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Evaluation of Tularemia cases in Ankara province, Turkey

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Summary: Tularemia; caused by *Francisella tularensis* is a zoonotic disease which can be seen endemic in the northern hemisphere. The distribution of tularemia cases according to years and the characteristics of the disease in Ankara province were evaluated in this descriptive study. The number of tularemia cases according to years in Ankara were as follows: 129 cases in 2010, 349 in 2011, 87 in 2012, 2 in 2013, 0 in 2014, 23 in 2015, 86 in 2016, 16 in 2017 and 4 in 2018. 52.3% of cases seen in the years 2010-2018 were female (n = 364) and 47.7% (n = 332) were male and the mean age was 38.99 ± 18.82. In these cases, the use of waterwork was 66.7%, the use of public fountains was 40.3%, the use of well water was 7.0%, the presence of rodents around was 25.6%. To control tularemia, well water, spring water and fountains outside the grid system must be controlled; used water tanks must be maintained and cleaned at regular intervals. It is important that the water against microbiological contamination are chlorinated by automatic devices and the residual chlorine measurements are made without interruption.

Keywords: *Francisella tularensis*, rodent diseases, tularemia, waterborne diseases.

Ankara ilinde görülen Tularemi olgularının değerlendirilmesi

Özet: Tularemi, etkeni *Francisella tularensis* olan, kuzey yarı kürede endemik olarak görülebilen zoonotik bir hastalıktır. Bu tanımlayıcı tipteki çalışmada, Ankara İli'nde görülen tularemi olgularının yıllara göre dağılımı ve bazı özellikleri değerlendirilmiştir. Ankara genelinde yıllara göre tularemi olgu sayıları şöyledir: 2010'da 129, 2011'de 349, 2012'de 87, 2013'te 2, 2014'te 0, 2015'te 23, 2016'da 86, 2017'de 16 ve 2018'de 4 vaka. 2010-2018 yıllarında görülen olguların %52.3'ü kadın (n=364), %47.7'si ise (n=332) erkektir; yaş ortalaması 38.99±18.82'dir. Bu olgularda şebeke suyu kullanımı %66.7, halk çeşmelerinden su kullanımı %40.3, kuyu suyu kullanımı %7.0; çevrede kemirgen varlığı %25.6, olarak saptanmıştır. Tulareminin kontrol edilmesi amacı ile şebeke sistemi dışındaki kuyu suyu, kaynak suları ve halk çeşmelerinin kontrolü sağlanmalı; kullanılan su depolarının bakımları yapılmalı ve düzenli aralıklar ile temizlenmelidir. Mikrobiyolojik kirlenmeye karşı suların otomatik cihazlar ile klorlanması ve bakiye klor ölçümlerinin aksatılmadan yapılması önemlidir.

Anahtar sözcükler: *Francisella tularensis*, kemirgen hastalıkları, su kaynaklı hastalıklar, tularemi.

Introduction

Tularemia, caused by *Francisella tularensis* is a zoonotic disease which is endemic in the northern hemisphere. *F. tularensis* is a small gram-negative, coccobacillus bacterium (10). More than 125 animal species have been reported as the host of *F. tularensis*. Many animals, such as rabbits, various wild birds, rat, mouse, squirrel, tick, cats, dogs, sheep and bears, serve as hosts for bacteria (4).

The risk factors include hunting and eating wild rabbit meat, use of spring and well water, unhygienic food consumption, contact with rodent extracts, increased number of rodents inside and around the house and nature-related activities. While the world's most frequent transmission is contact with infected animals and ticks, consumption of spring water and non chlorinated drinking water is the most important transmission route in Turkey (3-12-13).

In recent years, parallel to climate changes, tularemia epidemiology has changed significantly in the world due to unsuitable living conditions, changes in reservoirs and vector population as well as distribution and improper living conditions due to war and migration significant increases in number of cases have been observed (3).

Ministry of Health General Directorate of Primary Health Care published a circular, numbered 2005/61 in 11/04/2005 about tularemia. In the circular in 2005, Tularemia was put on the list of Group C diseases, in the Reporting and Communication System for Communicable Diseases Standard Diagnosis, Surveillance and Laboratory Guidance. In this way, standardization has improved for tularemia; sampling and sending rules for diagnosis laboratory criteria and case definition were formed.

While tularemia was common in Marmara Region and Western Black Sea Regions before 2005, new cases were reported in the first half of 2009-2010 especially from Central Anatolia Region (16). There were 5.434 new

cases reported in Turkey between 2005 and 2012; %41.2 of them were from Central Anatolia Region (13).

Because of the increase in the tularemia cases in Ankara in 2010, "Ankara Provincial Public Health Committee (PHC) has started works such as rehabilitation of water tanks in villages, towns and districts, disinfection of the using or drinking water by automatic device or system and protection of the storages from the tularemia disease with the 2010/3 numbered PHC decisions. When tularemia cases increased again in 2016, Ankara PHC convened and took decisions with heavy sanctions especially related to water sanitation.

Ministry of Health made a change in the regulation on the Water Intended for Human Consumption on 20/10/2016. According to the modification, disinfection of the drinking water by consuming the chlorine and chlorinated compound with the automatic chlorination equipment and disinfection process starts according to flow rate and water pressure with regulatable automatic chlorination machines and measurements at the end points stabled at the point of free chlorine levels of 0.2-0.5 mg/L. "In case of failure in chlorination, back up chlorination units have to be made by local administration" law brought from the administration (2).

Surveillance and evaluation of tularemia trend and its characteristics is important in determining the epidemics in a timely manner and taking control measures. The aim of this study is to investigate the trend of tularemia cases and related characteristics in Ankara Province, Turkey.

Material and Methods

Our research was a descriptive study. In the scope of research, numbers of tularemia cases have been detected by Ankara Provincial Health Directorate Public Health Services Presidency, in behalf of "Directorate of Public Health Services Primary Health Statistics Module" between 2010-2018. The characteristics of tularemia cases in the years 2015-2018 were analyzed.

Within the scope of the study, information about the number and characteristics of the water reservoirs in the province and the protection and control measures taken regarding the tularemia were taken from the related units of the Ankara Provincial Directorate of Health.

In order to use the data in the study, permission was obtained from the Ankara Provincial Health Directorate Public Health Services Presidency Provincial Research Demands Evaluation Commission with the decision of the meeting dated 08/08/2018.

Descriptive analyses were presented using number and percentage for categorical variables; mean, standard deviation, median, minimum and maximum values for continuous variables. The statistical analysis was carried out by using OpenEpi Version 3.01. The Chi-square test was used to compare categorical variables in different groups. A p-value of less than 0.05 was considered to show statistically significant result.

Results

Table 1 demonstrates the distribution of tularemia cases by months and years in Ankara Province. Grafic 1. shows distribution of the total tularamia cases by months between 2010-2018. The distribution of cases by sex and age according to years are given in Table 2. Tularemia cases in Ankara are generally seen in rural areas, but they are caused by feeding in contaminated foods during their visits to villages and rural areas, and by bringing drinking water from drums and drinking water to the house. After the onset of tularemia cases, the first case cluster occurred in November 2010 in Bala, followed by in Pursaklar District and in Çubuk District. In December 2010, the cases of tularemia occurred in Mamak District and later in many villages and towns of Haymana, Polatlı, Kızılcahamam, Bala, Şereflikoçhisar, Beypazarı, Çamlıdere. The residence addresses of these cases are shown in Figure 1.

Table 1. Distribution of tularemia cases by months and years (Ankara province, Turkey).
Tablo 1. Tularemi olgularının aylar ve yıllara göre dağılımı (Ankara, Türkiye)

Months	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
January	1	56	13	0	0	3	18	0	1	**92**
February	5	98	34	0	0	1	14	1	2	**155**
March	8	41	23	0	0	0	23	3	1	**99**
April	7	18	5	1	0	0	4	2	0	**37**
May	5	10	1	1	0	1	5	0	0	**23**
June	1	9	4	0	0	2	2	1	0	**19**
July	2	25	2	0	0	2	3	1	0	**35**
August	2	10	0	0	0	1	6	1	0	**20**
September	17	15	1	0	0	2	1	3	0	**39**
October	10	8	0	0	0	0	1	2	0	**21**
November	39	45	2	0	0	1	2	2	0	**91**
December	32	14	2	0	0	10	7	0	0	**65**
Total	**129**	**349**	**87**	**2**	**0**	**23**	**86**	**16**	**4**	**696**

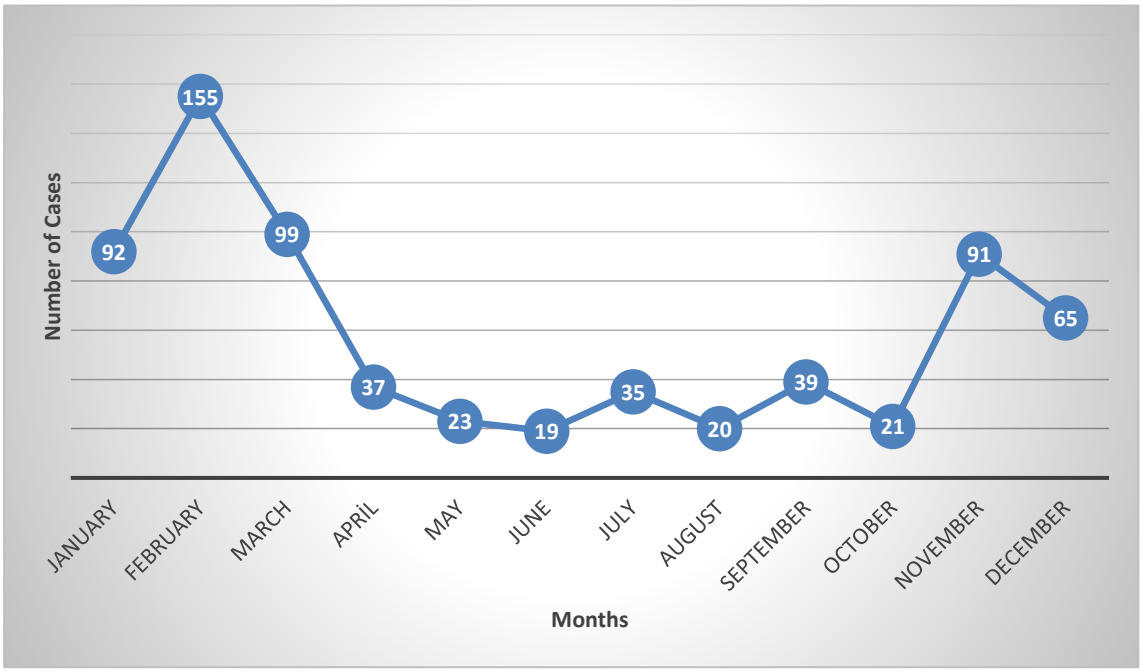

Figure 1. Distribution of tularemia cases by months between 2010-2018 (Ankara Province, Turkey).
Şekil 1. 2010- 2018 yılları arasındaki tularemi olgularının aylara göre dağılımı (Ankara, Türkiye)

Tularamia Cases (n=696)

1- Çubuk	(n=146)
2- Bala	(n=84)
3- Mamak	(n=50)
4- Haymana	(n=46)
5- Polatlı	(n=36)
6- Gölbaşı	(n=33)
7- Keçiören	(n=31)
8- Altındağ	(n=29)
9- Akyurt	(n=25)
10- Pursaklar	(n=25)
11- Beypazarı	(n=25)
12- Kalecik	(n=24)
13- Sincan	(n=22)
14- Elmadağ	(n=20)
15- Yenimahalle	(n=19)
16- Kızılcahamam	(n=14)
17- Çankaya	(n=13)
18- Etimesgut	(n=12)
19- Ayaş	(n=10)
20- Çamlıdere	(n=10)
21- Güdül	(n=8)
22- Nallıhan	(n=6)
23- Evren	(n=4)
24- Kahramankazan	(n=3)
25- Şereflikoçhisar	(n=1)

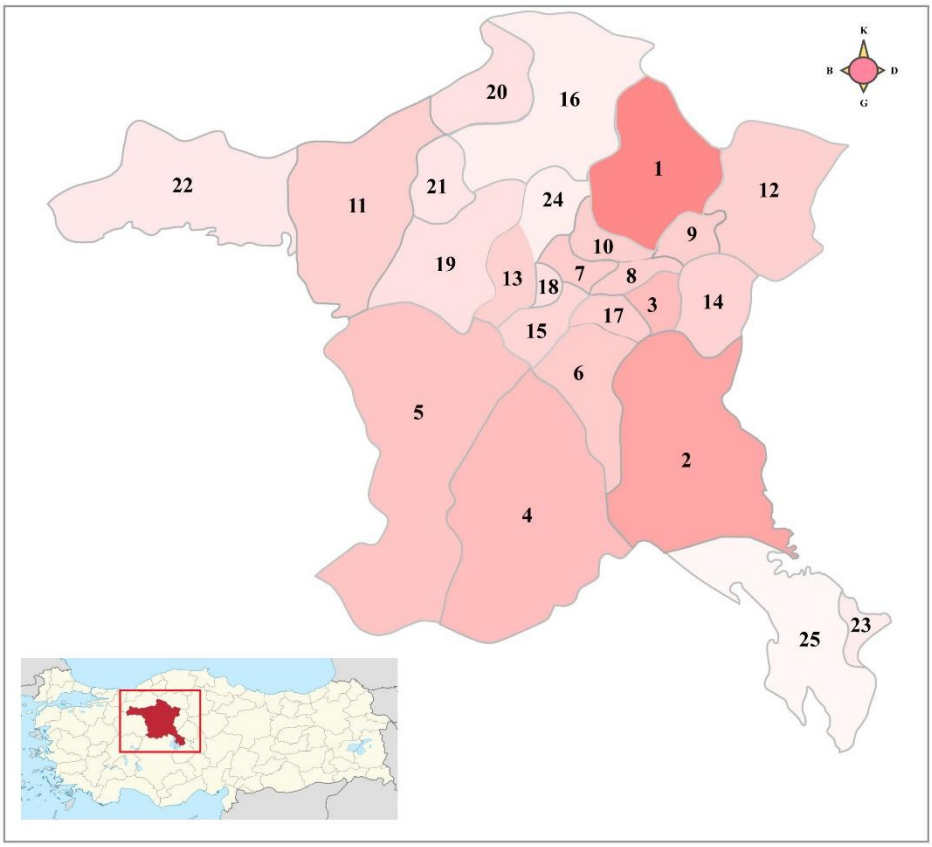

Figure 2. Place of residences of tularemia cases reported between 2010-2018 (Ankara Province, Turkey)
Şekil 2. 2010-2018 arasında bildirilen tularemi olgularının ikamet yerleri (Ankara, Türkiye)

Table 2. Distribution of tularemia cases by sex and age according to years.
Tablo 2. Tularemi olgularının yıllara göre cinsiyet ve yaş dağılımı

Characteristics	2010	2011	2012	2013	2015	2016	2017	2018	Total
	%	%	%	%	%	%	%	%	%
Sex									
Male (n=332)	48.8	47.3	47.1	50.0	43.5	47.7	62.5	25.0	47.7
Female (n=364)	51.2	52.7	52.9	50.0	56.5	52.3	37.5	75.0	52.3
Age									
0-10	4.7	6.9	8.0	0.0	0.0	2.3	6.3	0.0	5.7
11-20	14.7	10.0	11.5	0.0	8.7	15.1	12.5	75.0	11.6
21-30	22.5	19.5	12.6	0.0	26.1	12.8	6.3	0.0	18.5
31-40	20.2	16.9	18.4	0.0	8.7	16.3	43.8	0.0	17.8
41-50	21.7	15.2	10.3	0.0	21.7	17.4	18.8	25.0	16.4
51-60	7.8	14.3	20.7	100.0	26.1	18.6	6.3	0.0	14.8
61-70	8.5	12.6	9.2	0.0	0.0	12.8	6.3	0.0	10.8
71-80	0.0	4.3	6.9	0.0	8.7	2.3	0.0	0.0	3.6
81-90	0.0	0.3	2.3	0.0	0.0	2.3	0.0	0.0	0.7
Age (X±SD, Median, Min -Max)	35.01± 15.99 34.0 (5-69)	39.28±1 9.37 38.0 (1-81)	41.10±2 0.80 40.0 (2-82)	58.50± 0.71 58.5 (58-59)	41.70± 17.73 46.0 (12-74)	41.50± 18.84 42.5 (3-86)	36.19± 16.16 37.0 (22-68)	28.7± 8.26 25.5 (23-41)	38.99± 18.82 38.0 (1-86)
N of Cases	**129**	**349**	**87**	**2**	**23**	**86**	**16**	**4**	**696**

Table 3. Characteristics of tularemia cases reported between 2015-2018 (Ankara Province, Turkey
Tablo 3. 2015-2018 arasında bildirilen tularemi olgularının özellikleri (Ankara, Türkiye)

Characteristics	Yes (+) 2015		Yes (+) 2016		Yes (+) 2017		Yes (+) 2018		Yes (+) Total	
	N	%	N	%	N	%	N	%	N	%
History of raw vegetables / fruits eaten without washing	6	26.1	17	19.8	5	31,3	1	25.0	29	22.4
Is food open to animal contact	1	4.3	7	8.1	2	12.5	2	50.0	12	9.3
Has there been any rodent contact with food	2	8.7	3	3.5	0	0.0	0	0.0	5	3.9
Feeding any animal	4	17.4	24	27.9	3	18.8	0	0.0	31	24.0
There were tick around	0	0.0	10	11.6	3	18.8	0	0.0	13	10.1
History of contact with ticks or Mosquito / insect bite	0	0.0	6	7.0	5	31.3	0	0.0	11	8.5
Ever seen a rodent at home	0	0.0	7	8.1	0	0.0	0	0.0	7	5.4
There were rodents around	5	21.7	23	26.7	5	31.3	0	0.0	33	25.6
History of contact with hunting animals	1	4.3	4	4.7	0	0.0	0	0.0	5	3.9
Travel history in the last 1 month	6	26.1	30	34.9	9	56.3	3	75.0	48	37.2
Activity history in nature	5	21.7	24	27.9	11	68.8	0	0.0	40	31.0
Use of waterwork	11	47.8	47	54.7	12	75.0	4	100.0	74	66.7
Use of packaged water	5	21.7	30	34.9	4	25.0	3	75.0	42	32.6
Use of spring water	7	30.4	39	45.3	4	25.0	0	0.0	50	38.8
Use of public fountains	8	34.8	34	39.5	9	56.3	1	25.0	52	40.3
Use of well water	0	0.0	7	8.1	2	12.5	0	0.0	9	7.0
Use of lake / stream water	7	30.4	3	3.5	1	6.3	0	0.0	4	3.1
Clearance in water tank	2	8.7	7	8.1	1	6.3	0	0.0	10	7.8
Leaking from the water tank	1	4.3	4	4.7	1	6.3	0	0.0	6	4.7
Ever seen living / dead animals around the water tank	0	0.0	2	2.3	1	6.3	0	0.0	3	2.3
Is the water tank periodically cleaned	3	13.0	7	8.1	3	18.8	0	0.0	13	10.1
Does the chlorination device work in the water tank	3	13.0	7	8.1	7	43.8	0	0.0	17	13.2
Chlorine measurement in water tank	3	13.0	4	4.7	3	18.8	0	0.0	10	7.8
Is the water sample taken from the water source used for F. Tularensis analysis?	4	17.4	13	15.1	5	31.3	0	0.0	22	17.1
Is there space for animals to enter between the source and the water tank	0	0.0	9	10.5	1	6.3	0	0.0	10	7.8

Characteristics of tularemia cases reported between 2015-2018 are given in Table 3. A total of 22 water samples were collected and analyzed for *F. tularensis* in the field surveys between 2015-2018 and one of them was positive. The rate of activity in nature was 35.6% in women and 36.5% in men (p=0.918).

Discussion and Conclusion

Tularemia is known as a disease that can be seen in all age groups, and males in every age category and has a higher incidence in the world (6). In Turkey, the incidence of tularemia is higher in women than in men (3). In a study of 1091 tularemia cases seen in Turkey between 2005-2009, it was found that 54.7% of the cases were female and 45.3% were male (14). Korkmaz et al. evaluated tularemia cases in Eskişehir province, 46 (51.1%) of the cases with tularemia were reported as female and 44 (48.9%) as male (15). In our study, it was found that 52.3% of the cases with tularemia were female (n=364) and 47.7% were male (n=332). In other countries; the overrepresentation among males has been attributed to their more frequent outdoor professional and leisure activities As the consumption of spring water and non chlorinated drinking water is the main transmission route in Turkey, we thought that this difference in the distribution of the disease is due to the fact that women are more in contact with contaminated water and food in their home environment and that they are more exposed to reservoir animal extracts that carry the factor in their habitats. As a matter of fact in our study the rate of activity in nature was 35.6% in women and 36.5% in men (p=0.918).

When the distribution of tularemia cases according to age in Turkey is examined; the disease is mostly seen in adults over 30 years of age because adults have more risk group activities (3). According to Kılıç's study (14), 63.87% of the tularemia cases are seen over 30 years of age. In our study, 35.9% of the cases were seen between 0-30 years of age and 64.1% of the cases were over 30 years of age. Similarly, Christova et al. (7) found that tularemia disease affected all age groups but predominantly people of active age in Bulgaria.

The incidence of tularemia in countries where tularemia is endemic is the highest in late spring, summer and early spring months (6). In the outbreaks reported from Turkey, it is seen that tularemia cases usually occur in late autumn and winter periods, and they significantly decrease in the spring and summer months (1-3-14). Dikici et al. in their study that is covering the seasonal distribution of tularemia, it is has been seen in the most frequent in autumn in accordance with the general epidemiological characteristics (9). In our study, the most common cases of tularemia in Ankara were seen in winter in accordance with the general epidemiological characteristics of the seasonal distribution.

The World Health Organization's tularemia guide states that outbreaks of tularemia in humans often follow tularemia outbreaks in rodents, and the places where tularemia is endemic, antibodies to F. tularensis are frequently detected in sera of animals such as rats rats, beavers and field rats. The number of tularemia cases seen in the Novosibirsk region of the Russian Federation between 1956-2000 has been shown to be related to the density of the water vole population. A strong correlation has been reported in Sweden between peaks of hatchlings and rabbits and tularemia outbreaks (17). In various studies conducted in Turkey, a relationship has been established between tularemia epidemics and an increase in the population of field and water mice (5-11-16). In our study, it was found that 25.6% of patients who applied tularemia field research form had seen a rodent in their environment, 5.4% of them had seen a rodent in their homes and 3.9% of them had rodent contact with their food. This might be evidence of the rodents' role in tularemia disease.

Akalin et al. (1) outlined the findings that suggest water-borne epidemics as; limitation of the epidemics depends on the use of certain aqueducts in the same area, the lack of chlorination of the water system in some epidemic areas and PCR positivity for F. tularensis in water from epidemic areas (1). In our study, 40.3% of the cases examined in the field research form were found to use the public fountains. Çankaya et al. studied on the public fountains, 83% of the studied public fountains were found to be unsuitable for microbiological regulations (8). Therefore it was suggested that the fountains used by the public are frequently used and further, that the public fountains that could not be provided with clean and reliable water could be demolished or connected to the grid system.

As a result for the purpose of controlling tularemia, the control of well water, spring water, and public fountains should be ensured and the water tanks usage should be maintained and tanks should be cleaned at regular intervals. It is important that the water is chlorinated with automatic devices and the residual chlorine measurements are carried out without interruption, against microbiological contamination. Appropriate protection areas for water resources should be established and the contact with vector animals should be avoided. The training of health workers and the community on the subject should be carried out periodically.

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