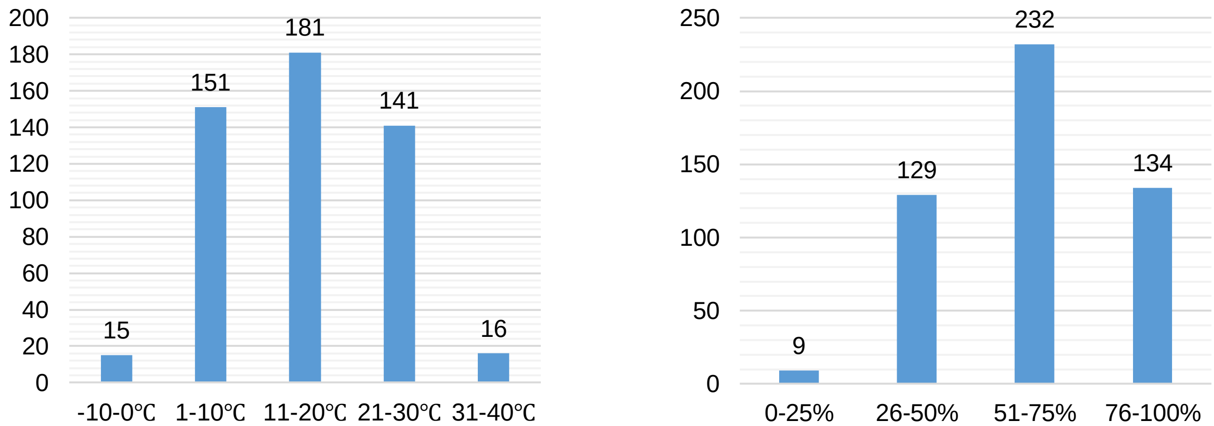

Figure 5. Numbers of food poisoning cases by temperature and relative humidity ranges

The Kruskal Wallis test was used to find out whether there were any differences between more than two independent groups in terms of the number of people affected by food poisoning and Bonferroni test was used to determine which groups had differences (Table 2).

Table 2. Examining the differences between the variables by the number of people affected by food poisoning

	n	Median (Min-Max)	X^2	p	Difference
Year					
2016	82	19.5 (1-332)			
2017	87	24 (1-221)			
2018	113	17 (1-1,221)	4.027	0.402	-
2019	128	25 (1-3,300)			
2020	94	23 (1-253)			
Month					
January	19	29 (1-176)			
February	33	10 (1-230)			
March	47	23 (1-331)			
April	44	21.5 (1-226)			
May	31	36 (1-1221)			
June	19	23 (1-200)	22.006	0.024*	2-5,7
July	55	31 (1-3,300)			
August	37	25 (1-163)			
September	38	16.5 (1-316)			
October	56	24 (1-332)			
November	53	24 (2-180)			
December	72	18 (1-473)			
Season					
Spring	122	24.5 (1-1,221)			
Summer	111	30 (1-3,300)	10.249	0.017*	2-4
Autumn	147	21 (1-332)			
Winter	124	16 (1-473)			
Region					
Aegean	95	26 (1-3,300)			
Mediterranean	50	23 (1-226)			
Marmara	78	20.5 (1-253)			
Central Anatolia	72	21.5 (1-300)	2.817	0.831	-
Black Sea	114	18 (1-473)			
Southeastern Anatolia	61	21 (2-332)			
Eastern Anatolia	34	25.5 (1-337)			
Place					
Home	81	7 (1-300)			
Workplace	89	30 (2-3,300)			
Restaurant	68	9.5 (1-110)			
Mevlit	30	45 (13-231)	118,372	0.000**	1,3-2,4,5,6,7 5-7
School	135	23 (1-473)			
Dormitory	47	36 (3-331)			
Other	54	67.5 (1-1,221)			
Profession					
Employee	95	30 (1-3,300)			
Student	218	22 (1-473)	27.125	0.000**	3-1,2,4
Citizen	154	13 (1-316)			
Other	37	44 (3-1,221)			

	n	Median (Min-Max)	X^2	p	Difference
Temperature (°C)					
-10-0	15	18 (2-176)			
1-10	151	20 (1-473)			
11-20	181	23 (1-1,221)	5.414	0.247	-
21-30	141	25 (1-3,300)			
31-40	16	25 (2-120)			
Relative Humidity (%)					
0-25	9	30 (1-300)			
26-50	129	29 (1-3,300)	5.928	0.115	-
51-75	232	20 (1-300)			
76-100	134	20.5 (1-473)			

*p<0.05, ** p<0.001, Min=Minimum, Max=Maximum, X^2=Kruskal Wallis Test, Difference= Bonferroni Test, p= Level of Significance

Table 2 shows that the Kruskal Wallis test did not reveal any statistically significant differences between the years, regions, temperature, and relative humidity ranges in terms of the number of people affected by food poisoning (median) ($p>0.05$). There was a statistically significant difference between the months, seasons, places and occupations in terms of the number of people affected by food poisoning ($p<0.05$). Accordingly, the number of people poisoned in May and July is significantly higher than the number of people poisoned in February while the number of people poisoned in summer is significantly higher than the number of people poisoned in winter. The number of people poisoned at homes and restaurants is significantly lower than the number of people poisoned at other places while the number of people poisoned at school is significantly lower than the number of people poisoned at other places. The number of poisoned citizens is significantly lower than the number of poisoned employees, students and other professional groups.

CONCLUSION

Food poisoning cases in Turkey between 2016 and 2020, and the number of people affected by those cases were statistically analyzed in terms of year, region, season, month, temperature, relative humidity, location, and occupation in this study, which is the first study conducted in this field. A total of 504 cases of food poisoning (100.8 cases/year, 42 cases/month) were experienced in Turkey between 2016 and 2020, and an estimated number of 27,196 people were affected. The number of food poisoning cases by region is the highest in the Black Sea region while the number of people affected by those cases is the highest in the Aegean region. The Aegean region is one of the important centers of Turkey in terms of population density and industry. It is thought that food poisoning cases occurring at workplaces operating in this region where mass food consumption takes place has an impact on the data. Surprisingly, most cases of food poisoning occurred in autumn and winter while the lowest number of cases took place in summer. The highest number of cases was seen in December, which is a winter month. It is thought that the main reason for the difference between the seasons is that the schools are closed during the summer season. Also, this may mean that consumers or manufacturers do not pay enough attention to product storage requirements in order to reduce energy costs due to temperature changes particularly caused by seasonal transitions and low air temperatures during the winter. Schools and workplaces stand out among the places where food poisoning takes place. As a general evaluation, it can be said that consumers tend to consume foods such as meat and meat products, which can cause poisoning, in winter. Therefore, consumers' food preferences and cooking characteristics styles may also be a reason fort he difference in poisoning between seasons. Both schools and workplaces are places where mass meal consumption takes place. Large masses are affected by contamination or negligence at any stage of the food chain at catering organizations where food is both produced and consumed at the same center and from which catering services are purchased. As a matter of fact, students and employees are the professional groups that are most affected by food poisoning. No direct correlation of food poisoning with ambient temperature and relative humidity was determined. However, it can be said that the number of food poisoning cases increases due to the increase in temperature and relative humidity. It is presumed that changes in nutrition methods of consumers caused by temperature have an impact on food poisoning cases. The fact that individuals tend to turn towards raw, quickly accessible and uncooked food in hot weather increases the risk of cross contamination. It should be noted that the data on food poisoning in this study include the minimum values. Another result of this study is the data on food poisoning are not systematically recorded and there is no transparency in information sharing. It must be kept in mind that food poisoning can significantly affect public health and national economies. This is why food poisoning should be criminally investigated and the public and private sectors should work together to prevent similar cases.

Conflict of Interests

No potential conflict of interest was reported by the authors.

Financial Disclosure

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