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AN ANALYSIS OF FIFTY-YEAR-SURVEILLANCE OF FOOD RELATED DISEASES IN TURKEY

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ABSTRACT

Occurrence rate and magnitude of food-related diseases (FRD) are of global concern causing socio-economic issues, and thus, they must be continuously monitored. The objectives of the study were to determine occurrence rate and trends of FRD in Turkey from 1960 to 2010 in parallel to increased rate of population growth. Recorded incidents of foodborne illnesses/diseases were obtained as annual reports and expressed as disease/population rate in order to determine trends of each disease. Long-term evaluations of bacillary dysentery (BD), brucellosis, gastrointestinal diarrhea (GD), meningitis infections, meningitis and central nervous system infections (MCNSI), other bacterial infections, other infections and parasite-caused diseases (OIPCD), other virus-caused infections, paratyphoid, and typhoid showed different trends in terms of occurrence rate but an overall decrease in the occurrence rates of BD, GD, OIPCD, and typhoid.

Keywords: foodborne diseases, public health, Turkey

1. INTRODUCTION

Foodborne illnesses/diseases are the major causes with high socio-economic impacts of death of infant, elderly and people with immune deficiency. Although foodborne illnesses/diseases exert significant impacts on societies, they are seriously underreported and underestimated [1-3]. However, the quantification and monitoring remain essential to efforts to understand and prevent them [2, 4, 5]. In contrast to advances in food quality and safety, efforts to establish HACCP plans and other safety precautions, many foodborne illnesses/diseases and outbreaks are reported each year in related literature [6-9]. The reasons for these illnesses/diseases can be cross-contamination, improper cooling, storage and/or handling, contaminated raw food/ingredient, and poor personal hygiene in handling of foods [10-13].

Several studies were reported to estimate occurrence rate and magnitude of foodborne illnesses/diseases in different European and North American countries [6, 9-12]. Even though foodborne illnesses are receiving public attention, not enough data are published for different countries to estimate their magnitude. In most cases, reported illnesses published in the related literature are from developed countries; however, it is also important to establish database about foodborne illnesses from developing and third world countries [10-13].

With its growing food industry in parallel to its increasing population growth, Turkey has been facing some issues with foodborne/food-related illnesses. Some of these illnesses occur in villages and towns where not adequate sanitation and proper handling exist, while some are caused by contamination in modern food production and distribution chain. The municipal authorities of environmental and public health are encouraged to report foodborne diseases to the Turkish Statistical Institute (TUIK) that releases yearly reports based on received information. However, there exist no published data on magnitude and/or occurrence of foodborne illnesses in Turkey. Therefore, the objectives of the study are to determine occurrence and magnitude of foodborne illnesses such as bacillary dysentery (BD), brucellosis, gastrointestinal diarrhea (GD), meningitis infections (MI), meningitis and central nervous system infections (MCNSI), other bacterial infections (OBI), other infections and parasite-caused diseases (OIPCD), other virus-caused infections (OVCI), paratyphoid, and typhoid; thus providing trends of each disease in parallel to population growth in Turkey from 1960 to 2010.

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2. MATERIALS AND METHODS

2.1. Data source

Individual outbreak investigations performed by local authorities, related-government ordinances, and hospitals were collected from 1960 to 2010 and issued as "Death Statistics Province and District Centers" by Turkish Statistical Institute (TUIK) (Ankara, Turkey) [14]. Population data between 1960 and 2010 were also obtained from TUIK [15].

2.2. Data processing

The data about foodborne diseases as obtained from TUIK were selected and categorized according to gender and total population. In order to determine trends of each disease, annual outbreak incidents obtained were divided into related portions of population and expressed in disease/population rate.

2.3. Statistical analysis

Best-fit least-square regression analysis was applied to time series data of foodborne diseases. Regression equations and their (adjusted) coefficient of determination [$R^2_{(adj)}$] values were reported. All the statistical analyses were conducted using Minitab 16.1 (Minitab Inc., State College, PA).

3. RESULTS AND DISCUSSION

The data analysis showed that while some disease records (BD, typhoid, OIPCD, and MI) were started from 1960, the others were started from 1975 (GD) and 1988 (MCNSI, paratyphoid, brucellosis, OBI and OVCI), respectively, in Turkey. BD was one of the most common foodborne diseases from 1960 to the 1970s with infection rate close to 25 per 1000. After the year 1970, the occurrence rate of the disease was lowered but increased between 1973 and 1976 again. From 1976 to 2010, the occurrence rate of the disease increased to 5 per 1000 for every four to five years and went down to per 1.74 per 1000 between 2008 and 2010 (Fig. 1). The occurrence rate of GD was much lower than that of BD between 1975 and 2002. Although few incidences were recorded between 1992 and 1994 as well as 1996 and 1998, the occurrence rate of GD was mostly less than 1 per 1000 by 2002 (Fig. 1).

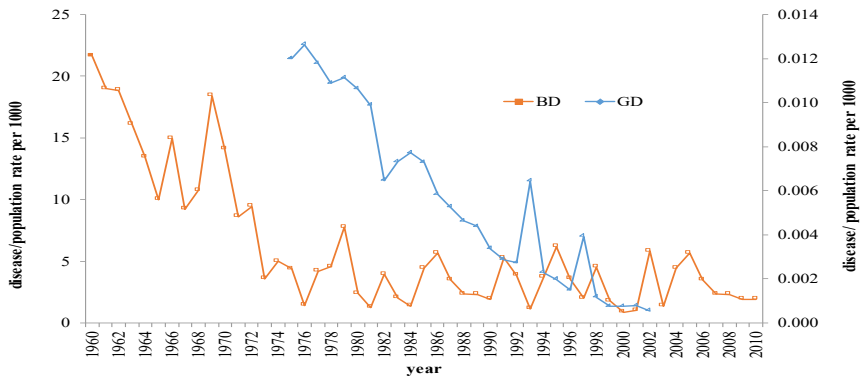

Figure 1. Occurrence rates of bacillary dysentery (BD) and gastrointestinal diarrhea (GD) in Turkey between 1960 and 2010

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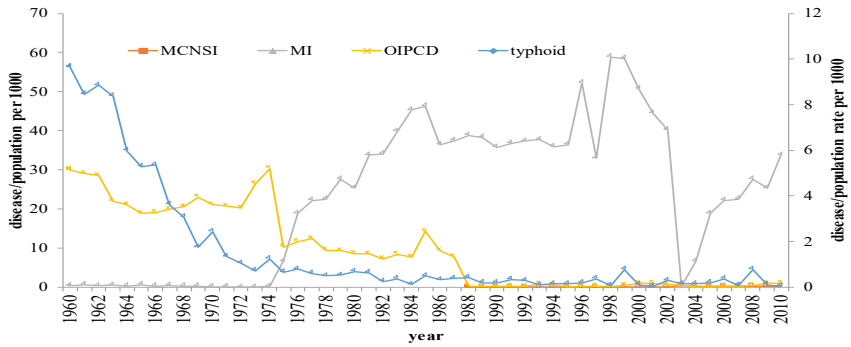

Figure 2. Occurrence rates of typhoid, other infections and parasite-caused diseases (OIPCD), meningitis infections (MI), meningitis and central nervous system infections (MCNSI), and typhoid in Turkey between 1960 and 2010

The reported cases of MI were relatively low from 1960 to 1974. From 1974 to 1985, there was a significant increase in the number of the reported cases up to 48 per 10000. However, the occurrence rate of the disease did not change between 1986 and 1995. An increase occurred in the reported cases from 1995 to 1996 up to 50 per 10000 and from 1998 to 1999 up to 58 per 10000. Starting from 2000, the number of the reported cases diminished close to zero until 2002. Unfortunately, there was another rise starting from 2002 to 2010 with 34 per 10000 (Fig. 2). Records for MCNSI were started in 1988 whose occurrence rate stayed relatively low from 1988 to 1992. In the years 1992 and 1995, the disease occurrence rate was highest with 5 per 10000. After 1996, its occurrence rate was greatly reduced; however, starting from 1996 to 2002, there was a slight increase in the outbreaks of the disease in every two to three years up to 8 per 10000 (Fig. 2).

The reported cases of OIPCD were much higher between 1960 and 1988 than over the period from 1988 to 2010. The occurrence rate of the disease was 30 per 10000 in both 1960 and 1973. Its occurrence rate was slightly reduced until 1975. The reported cases of OIPCD were highest with 13 per 10000 in 1976. After 1975, the number of reported cases, except for the increase in 1985 up to 16 per 100000, were greatly diminished and became almost zero from 1988 to 2010 (Fig. 2). The number of reported cases of typhoid started to decrease from 1960 to 1988, and did not show any significant change from 1988 to 2010. The reported cases were around 10 per 10000 in 1960 and were declined close to zero by 2010 despite a slight increase in both 1999 and 2008 (Fig. 2).

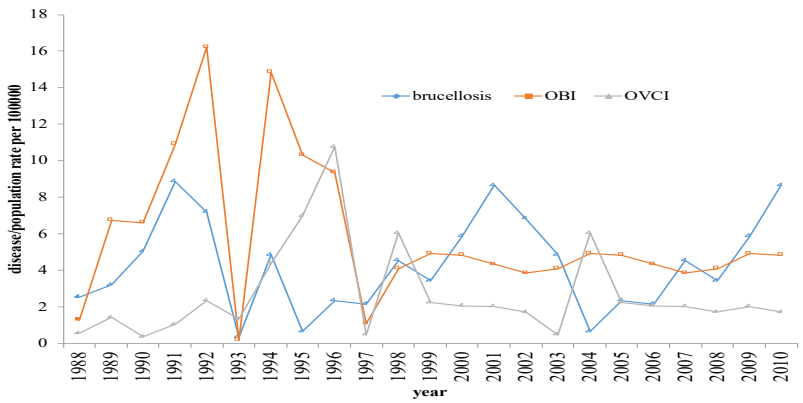

Figure 3. Occurrence rates of brucellosis, other bacterial infections (OBI), other virus-caused infections (OVCI), and paratyphoid in Turkey between 1960 and 2010

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The earliest recording of brucellosis was started in 1988. From 1988 to 1991, the occurrence rate of brucellosis increased up to 8 per 100000. In 1992, the rate was greatly diminished to zero but increased again from 1994 to 1996. Although its occurrence rate changed in every couple of years, the maximum increase was observed between 2000 and 2002 with 8 per 100000. The occurrence rate was reduced to 1 per 100000 in 2004 and gradually increased back to 8 per 100000 in 2010 (Fig. 3). The occurrence rate of OBI was also recorded after 1988 whose occurrence rate increased until 1992 with 16 per 100000. In 1993, the number of the reported cases were markedly diminished but increased back to 14 per 100000 in 1995. Despite the increase in its occurrence rate after 1997, the number of the reported cases was much lower than in 1993. Its occurrence rate was around 4 per 100000 between 1999 and 2010 (Fig. 3). The reported cases of OVCI increased up to 12 per 100000 in 1996. The reported cases decreased from 1996 to 1997 but both increased up to 7 per 100000 from 1998 to 2004. Starting from 2005, the occurrence rate was around 3 per 100000 (Fig. 3).

The reported cases of paratyphoid were started from 1988 and had an occurrence rate of 3 per 1000000, which was almost zero between 1990 and 1992. Starting from 1992, its occurrence rate rose to around 5 per 1000000 from 1994 to 2000. Its occurrence rate was diminished by 2000 but increased after 2001 to 3 per 100000 until 2006. Its occurrence rate became almost zero between 2006 and 2010 (Fig. 3).

GD was one of the most common diseases that occurred in Turkey followed by MI and OIPCD. The total numbers of GD cases were 79367 with 41446 male and 37920 female subjects. The total numbers of MI cases were 59723 with 33105 male and 26618 female subjects, whereas these numbers were 18175 with 9732 males and 8443 females for OIPCD (Tab. 1).

Table 1. Reported cases of foodborne diseases in Turkey between 1960 and 2010

Disease	Total number	Male	Female
BD	1144	624	520
Brucellosis	422	204	218
GD	79367	41446	37920
MI	59723	33105	26618
MCNSI	888	564	324
OBI	619	327	292
OIPCD	18175	9732	8443
OVCI	279	158	121
Paratyphoid	54	28	26
Typhoid	2643	1284	1359

Gender and age distributions of FRD revealed that while the occurrence rates of typhoid, BD, MI, OBI, and OVCI differed significantly ($P \leq 0.05$), no significant difference was detected for paratyphoid, and brucellosis among all the age groups (Tab. 2). It was obvious that most FRD diseases except for typhoid were reported mostly for the newborns. The higher occurrence rate of typhoid was reported for the age groups of 15-24, 5-14, and 25–34 ($P \leq 0.05$); whereas the lower occurrence rate was reported for age groups of 65-74, >75, 55-64, and 45-54, respectively. The BD cases were mostly reported for the newborns followed by the age groups of 25-34, 15-24, 35-44, and 5-14. On the other hand, the higher occurrence rate occurred for 5-14, newborns, and 1-4 ($P \leq 0.05$) (Tab. 2).

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Table 2. Male age distribution of foodborne diseases reported in Turkey between 1960 and 2010

Disease	Age group									
	<1	**1–4**	**5–14**	**15–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65–74**	**>75**
BD	4.76^{a}	2.07^{b}	0.73^{c}	0.59^{c}	0.28^{c}	0.71^{c}	0.95^{bc}	1.57^{bc}	1.83^{bc}	1.33^{bc}
Brucellosis	1.25^{a}	0.5^{a}	0.5^{a}	0.25^{a}	0.5^{a}	1.00^{a}	1.75^{a}	2.12^{a}	2.75^{a}	2.12^{a}
GD	859.9^{a}	219.3^{b}	32.9^{c}	8.4^{c}	7.7^{c}	7.2^{c}	9.4^{c}	13.9^{c}	22.5^{c}	33.3^{c}
MI	509.5^{a}	100.4^{b}	32.9^{b}	17.0^{b}	14.4^{b}	16.9^{b}	23.7^{b}	28.9^{b}	30.8^{b}	19.2^{b}
MCNSI	2.37^{a}	3.75^{a}	1.62^{a}	1.5^{a}	2.25^{a}	1.12^{a}	2.00^{a}	2.37^{a}	2.00^{a}	1.62^{a}
OBI	11.75^{a}	2.00^{b}	0.87^{b}	1.62^{b}	1.50^{b}	1.75^{b}	2.12^{b}	4.00^{b}	2.87^{b}	2.00^{b}
OIPCD	90.83^{a}	36.48^{b}	30.71^{bc}	16.71^{bc}	13.57^{bc}	16.19^{bc}	19.50^{bc}	24.02^{bc}	19.41^{bc}	10.86^{c}
OVCI	5.5^{a}	0.5^{b}	0.87^{b}	0.37^{b}	0.87^{b}	1.25^{b}	0.5^{b}	1.37^{b}	0.75^{b}	0.62^{b}
Paratyphoid	0.62^{a}	0.25^{a}	0.00^{a}	0.00^{a}	0.00^{a}	0.12^{a}	0.37^{a}	0.37^{a}	0.25^{a}	0.25^{a}
Typhoid	1.39^{ac}	2.07^{a}	6.61^{b}	8.26^{b}	6.00^{b}	3.14^{c}	1.46^{a}	1.34^{a}	0.75^{a}	0.87^{a}

There was a significant difference in female subjects among all the age groups for typhoid, BD, OBI, and OVCI, while no significant difference was detected for the other FRD (Tab. 3). Similar to male subjects, most FRD diseases except for typhoid were reported mostly for newborns. The most frequent occurrence rate of typhoid was reported for the 15–24 age groups ($P \leq 0.05$) of women followed by the 5–14 and 25–34 age groups, with the lowest occurrence rate for the age group >75. The occurrence rates based on the records of BD for female subjects in decreasing order of age groups were as follows: 0 > 1-4 > 25-34 > 35-44 > 15-24 > 45-54 > 5-14 (Tab. 3).

Table 3. Female age distribution of foodborne diseases reported in Turkey between 1960 and 2010

Disease	Age group									
	<1	**1–4**	**5–14**	**15–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65–74**	**>75**
BD	3.81^{a}	2.11^{b}	0.64^{c}	0.5^{c}	0.19^{c}	0.47^{c}	0.52^{c}	1.02^{bc}	1.23^{bc}	1.76^{bc}
Brucellosis	0.62^{a}	0.37^{a}	0.12^{a}	0.00^{a}	0.25^{a}	1.00^{a}	1.37^{a}	3.12^{a}	1.75^{a}	4.25^{a}
GD	936.1^{a}	218.7^{b}	35.3^{c}	11.8^{c}	8.7^{c}	10.9^{c}	19.4^{c}	25.9^{c}	31.7^{c}	29.3^{c}
MI	390.2^{a}	83.5^{b}	25.7^{b}	16.1^{b}	16.8^{b}	14.9^{b}	18.0^{b}	22.6^{b}	26.0^{b}	21.1^{b}
MCNSI	2.62^{a}	3.62^{a}	2.5^{a}	1.5^{a}	0.62^{a}	0.75^{a}	1.5^{a}	1.25^{a}	1.00^{a}	0.62^{a}
OBI	8.25^{a}	2.75^{b}	2.12^{b}	1.62^{b}	2.75^{b}	1.12^{b}	0.75^{b}	2.00^{b}	3.37^{b}	2.37^{b}
OIPCD	64.86^{a}	29.17^{b}	19.50^{b}	16.76^{b}	24.40^{b}	18.86^{b}	13.76^{b}	16.23^{b}	14.46^{b}	13.79^{b}
OVCI	3.62^{a}	1.0^{b}	0.12^{b}	1.00^{b}	0.37^{b}	0.50^{b}	0.37^{b}	0.87^{b}	0.87^{b}	0.37^{b}
Paratyphoid	0.00^{a}	0.25^{a}	0.25^{a}	0.00^{a}	0.00^{a}	0.12^{a}	0.25^{a}	0.5^{a}	0.12^{a}	0.12^{a}
Typhoid	1.54^{a}	2.35^{b}	4.66^{c}	7.23^{d}	4.33^{e}	3.47^{b}	2.59^{b}	1.59^{a}	1.35^{a}	0.64^{c}

In order to evaluate long-term behavior of each FRD best-fit least-square regression analyses were performed. Due to the fluctuations in the occurrence rate of each FRD, no distinctive conclusions can be made regarding the future trends of each disease. However, typhoid, GD, MI and OIPCD diseases led to R^2 values of 0.87, 0.89, 0.81, 0.84, and 0.83, respectively. The other reported diseases resulted in lower R^2 values than 0.60 (Tab. 4).

Occurrence rates and prevalence of foodborne diseases have been reported mostly by developed countries including USA, Canada, and Europe [6, 9-11, 16-18] along with mortality and morbidity rates, magnitude, direction, and future trends [6, 9, 16, 17, 19, 20]. Unfortunately, no reported data and long-term evaluations of foodborne diseases are available from developing countries (including Turkey) although these countries experience a rapid rate of population growth.

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Table 4. Best-fit least-square regression analyses of time series data for foodborne diseases that occurred in Turkey between 1960 and 2010

Disease	Regression equation	$R^2_{(adj)}$
BD	$y = -5.761\text{Ln}(x)+22.937$	0.78
Brucellosis	$y = 0.0575x^2-4.002x+72.918$	0.18
GD	$y = -0.4722x+19.464$	0.89
MI	$y = -0.0113x^2+1.9417x-11.42$	0.84
MCNSI	$y = -0.0116x^2+0.8055x-12.831$	0.03
OBI	$y = -0.1109x^2+7.735x-126.08$	0.20
OIPCD	$y = -0.7377x+27.458$	0.83
OVCI	$y = -0.0897x^2+6.6032x-116.91$	0.32
Paratyphoid	$y = 0.0039x^2+0.004x-0.5468$	0.45
Typhoid	$y = -2.8908\text{Ln}(x)+9.9688$	0.87

Another important issue with the data is that they do not have enough information such as detection of pathogenic causes, actions taken to cure the diseases, steps taken for legal procedures, and consequences of the diseases. For example, the occurrence rates of some diseases such as bacillary dysentery, typhoid, gastrointestinal diarrhea, diphtheria and OIPCD were diminished from 1960 to 2002; however, causes for these fluctuations were not correlated with social and economical facts. The reasons for this reduction in can be owing to improvements of hygiene and sanitary conditions in food production and processing plants, implementation of HACCP, GMP and ISO standards by food processing plants, their enforcement by government and local authorities, and/or increased quality of processing water. As opposed to the above mentioned diseases, the number of the reported cases increased for brucellosis and MI. One of the major pitfalls of the data records in Turkey was that the links of foods vehicle and disease agent to the reported disease were not explored. Although foods involved in these cases were not reported, there is a possibility that the increases in consumer demands for local and traditional cheeses produced from raw milk and the numbers of small cheese production plants grew the number of reports for brucellosis cases in the recent years. In their current state, these records do not suffice to understand disease agents, vehicles and contributing factors behind the diseases unless multiple correlations among them are explored. Previous studies about the incidents of foodborne diseases generally indicated most likely relationships between food vehicle and disease agent which in turn makes the reported incidents more useful [19-22].

It is well known fact that foodborne diseases are underreported, and these numbers represent only a fraction, maybe less than 1% of those who are actually exposed [23]. Hence, it is safe to assume that more than 99% of the cases in Turkey were not reported. It appears to be the reason why foodborne disease incidents reported were significantly less in this study than in Europe, United States, and Canada [6, 9-11, 16, 17]. As was also emphasized that legal authorities in Turkey should also strive to detect relationships among food vehicle, disease agent, history of food vehicle, and subsequent growth of pathogens in order to have a better understanding of foodborne diseases and outbreaks in the future [24].

REFERENCES

[1] J. A. Haagsma, S. Polinder, C. E. Stein, A. H. Havelaar, Systematic Review of Foodborne Burden of Disease Studies: Quality Assessment of Data and Methodology, International Journal of Food Microbiology, 166 (1) (2013), pp. 34-47.

[2] T. Kuchenmüller, B. Abela-Ridder, T. Corrigan, A. Tritscher, World Health Organization Initiative to Estimate the Global Burden of Foodborne Diseases. Revue Scientifique et Technique, 32 (2013), pp. 459–467.

[3] B. Devleesschauwer, A. H. Havelaar, C. Maertens de Noordhout, J. A. Haagsma, N. Praet, P. Dorny, L. Duchateau, P. R. Torgerson, H. V. Oyen, M. Speybroeck, Calculating Disability-adjusted Life Years to Quantify Burden of Disease, International Journal of Public Health, 59 (3) (2014), pp. 565–569.

[4] C. Maertens de Noordhout, B. Devleesschauwer, F. J. Angulo, G. Verbeke, J. Haagsma, M. Kirk, A. Havelaar, N. Speybroeck, The Global Burden of Listeriosis: A Systematic Review and Meta-analysis, Lancet Infectious Diseases, 14 (11) (2014), pp. 1073-1082.

[5] S. F. Altekruse, Consumer Knowledge of Foodborne Microbial Hazards and Food-handling Pratices. Journal of Food Protection, 59 (3) (1996), pp. 287-294.

[6] S. Yang, M. G. Leff, D. McTague, K. A. Horvath, J. Jackson-Thompson, Y. Murayi, G. K. Boeselager, T. A. Melnik, M. C. Gildemaste, D. L. Riding, S. F. Alterkruse, F. J. Angulo, Multistate Surveillance for Food-Handling, Preparation, and Consumption Behaviors Associated with Foodborne Diseases: 1995 and 1996 BRFSS Food-Safety Questions. Morbility and Mortality Weekly Report Surveillence Summmary, 47 (1998), pp. 33-57.

[7] A. E. Johnson, J. M. Donkin, K. Morgan, J. M. Lilley, R. J. Neale, R. M. Page, R. Silburn, Food Safety Knowledge and Practice Among Elderly People Living at Home. Journal of Epidemiology and Community Health, 52 (1998), pp. 745-748.

[8] M. E. Parish, Coliforms, *Escherichia coli* and *Salmonella* serovars Associated with Citrus-processing Facility Implicated in a Salmonellosis Outbreak. Journal of Food Protection, 61 (1998), pp. 280-284.

[9] S. D. Bennett, K. A. Walsh, L. H. Gould, Foodborne Disease Outbreaks Caused by *Bacillus cereus*, *Clostridium perfringens*, and *Staphylococcus aureus*-United States, 1998–2008. Clinical Infectious Diseases, 57 (3) (2013), pp. 425-433.

[10] R. L. Shapiro, S. Altekruse, L. Hutwagner, R. Bishop, R. Hammond, S. Wilson, B. Ray, S. Thompson, R. V. Tauxe, P. M. Griffin, the Vibrio Working Group, The Role of Gulf Coast Oysters Harvested in Warmer Months in *Vibrio vulnificus* Infections in the United States, 1988-1996. Journal of Infectious Diseases, 178, (1998), pp. 752-759.

[11] R. Shapiro, M. L. Ackers, S. Lance, M. Rabbani, L. Schaefer, J. Daugherty, C. Thelen, D. Swerdlow, Salmonella *Thompson* Associated with Improper Handling of Roast Beef at a Restaurant in Sioux Falls, South Dakota. Journal of Food Protection, 62 (1999), pp. 118-122.

[12] I. F. Angelillo, Food Handlers and Foodborne Diseases: Knowledge, Attitudes, and Reported Behavior in Italy. Journal of Food Protection, 63 (3) (2000), pp. 381-385.

[13] J. Schlundt, New Directions in Foodborne Disease Prevention. International Journal of Food Microbiology, 78 (2002), pp. 3-17.

[14] Turkish Statistical Institute (TUIK), Death Statistics Province and District Centers, Ankara Turkey, 1960-2010.

[15] Turkish Statistical Institute (TUIK), Population Statistics, Ankara Turkey, 1960-2010.

[16] J. C. M. Sharp, W. J. Reilly, Recent Trends in Foodborne Infections in Europe and North America. British Food Journal, 96 (7) (1994), pp. 25-34.

[17] N. H. Bean, P. M. Griffin, Foodborne Disease Outbreaks in the United States, 1973-1987: Pathogens, Vehicles, and Trends. Journal of Food Protection, 53 (1990), pp. 804-817.

[18] T. E. Steahry. An Estimate of Foodborne Illness in the Elderly Population of the United States, 1987-93. International Journal of Environmental Health Resources, 8 (1998), pp. 23-34.

[19] D. J. Wallace, T. Van Gilder, S. Shallow, T. Fiorentino, S. D. Segler, K. E. Smith, B. Shiferaw, R. Etzel, W. E. Garthright, F. J. Angulo, Incidence of Foodborne Illnesses Reported by the Foodborne Disease Active Surveillance Network (Foodnet)-1997. Journal of Food Protection, 63 (6) (1997), pp. 807-809.

[20] A. M. Sewell, J. M. Farber, Foodborne Outbreaks Linked to Produce. Journal of Food Protection, 64 (11), (2001), pp. 1863-1877.

[21] F. L. Bryan, Risks of Practices, Procedures and Processes that Lead to Outbreaks of Foodborne Diseases. Journal of Food Protection, 51 (1998), pp. 663-673.

[22] R. V. Tauxe, Emerging Foodborne Pathogens. International Journal of Food Microbiology, 78 (2002), pp. 31-41.

[23] Y. Motarjemi, F. Kaferstein, Global Estimation of Foodborne Disease. World Health Statistics

Quarterly, 50 (1/2) (1997), pp. 5-11.
[24] R. Lindqvist, Y. Andersson, B. De Jong, P. Norberg, A Summary of Foodborne Disease Incidents in Sweden, 1992 to 1997. Journal of Food Protection, 63 (10) (2000), pp. 1315-1320.