International Journal of Infectious Diseases (2006) **10**, 248—254





http://intl.elsevierhealth.com/journals/ijid

An important public health problem: rabies suspected bites and post-exposure prophylaxis in a health district in Turkey

Bulent Kilic [a,*], **Belgin Unal** [a], **Semih Semin** [b], **Serap Kayser Konakci** [a]

[a] *Department of Public Health, Dokuz Eylul University, School of Medicine, 35340 Inciraltı-Izmir, Turkey*
[b] *Department of Medical Ethics, Dokuz Eylul University, School of Medicine, Izmir, Turkey*

Received 13 January 2005; received in revised form 25 April 2005; accepted 4 May 2005
Corresponding Editor: Jane Zuckerman, London, UK

KEYWORDS
Rabies;
Post-exposure prophylaxis;
Suspected animal bites;
HDCV;
Vaccine

Summary
Objective: The aim of this study was to describe rabies suspected animal bites and post-exposure prophylaxis (PEP) practices in Narlidere District in Turkey between 1999 and 2001.
Methods: One thousand five hundred and sixty-nine rabies suspected bite cases reported were identified from the District's rabies surveillance forms.
Results: Males comprised 66.7% of the cases, and 43.5% of the total were under 20 years old. In 74% of cases the animal involved in the bite was a dog. Only 70% of the animals had an owner, and only 17% of the animals had a rabies vaccination certificate. In terms of treatment, 68% of the human cases received PEP, and 21% of cases had an extra (sixth) vaccination dose, which is a substantial burden on the healthcare system, costing half a million US dollars per year. The place where the bite occurred (rural areas), the age of the recipient (more than 10 years old), the animal type (animals other than dogs and cats), lack of a vaccination certificate for the animal, and place of wound treatment (hospital) were significantly associated with PEP application.
Conclusions: In addition to the currently recommended strategy of controlling the dog population and of vaccinating domesticated animals, adults and children should be educated about bite prevention to reduce the number of animal bites.
© 2005 International Society for Infectious Diseases. Published by Elsevier Ltd. All rights reserved.

* Corresponding author. Dokuz Eylul Universitesi Tip Fakultesi Halk Sagligi, 35340 Inciraltı-Izmir, Turkey. Tel.: +90 232 412 4000; fax: +90 232 278 6864.
E-mail address: bulent.kilic@deu.edu.tr (B. Kilic).

1201-9712/$32.00 © 2005 International Society for Infectious Diseases. Published by Elsevier Ltd. All rights reserved.
doi:10.1016/j.ijid.2005.05.010

Introduction

Rabies is estimated to cause approximately 40 000–70 000 deaths every year in the world, almost all deaths occurring in developing countries.[1] These potentially preventable deaths occur primarily in Asia and Africa where animal control, vaccination programs, and effective human post-exposure prophylaxis (PEP) are not widely available. In developed countries, rabies is present mainly in wild animal hosts, from which the disease spills over to domestic animals and humans. Recently, bat rabies has emerged as an important epidemiologic reservoir in some parts of the world (i.e., the Americas and Australia). In contrast, in most countries in Africa and Asia, dogs continue to be the main hosts and are responsible for most of the human rabies deaths that occur worldwide.[2] Approximately 10 million people receive post-exposure treatment after being exposed to rabies suspected animals every year.[2,3]

Some countries, such as Australia, New Zealand, Japan, Taiwan, the UK, Ireland, Iceland, Finland and Greece are free from rabies.[1,2] Turkey is the only European country in which dog rabies is still prevalent, and human rabies and rabies suspected animal bites are still an important public health problem. Each year, a few rabies cases and around 90 000 rabies suspected animal bites are reported.[4] According to Turkish Ministry of Health statistics, the incidence rates of rabies suspected animal bites and rabies cases remained almost constant between 1991 and 2001[4] (Table 1).

However, there is a discrepancy regarding the number of rabies deaths in Turkey between WHO's World Survey of Rabies and the Turkish Ministry of Health statistics. According to the WHO Global Atlas, there were no rabies fatalities for Turkey after 1999.[5] This may be the result of under-reporting of rabies cases after 1999 to the WHO.

It was noticed that rabies suspected animal bite rates were higher in Narlidere Health District, compared with the national figures between 1999 and 2001 (Figure 1). The incidence of rabies suspected animal bites were 54.3/10 000 (588 cases), 56.4/10 000 (635 cases) and 40.7/10 000 (476 cases) in 1999, 2000 and 2001, respectively. However, no human rabies cases were reported in Narlidere District. The aim of this study was therefore to describe rabies suspected animal bites by personal, place, and time characteristics and PEP practices in Narlidere Health District.

Table 1 Incidence of suspected animal bites and rabies in Turkey, 1991–2001

Year	Suspected animal bites		Rabies	
	Number	Rate (/10 000)	Number	Rate (/million)
1991	90 049	15.6	9	0.16
1992	89 399	15.1	5	0.09
1993	97 354	16.1	4	0.07
1994	107 766	17.4	1	0.02
1995	116 226	18.4	1	0.02
1996	99 641	15.9	1	0.02
1997	80 630	12.6	5	0.08
1998	86 267	13.3	3	0.05
1999	82 384	12.5	7	0.11
2000	87 508	13.1	3	0.04
2001	85 030	12.5	3	0.04

Source: Ministry of Health, 2003 [4].

Methods

In this descriptive study, all 1569 rabies suspected bite cases reported between 1999 and 2001 were retrieved from the District's communicable diseases register and included in this analysis. Data were analyzed with respect to demographic factors, animal characteristics, type of contact, date and place of bite, and PEP. Data were abstracted from rabies surveillance forms used in the district. These forms are used to evaluate and follow-up the suspected bites. A bite was defined as suspect if the animal bit a human without any reason, if the animal was wild or not vaccinated, or if the animal escaped or died after the bite.[6]

When a bite case is admitted to a health centre, a nurse or a physician responsible for communicable disease control performs an examination, decides whether prophylaxis is necessary, completes the form and follows-up the case until

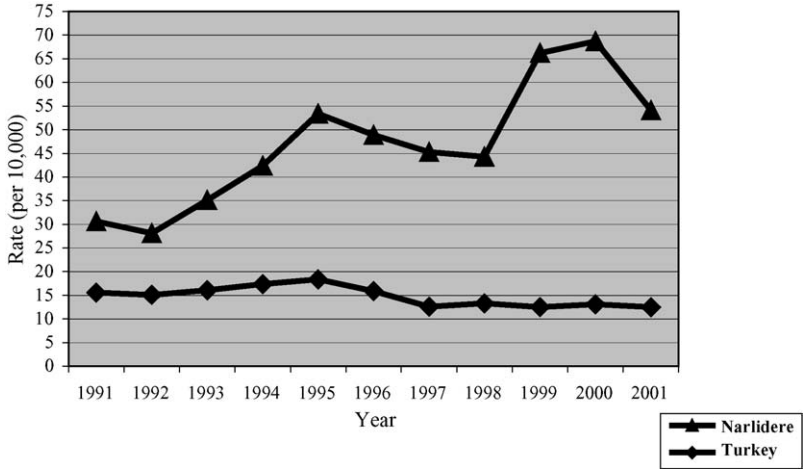


Figure 1 Rabies suspected animal bites in Narlidere Health District and Turkey between 1991 and 2001.



Figure 2 Map of Narlidere District, Izmir, Turkey.

the end of PEP. All the forms completed during a calendar month are evaluated at the end of the month and reported to the regional health office.

Narlidere Health District is a semi-urban neighborhood in Izmir, Western Anatolia near the Aegean Sea (see Figure 2).[7] Narlidere District is similar to any other health district in Turkey in terms of demographic, social and population characteristics.

The district has 18 health centres and each health centre provides primary healthcare services to an average population of 5000—25 000 people in the urban areas and 1000—10 000 people in the rural areas. Twelve of the 18 health centres are in rural areas. Narlidere Health District was affiliated to the University of Dokuz Eylul, Department of Public Health between the years 1983 and 2002. The district was used as a research and training area for public health professionals. This may have resulted in better record-keeping in this region from 1983 onwards. The place of bite was defined as urban if it was in the metropolitan city centre of Izmir, and otherwise as rural. The mid-year population of Narlidere Health District was 108 325 in 1999, 112 490 in 2000 and 116 816 in 2001. The total population of the urban area was 60 627 people (52%) in 2001.

All descriptive data were presented as percentage distributions in tables. PEP practices by place, time, age-group, gender and animal characteristics were analyzed using the Chi-square test. The direct cost of human diploid cell vaccine (HDCV) to Turkey in the year 2001 was estimated by applying HDCV doses reported in Narlidere District between 1999 and 2001 to the total national bite numbers (PEP protocol at that time was giving HDCV to suspected bite cases on days 0, 3, 7, 14, 28 and 60[8]). SPSS Version 11.0 was used for statistical analysis and the differences between annual rates were tested using the Epi-Info 'comparison percentages' method.

Results

All 1569 cases reported as rabies suspected bites in Narlidere District between 1999 and 2001 were included in this descriptive study. There were 546, 613 and 410 bites reported in the years 1999, 2000 and 2001, respectively, with no human rabies cases. Cases ranged in age from 0 to 85 years (median, 25 years), 43.5% of them were younger than 20 years (Figure 3), and 66.7% were male.

Rabies suspected bites showed an increase starting from the spring months, April and May. Most of the cases were seen in July (12.8%) and approximately three of every four animal bites occurred in the summer (31%) and fall (24%). The fewest cases were seen in March (5.6%).

Most of the exposures were reported from health centres in rural areas (56%). The most bitten body sites were hands (32%), legs (27%) and feet (12%). In 74% of the cases the animal involved in the bite was a dog. The remaining bites were inflicted by cats (19%), cattle (3%), rats (3%) and wild animals such as foxes or jackals (0.1%). Only 70% of the animals had an owner and only 17% of the animals had a rabies vaccination certificate.

WHO suggests 10-day observation of the animal after a suspected bite.[9] In our study 72% of the animals were observed by their owner for 10 days after a suspected bite, and 74% of these were reported by the owners as 'normal' at the end of the 10th day. Brain samples were sent to the reference laboratory in the case of rabies symptoms or the death of the animal. Using both Seller stain for Negri bodies

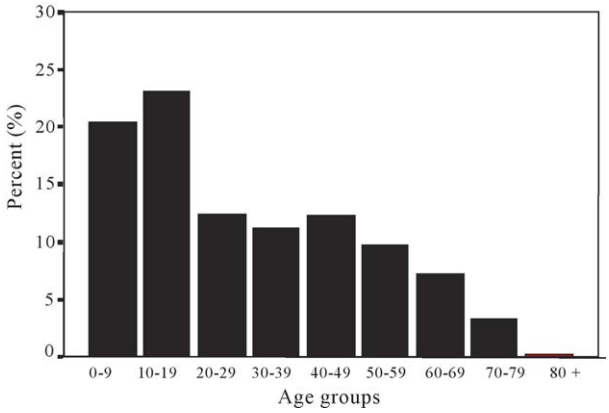


Figure 3 Percentage distribution of rabies suspected animal bites by age group, Narlidere, 1999—2001.

and fluorescent antibody test methods, a total of 189 animal brain samples (12% of the total cases) were evaluated and 79 of these (5% of the total cases) were found to be rabies positive.

Among the 1569 bites, 1067 cases (68%) were included in a post-exposure rabies vaccination program. Post-exposure rabies vaccination percentages according to the place, time, person and animal conditions are presented in Table 2. PEP was more common if the victim was over 10 years of age ($p < 0.001$), if the animal involved was not a cat or dog ($p = 0.04$), if the animal did not have a vaccination certificate ($p < 0.001$), if the place of bite was rural ($p < 0.001$) and if the wound was treated in the hospital ($p < 0.001$).

The most prevalent vaccination practices were the administration of three (53%) or six (21%) doses of HDCV. However, 19 of the cases (2%), in which the animal under observation died or escaped, received fewer doses of vaccination than they needed (Table 3). In contrast 202 of the cases (21%) received one dose more of HDCV vaccination (six doses) than they needed, as illustrated in Table 3. There was no immunologic prevention of rabies (human rabies immunoglobulin, HRIG) for suspected animal bites.

The surveillance forms used for animal bites were also evaluated in this study; some were missing information. The most common missing items were vaccination situation of the animal (63%), owner of the animal (46%), occupation of the victim (32%), the bitten part of the body (17%) and last situation of the animal (11%).

Table 2 Post-exposure prophylaxis according to the place, time, person and animal conditions

	n	PEP[a] (+)	*p*[b]
Age (years)			
0–9	304	60.5%	<0.001
10+	1157	73.4%	
Gender			
Men	1000	71.1%	0.46
Women	495	69.1%	
Animal involved			
Dogs and cats	1385	69.8%	0.040
Other (cattle, rat, etc.)	112	79.5%	
Owner of the animal			
Known	740	71.1%	0.29
Unknown	321	74.5%	
Vaccination certificate for the animal			
Yes	264	61.4%	<0.001
No	351	76.6%	
Body parts bitten			
Hands–arms	493	68.3%	0.74
Legs–feet	457	68.7%	
Other	232	71.1%	
Season of bite			
Spring–Summer	773	67.2%	0.01
Autumn–Winter	714	73.5%	
Place of bite			
Urban	668	54.8%	<0.001
Rural	844	83.0%	
Place of wound treatment			
Hospital	181	88.4%	<0.001
Other (health centre, etc.)	591	67.0%	
Year of bite			
1999	512	69.1%	0.35
2000	600	72.7%	
2001	400	69.3%	

[a] PEP, post-exposure prophylaxis.
[b] Chi-square.

Discussion

The corrected rabies suspected bite rates in Narlidere District were 504 (546 cases), 545 (613 cases) and 351 (410 cases) per 100 000 in the years 1999, 2000 and 2001, respectively. The differences between annual rates were not significant ($p = 0.786$). The incidence and the nature of animal bites are different in developed countries compared with developing countries. For example, while the annual bite incidence rate was 234/100 000 people in Kenya,[10] it was only 37.5/100 000[11] in a study conducted in Lyon, France. It was 1900/100 000 in a survey conducted in Bangalore, India[12] and 273/100 000 in Mexico.[13] The developing country statistics may be underestimates as human rabies cases may have been substantially under-reported in these areas.[14] However, Latin America has made excellent progress in drastically reducing human rabies over the past decade as a result of dog vaccination.[15]

Dog rabies prevails in Turkey, but several rabies cases have also been confirmed in wildlife. Between the years 1988 and 1997, 2743 (76.2%) of all registered rabies cases were in dogs and only 43 (1.2%) cases were diagnosed in wildlife. Between 1988 and 1997, the rabies incidence decreased significantly in the whole country. The number of animal cases dropped from 710 to 142. This decrease was observed not only in dogs, but also in all domestic animals. In 1988, 546 rabid dogs were registered, whereas the number was 117 in 1997. Between 1994 and 1996, the highest rabies incidence was observed in the province of Istanbul which is the largest city in Turkey, and where, in contrast to other areas, the number of rabies cases increased.[16]

In our study, it was found that young age groups and males are attacked more. It has repeatedly been reported in many studies that school-aged children are at the highest risk for animal bites.[12,17–20]

Approximately half of rabies suspected bites (44%) in Narlidere Health District were reported in the urban area. This could be a result of rapid urbanization with a lack of infrastructure in the region and as a result of dog immigration from rural areas to the city centre. There are still many agricultural areas in the urban area in Narlidere. Dogs are kept to secure the orchards and greenhouses, and they are more likely than domestic pets to attack strangers.

The breeding season of dogs may cause the seasonal difference in dog bite prevalence in many countries. In Turkey the breeding season for dogs is February and March. However, animal bites are particularly common in summer and autumn seasons when school children are usually on

Table 3 Post-exposure rabies vaccine doses received by the cases according to animal condition

Doses of HDCV	Animal condition					
	Escaped (%)	Dead (%)	Unknown (%)	Observed (%)	Total	
					n	(%) [d]
1	–	4.7 [a]	5.8	89.5	86	9.1
2	1.7 [a]	3.4 [a]	5.1	89.8	59	6.2
3	1.4	4.5	8.8	85.3	511	53.8
4	8.7 [a]	17.4 [a]	13.0	60.9	46	4.8
5	23.9	45.7	8.7	21.7	46	4.8
6	17.8 [b]	50.5 [b]	21.8 [b]	9.9 [b]	202 [b]	21.3
Total	6.2	16.8	11.3	65.7	950 [c]	100.0

[a] Fewer doses of vaccination (19 cases); when the animal escapes or dies the victim should receive a full five dose of vaccination.
[b] More doses of vaccination (202 cases); WHO recommends five doses of vaccination therefore the sixth dose is unnecessary.
[c] 1067 cases were included in the vaccination program, however only 950 of these had information on animal condition.
[d] Column percentage.

holiday and they are more likely to play outdoors. This puts them in contact with stray dogs, cats and other animals.[21]

The most common sites of bites were the legs and feet (39%) with the second most common sites being the hands and fingers (32%). This finding is supported by many other studies.[17,21]

As reported in many other studies, dogs are the usual perpetrators of animal bites.[17,22–26] In our study most of the cases were bitten by dogs (74%). This may suggest an intervention point for rabies control. However bites from other animals also occur at relatively high rates: cats (19%), cattle (3%), and rats (3%). This also needs consideration in rabies control measures (Table 2). Bites from mice or rats rarely require rabies prevention because these rodents are typically killed by any encounter with a larger, rabid animal, and would, therefore, not be carriers. However in our study we found that 57% of rat bites received PEP.

In our study, suspected bites from animals other than dogs and cats received PEP significantly more often (Table 2). This may be the result of unusual domestic animal behavior, and health personnel may evaluate bites from wild animals as high-risk for rabies. It may also be possible that domestic animals are easier to monitor after the bite than wild animals. Health personnel decisions and perceptions on PEP can be further evaluated using qualitative research methods.

PEP practices

In Narlidere District the post-exposure rabies vaccination rate was higher in rural areas than in urban areas. Other significant factors for post-exposure rabies vaccination were age, animal type, vaccination certificate of the animal and place of wound treatment (Table 2). These may suggest that place of bite and animal conditions are important to the health personnel in deciding whether or not to administer vaccinations.

In this study 68% of all the 1569 bites received post-exposure rabies vaccination but none of the bite cases received HRIG. Despite this finding, there were no reported cases of human rabies in Narlidere District. However in the same period, three rabies deaths were reported in other districts in the metropolitan city area of Izmir.[27]

In India about 86% of bite cases receive anti-rabies vaccination.[12] In Narlidere, 19 of the cases (2%), where the animal under observation died or escaped, received fewer doses of vaccination than they needed. This is an important problem since such mistakes in treatment may result in preventable human deaths. There are also concerns about insufficiency of public and professional education for rabies and rabies treatment in rabies endemic countries.[28] A survey could be conducted to get data on the criteria used for treating a bite injury. However this was not the main objective of the current study, therefore health personnel decisions and perceptions on PEP can be further evaluated using qualitative research methods.

In Turkey, PEP is free of charge if a person has health insurance, otherwise the expenditure is out of pocket; approximately 75% of the population are insured. A rough estimate of the HDCV vaccine cost for Turkey in the year 2001 was approximately 9 million US dollars. However, the main factors contributing to this high cost in 2001 were inappropriate HDCV schedules and the administration of an extra (6th) dose of vaccination (Table 3). In our study 202 of the cases (21%) had one extra dose of vaccination. This practice might place a large financial burden on Turkey since HDCV vaccine is imported from abroad. Every dose of HDCV costs approximately 30 US dollars in Turkey. If 17 000 (21% of 85 000) suspected bites had one extra dose as in 2001, that would cost in excess of a half a million US dollars per year.

This six-dose schedule was at one time recommended by WHO.[29] Although it was changed, in most parts of the world, in 1992[9] to five doses of HDCV to be given on days 0, 3, 7, 14 and 28, the six-dose schedule was continued in Turkey for a further 10 years. The Turkish Ministry of Health was quite slow in adopting these changes to the vaccine schedule and it was only in 2001 that they published new updated rabies control and prevention guidelines.[6] If this change had been adopted in 1992, Turkey would have saved approximately 5 million US dollars by 2001.

In our study, 70% of the animals had owners. However, only 17% of them were up-to-date with rabies vaccinations. This low vaccination level could be the result of lack of regulations and control mechanisms for pet owner-

ship in Narlidere District and in Turkey. However, further thorough evaluations are necessary to support this statement.

Keeping records

Rabies suspected bites in Narlidere Health District were more common than in other districts when national figures were compared. This could be the result of better record-keeping in this region since this district was affiliated with Dokuz Eylul University from 1983.[30,31] The quality of record-keeping depends on a clear case definition. Bites were defined as suspect "if the animal bit a person without any reason or if the animal was wild or not vaccinated or escaped/died after the bite" and this definition was used by all the health centres in the Narlidere District.

This analysis provided incidence rates for a geographically defined population using routine surveillance data. Rabies suspected bites surveillance data are reliable because rabies is a fatal disease and people usually attend health centres as soon as possible in the case of a suspected bite. However, our evaluation showed that there was missing information on animal and wound conditions in some surveillance forms. Although this missing information could be useful for clinical management of the cases, it would not affect the reported incidence rate.

Recommendations

Rabies is an important public health problem for Turkey. To reduce the number of animal bites, adults and children should be educated about bite prevention. Public education must be an integral part of the efforts to decrease the incidence of animal bites and to ensure that they are managed properly.[17] In addition to the currently recommended strategy of controlling the dog population, and of vaccinating domesticated animals, a better surveillance for dog rabies by appropriate laboratory investigations of suspected animals is also recommended. Unfortunately, the relative or absolute effectiveness of any of these strategies has not been assessed.

Municipalities are responsible for controlling the stray dog population and establishing dog homes in Turkey. However many municipalities are far from meeting their responsibilities due to lack of adequate resources and personnel.

Continuing surveillance for dog bites will be needed if we are to better understand how to reduce the incidence of dog bites and evaluate prevention efforts.[32] Therefore the traditional passive-surveillance system should be supported with active surveillance in rabies outbreaks since the passive-surveillance system may underestimate the magnitude of the rabies problem.

Conflict of interest: No conflict of interest to declare.

References

1. Chin J. *Control of communicable diseases manual*. Washington DC: APHA; 2000.
2. WHO. Rabies fact sheets: Fact Sheet No. 99 (revised June 2001), http://www.who.int/mediacentre/factsheets/fs099/en/ (26 July 2004).
3. Patrick GR, O'Rourke KM. Dog and cat bites: epidemiologic analyses suggest different prevention strategies. *Public Health Rep* 1998;**113**:252—7.
4. Turkish Ministry of Health. General Directorate of Primary Health Services. Annual Report, 2003. Ankara, Turkey, 124 pp (in Turkish).
5. WHO. Global atlas of infectious diseases—rabies. http://www.who.int/GlobalAtlas 2005.
6. Turkish Ministry of Health. General Directorate of Primary Health Care. Guidelines for rabies prevention and control, 2001. Ankara, Turkey (in Turkish).
7. World Atlas. http://www.worldatlas.com/webimage/countrys/europe/tr.htm. Turkey Map; 2005.
8. Turkish Ministry of Health. General Directorate of Primary Health Care. Guidelines for rabies vaccine application, 1992. Ankara, Turkey (in Turkish).
9. WHO Expert Committee on Rabies. WHO Technical Report Series, Eighth Report. Geneva; 1992. 24 pp.
10. Kitala PM, McDermott JJ, Kyule MN, Gathuma JM. Community-based active surveillance for rabies in Machakos District, Kenya. *Prev Vet Med* 2000;**44**:73—85.
11. Chomel BB, Trotignon J. Epidemiologic surveys of dog and cat bites in the Lyon area, France. *Eur J Epidemiol* 1992;**8**:619—24.
12. Sudarshan MK, Mahendra BJ, Narayan DH. A community survey of dog bites, anti-rabies treatment, rabies and dog population management in Bangalore city. *J Commun Dis* 2001;**33**:245—51.
13. Gracia RJ, Labarta Aizpun JI, Monreal Galvez MJ, Elias PJ. Dog bites in children. Epidemiologic and clinical study of 144 cases. *An Esp Pediatr* 1992;**37**:287—90.
14. Cleaveland S, Fevre EM, Kaare M, Coleman PG. Estimating human rabies mortality in the United Republic of Tanzania from dog bite injuries. *Bull World Health Organ* 2002;**80**:304—10.
15. WHO. Animal Rabies — Dog Rabies Control. http://www.who.int/rabies/animal/en, 2005.
16. WHO Zoonotic Diseases. Division of Emerging and Other Communicable Diseases. Field application of oral rabies vaccines for dogs. WHO/EMC/ZDI/98.15, 7. 22-7-1998, Geneva, Switzerland.
17. Mitmoonpitak C, Tepsumethanon V, Raksaket S, Nayuthaya AB, Wilde H. Dog-bite injuries at the Animal Bite Clinic of the Thai Red Cross Society in Bangkok. *J Med Assoc Thai* 2000;**83**:1458—62.
18. Shaikh ZS, Worrall SF. Epidemiology of facial trauma in a sample of patients aged 1—18 years. *Injury* 2002;**33**:669—71.
19. Nonfatal dog bite-related injuries treated in hospital emergency departments—United States, 2001. *MMWR Morb Mortal Wkly Rep* 2003;**52**:605—10.
20. Weiss HB, Friedman DI, Coben JH. Incidence of dog bite injuries treated in emergency departments. *JAMA* 1998;**279**:51—3.
21. Ndon JA, Jach GJ, Wehrenberg WB. Incidence of dog bites in Milwaukee. *Wis Med J* 1996;**95**:237—41.
22. Ozanne-Smith J, Ashby K, Stathakis VZ. Dog bite and injury prevention—analysis, critical review, and research agenda. *Inj Prev* 2001;**7**:321—6.
23. Borud LJ, Friedman DW. Dog bites in New York City. *Plast Reconstr Surg* 2000;**106**:987—90.
24. Loke YK, Murugesan E, Suryati A, Tan MH. An outbreak of rabies in dogs in the State of Terengganu, 1995—1996. *Med J Malaysia* 1998;**53**:97—100.
25. Thompson PG. The public health impact of dog attacks in a major Australian city. *Med J Aust* 1997;**167**:129—32.
26. Unshelm J, Rehm N, Heidenberger E. The problem of the danger of dogs; a study of incidents with dogs in a large city. *Dtsch Tierarztl Wochenschr* 1993;**100**:383—9.
27. Province Health Directorate. Province of Izmir, Annual Health Report, 2000. Izmir; 2002. 124—125 (in Turkish).

28. Haupt W. Rabies—risk of exposure and current trends in prevention of human cases. *Vaccine* 1999;**17**:1742—9.
29. Benenson AS. *Control of communicable diseases in man*. Washington DC: The American Public Health Association; 1985.
30. Dokuz Eylul University, School of Medicine, Department of Public Health. Narlidere Health District Annual Health Report 1999—2001. Izmir; 2005 (in Turkish).
31. Kilic B, Aslan Unal B, Semin S. Animal bites and post-exposure prophylaxis for rabies in Narlidere Health District in Turkey. IEA European Regional Meeting, Kaunas, Lithuania, 135. 24 August 2000.
32. Sacks JJ, Kresnow M, Houston B. Dog bites: how big a problem? *Inj Prev* 1996;**2**:52—4.