Journal of Feline Medicine and Surgery (2007) **9**, 188–195
doi:10.1016/j.jfms.2006.11.001

ELSEVIER

jfms

Incidence of and risk factors for cat bites: a first step in prevention and treatment of feline aggression

Jorge Palacio DVM, PhD[1]*, Marta León-Artozqui DVM, PhD[2], Eliseo Pastor-Villalba MD[3], Fernando Carrera-Martín DVM[4], Sylvia García-Belenguer DVM, PhD[1]

[1]*Animal Pathology Department, Faculty of Veterinary, University of Zaragoza, C/ Miguel Servet, 177, 50013 Zaragoza, Spain*
[2]*Faculty of Experimental and Health Sciences, Cardenal Herrera-CEU University, Valencia, Spain*
[3]*General Office of Public Health, Valencia, Spain*
[4]*Provincial Office of Public Health, Huesca, Spain*

Date accepted: 1 November 2006

Feline aggression towards people has a smaller incidence than canine aggression, but also represents an important public health problem. The aim of this work was to analyse feline aggression reported towards people, to estimate its incidence and to assess the risk factors involved. The information was obtained from the Public Health Centres in the Valencian Region (Spain). A total of 936 acts of feline aggression were analysed. Cats inflicted 8% of all animal bites reported. The annual average was 6.36 feline aggression incidents per 100,000 people. Most aggressive incidents occurred during the summer months. Children (0–14 years old) and women were more likely to be bitten. Wounds were mainly punctures, single, and mild, and were located mostly on the hands. In children, the head and neck areas were affected much more than in adults. The cats involved in incidents were mostly Siamese, female and owned; these cats mainly attacked their owners. Most occurrences were a defensive response by the cat.

The number of pets, including cats, has increased over the last few years (Rochlitz 2000). In countries like the USA and UK the number of cats has surpassed the number of dogs (Canosa and Minguell 2002). The increase in pet ownership has been accompanied by an increase in recorded aggressive acts by pets towards people (Chomel and Trotignon 1992). In the United States, for example up to 4.5 million acts of canine aggression (Sacks et al 1996) and 400,000 acts of feline aggression (García 1997) occur each year.

Feline aggression represents a lower incidence than canine aggression but these aggression acts are an important public health problem. Cat scratches or cat bites may transmit infectious diseases such as rabies and cat-scratch disease (bartonellosis). On the other hand, feline aggression (towards cats or people), as a behavioural problem, is an important cause of poor welfare in cats, due to the abandonment and euthanasia of the animals (Rochlitz 2000).

*Corresponding author. Departamento de Patología Animal, Facultad de Veterinaria, C/ Miguel Servet, 177, 50013 Zaragoza, Spain. E-mail: jpalacio@unizar.es

Epidemiological studies of feline aggression towards people, which contemplate the profiles of the victim and the aggressor animal, as well as the context where they take place, are necessary in order to carry out prevention programmes. Nevertheless, there are few studies carried out with this aim in the literature (Wright 1990, Patrick and O'Rourke 1998). In addition, the few studies carried out in Spain have focused on canine aggression (Rufino González 1990, Gracia Romero et al 1992, Knobel Freud et al 1997, Palacio et al 1998, Méndez Gallart et al 2002).

The aim of this work was to analyse feline aggressive behaviour towards people reported in the Valencian Region (Spain), to estimate its incidence and to assess the risk factors involved.

Materials and methods

The information was obtained from the Public Health Centres (PHC) of the Valencian Region (Spain) using the Rabies Control and Prevention Programme. The years included in the study range from 1995 through 2000. The cases obtained were distributed according to the PHC where the incidents took place or were looked

1098-612X/07/030188+08 $32.00/0

after. The Valencian Region is organised into 17 PHC that cover 20 health areas.

Although most feline aggression incidents were cat bites, the cases included both scratches and bites.

Information was obtained from the Public Health Centre archives, where the victim was attended. The information obtained has been organised into four main sections: general characteristics of the aggressive episode, the victim, the aggressor cat and the context within which the aggression took place. With respect to general characteristics of the aggressive episode, information included the Public Health Centre where the incident was reported and the date when it took place.

The data related to the victim were age, sex, number of wounds, anatomic areas affected, type and severity of the wounds, as well as information on health-care received. The age of the victims was divided into three groups (0–14, 15–64 and ≥65 years old). A second criterion was used considering young–adult victims (0–19 and >19 years old) and sex (Matter and Arbeitsgemeinschaft 1998). Type of wounds were classified according to WHO recommendations (WHO 1996) where category I were wounds that showed neither skin penetration nor injury in the dermis (intact skin), category II includes injuries such as minor scratches or abrasions without bleeding and without skin penetration and finally, category III were injuries with skin penetration. According to the severity, wounds were classified into mild (category I) or severe (categories II and III).

The breed, sex, ownership, relationship of the victim with the aggressor cat, rabies vaccination status and whether the cat was submitted to an observation period or not were recorded. The context refers to the main type of interaction between the victim and the aggressor cat.

Incidence (number of new cases/population at risk) of cat bites was calculated. As population at risk, the official census of the population of the health areas in 1998 was used ($n = 2{,}961{,}750$ inhabitants). Only those health areas where complete information was obtained were included in this study (15 of 20 areas). Case–control study (Thrusfield 1999) was applied to compare a group of cases (affected people) with a group of controls (non-affected people) with regard to age and sex as possible risk factors. Association between occurrence of aggression and exposure to the factor (age and sex of the victim) was confirmed with a χ^2 test. Values of $P \leq 0.05$ were considered significant. Strength of this association was measured by means of the odds ratio (OR) and its confidence interval (CI) parameters (OR > 1: risk factor). Statistical analysis includes a descriptive study of all the variables obtained. A Spearman test to determine whether there is a significant correlation between the demographic density (people/km^2) and the incidence of feline aggression in each PHC or not was performed. StatVIEW for SAS and Win Episcope 2.0 programs were used.

Results

Incidence

A total of 12,040 acts of animal aggression towards people in the Valencian Region (1995–2000) were obtained with an average incidence of 80.3 acts of animal aggression per 100,000 people per year. Of these, 89% were produced by dogs, 8% (936) were produced by feline species and the remaining (3%) were produced by animals of other species (rodents, monkeys, horses, etc.).

The average incidence of feline aggression in the Valencian Region was 6.36 aggressive acts per 100,000 people per year. The average incidence was higher in females (7.1 acts of aggression per 100,000 people per year) than in males (4.6 per 100,000 people per year). According to age, the incidence was greater in children than in other groups (0–14: 6.8; 15–64: 5.1 and ≥65: 4.7 acts of aggression per 100,000 people).

The correlation study between the annual average incidence in each PHC and the demographic density of each area (people/km^2) indicated a negative and non-significant correlation ($r = -0.516$; $P = 0.062$).

Seasonal variation

Acts of feline aggression were reported mainly in summer months (33%). Twenty-eight percent, 20% and 19% of feline aggression episodes were reported in spring, autumn and winter, respectively.

The day of the week on which more cases took place was Sunday (18%). Thirty-one percent of the cases took place at weekends.

Characteristics of victims

Age of victims

Significant association between the age of the victim and aggression was found ($P \leq 0.01$). The study of the risk factors revealed that the

age group under 15 years old had 1.37 times more risk of being attacked than the rest (CI = 1.147−1.626). The number, percentage and odds ratio of each age group can be observed in Table 1.

Sex of victims

Females were more significantly affected than males ($P \leq 0.001$), accounting for 62% of aggression incidents, and additionally they behaved as a risk factor (OR = 1.54; CI = 1.345−1.763) (Table 1). The adult female group (>19 years old) was the most commonly affected group (46%).

The number, percentage and odds ratio of feline aggression according to age and sex of victims are shown in Table 1.

Characteristics of wounds

Most injuries were single bites (83%). Multiple injuries accounted for 17% of cases.

Related to the type of wound produced by aggression, 55% were injuries with skin penetration; 42% were wounds without skin penetration but with injury in the dermis (scratches, erosions, etc.) and 3% were wounds that showed neither skin penetration nor injury in the dermis (inflammations, etc.).

Wounds were mainly produced by bites (77%). The remaining wounds were scratches (23%).

In relation to the severity of the injury, 79% and 21% were mild and serious injuries, respectively.

Most injuries were located on upper extremities. Due to the high incidence, hands were considered as a different anatomic region to the upper extremities and were affected in 48% of cases. Anatomic regions as lower extremities (24%), upper extremities (20%), head and neck (7%) and trunk (1%) were affected in a lesser proportion. A greater proportion of injuries located in the head and neck areas can be observed in children under 15 years old (19%). The anatomic distribution of injuries in children between 0 and 14 years old can be observed in Fig 1.

Medical assistance

Sixty-two percent of victims received medical treatment. Of these victims, 4% of the cases received antibiotic treatment. The most commonly used antibiotic was the amoxycillin−clavulanic acid combination. Eighty-one percent of victims received antitetanic prophylaxis. In 3% of cases antirabies prophylaxis was administered. Of these cases, 76% of victims had been attacked by unowned cats.

Characteristics of aggressive cats

The breed most frequently involved in aggressive incidents was the Siamese with 43% of aggressive episodes. Other involved breeds were the European (34%), Persian (15%), mixed (5%) and Angora (3%). Most cats involved were females (76%).

Aggressive incidents were mainly produced by owned cats (69%); 31% of the cats were unowned, that is, wild, stray or abandoned cats. At least 68% of owned cats were known by the victims. The majority (93%) of aggressive acts involved cats owned by the victim's family.

With respect to the rabies vaccination of the aggressive cat, 38% of the animals had been vaccinated. In 51% of the cases the aggressive cat was submitted to the regulated observation period (ten days); 79% of the owned and 10% of the unowned cats were submitted to this observation period.

Table 1. Distribution of feline aggression according to age and sex of victims

Factor	Group	*n*	%	OR	CI
Age (years)	0−14	157	20.1	1.37	1.147−1.626
	15−64	518	66.1	0.88	0.756−1.016
	≥65	108	13.8	0.88	0.715−1.073
Sex	Men	335	38.3	0.65	0.567−0.743
	Women	540	61.7	1.54	1.345−1.763
Sex and age	Men 0−19	95	12.8	1.09	0.880−1.354
	Men >19	189	25.4	0.58	0.492−0.682
	Women 0−19	121	16.3	1.54	1.269−1.867
	Women >19	339	45.5	1.26	1.090−1.454

OR = odds ratio, CI = confidence interval.

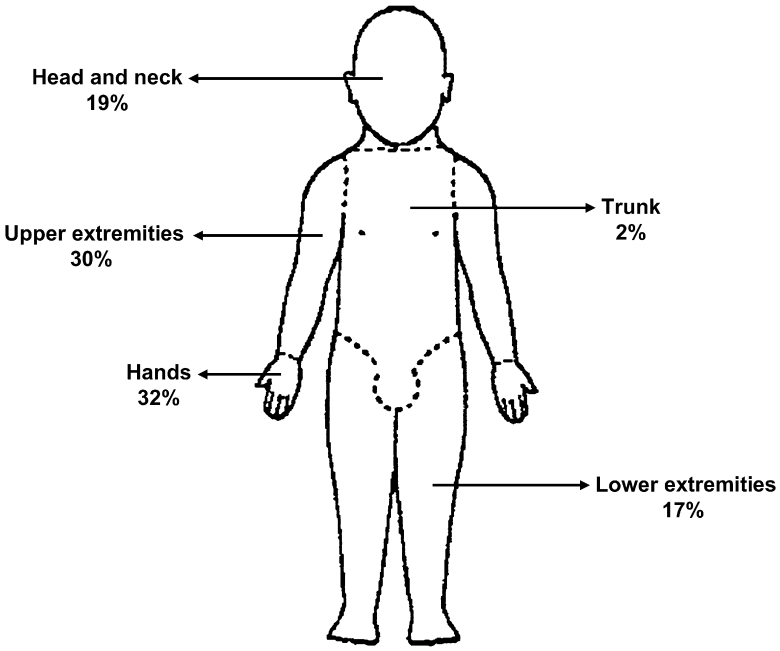

Fig 1. Anatomic distribution of injuries resulting from feline aggression towards children between 0 and 14 years old.

Context in which the aggression takes place

Related to the characteristics of the episode, 92% of the acts of aggression were described by the victim as provoked. Of those, 38% were the result of a defensive response by the cat (Table 2).

Discussion

Incidence

Pet aggression towards people is quite frequent. Although many epidemiological surveys exist, most of them have focused on aggressive behaviour shown by canine species.

Aggressive behaviour shown by cats accounted for 8% of all reported animal aggression in the Valencian Region. This fact agrees with the reviewed bibliography that reported feline aggression accounts for 3% and 25% of all acts of animal aggression − dogs being responsible for most cases (Berzon et al 1972, Wright 1990, Knobel Freud et al 1997, Palacio et al 1998, Matter and Arbeitsgemeinschaft 1998, Quiles Cosme et al 2000). The average incidence of acts of feline aggression found in our research was 6.36 acts per 100,000 people per year, which places it far below the incidences reviewed (20−80 acts of aggression per 100,000 people per year) (Matter and Arbeitsgemeinschaft 1998, Moore et al 2000).

Probably, feline aggression is less reported than canine aggression because the population considers injuries produced by cats less serious than those caused by dogs. Moreover, people do not know the risks associated with cat bites and scratches. Medical centres may even contribute for this low incidence of reporting of feline aggression. Acts of feline aggression may be reported less frequently than canine aggression as

Table 2. Main type of interaction between victim and aggressive cat

Type of interaction	*n*	%
Defensive response (fear, grabbing the cat, approaching the cat)	137	38
Aversive manipulations (pain)	59	16
Non-aversive manipulations (petting, feeding, bathing, combing the cat)	57	15
Playing	32	9
Taking part in the interaction between a cat and another animal	21	6
Others	59	16

injuries produced by dogs are considered more serious (Patrick and O'Rourke 1998). However, as several studies show, the real incidence of animal aggression towards people is not known and the unreported incidence is likely to be much higher than the reported one (Berzon et al 1972, Chomel and Trotignon 1992, Quiles Cosme et al 2000). The differences in reported cases by country or geographic area where the study was made can be explained, on the one hand, by the epidemiological situation of the area with respect to rabies and, on the other hand, by the information source base for the studies. Our study was carried out in a terrestrial mammals rabies-free area and this may have contributed to the fact that the population gave less importance to pet bites, including cats.

Although demographic density of the PHC and incidence of cat bites did not show a significant correlation ($r = -0.52$; $P = 0.06$), a negative relationship between both variables was observed. This aspect has not been reported in cats, however in dogs, low density areas were related with a worst control of pets and so, a higher incidence of bites (Harris et al 1974).

Seasonal variation

Most aggression incidents occurred during the summer months. There are studies that agree with our results (Wright 1990) but other authors do not find any variation in the number of aggressive incidents according to the season (Patrick and O'Rourke 1998). This fact could be explained because, during the summer holiday months, people spend more time at home, thus increasing the interaction time with the cats.

Characteristics of victims

Age and sex

Children under 15 years old were a risk factor, as for studies undertaken on the canine species (Sacks et al 1996, Palacio et al 1998). Female victims also behaved as a risk factor. If the age and sex of victims are analysed together we can observe that the adult female group is the most affected group and, in addition, they behave as a risk factor with respect to the rest of groups. The bibliography shows that most victims of feline aggressions are adult women (Kizer 1979, Wright 1990, Gasser et al 1993, Patrick and O'Rourke 1998, Matter and Arbeitsgemeinschaft 1998, Dahl 1998). Probably, women's predilection for cats and the fact that women are more likely to have cats as pets explains the frequent contact between women and cats (Kizer 1979, Wright 1990, Gasser et al 1993).

Characteristics of wounds

Most wounds were single bites, with skin penetration, and mild severity. Punctures were the most frequent type of injuries produced by cats, which can be due to the fine sharp teeth of these animals (Dire 1991, García 1997, Sandora and Bernstein 2001). Scratches were also frequent (García 1997), and according to some studies this type of injury was the most frequent (Wright 1990). However, these studies did not specify if the wound was produced by the animal's tooth or claw. In our study, 23% of the scratches were produced by claws.

Injuries were located on upper extremities, the hands being the most affected anatomic region, followed by the lower extremities. The head, neck and trunk were the less affected anatomic regions. Hands and upper extremities are usually the most frequent anatomic locations of acts of feline aggression (Wright 1990, Dire 1991, García 1997, Dahl 1998, Patrick and O'Rourke 1998, Matter and Arbeitsgemeinschaft 1998, Moore et al 2000, Kravetz and Federman 2002). This fact may be related to a frequent use of hands, either to avoid physical contact with cats (Wright, 1990) or to play with them.

The head and neck areas were much more affected in children under 15, compared with the total population, which agrees with the reviewed studies (Wright 1990). This fact is mainly due to their smaller height and to the interaction with the animal's head (Chun et al 1982, Podberscek et al 1990).

Medical assistance

The treatment of injuries produced by cats may include washing or irrigating the wound, debridement, assessment of the state of antitetanic vaccinations and risk of exposure to rabies (Kravetz and Federman 2002). In our work the majority of patients received antitetanic prophylaxis (81%) at the time of injury.

The possibility of infection in injuries produced by feline aggression is much higher than in aggression produced by canine species. The infection rate in injuries produced by cats ranges between 30% and 50% (García 1997, Matter and Arbeitsgemeinschaft 1998, Sandora and Bernstein 2001). In addition, hand wounds are more likely to become infected. For this reason, the administration of prophylactic antibiotics is indicated in people bitten by cats

(August 1988). In our work, antibiotic treatment was only documented in 4% of cases. Probably, many more people received antibiotic treatment but the lack of a specific section for antibiotic treatment in the bite report may be the reason why it was not reflected. *Pasteurella multocida* is the microorganism most commonly isolated from wounds by cat bites (Kizer 1979, García 1997, Sandora and Bernstein 2001). It is important not to forget that injuries resulting from feline aggression can produce cat-scratch disease, which is relatively common and caused by *Bartonella henselae* (Kravetz and Federman 2002). The most commonly used antibiotic was an amoxycillin–clavulanic acid combination; this antibiotic is one of the most indicated in cat bites (Gasser et al 1993, García 1997, Goldstein 1999).

Only 3% of attacked people received rabies prophylaxis. These people were mainly attacked by unowned cats (76%). There are studies which show that victims of feline aggression are more likely to require rabies prophylaxis in comparison with the rest of animal aggression, mainly when the aggressive cat is unowned (Hensley 1998, Moore et al 2000). The current epidemiological situation in the Spanish Peninsula presenting a rabies-free area except for bats (Gálvez Vargas et al 2001) may explain the fact that so few rabies treatments were administered.

Characteristics of aggressive cat

Siamese cats were the most reported breed in aggressive incidents, which could be due to the popularity of this breed in the Valencian Region. However, an official census of cats in the area was not available. Unlike what occurs in canine aggression, the feline breed is not an outstanding detail in reviewed epidemiological studies (García 1997).

The majority of the cats involved were females. In aggression produced by cats, females are usually more frequently involved than males (Wright 1990) or at least in a greater proportion than in canine aggression (Patrick and O'Rourke 1998). This observation can be due to the existence of a greater number of female than male cats (Wright 1990) although we have not got official data about our feline population. It is also possible that certain aggressive behaviours occur more in females than in males (Patrick and O'Rourke 1998) such as the aggression that some female cats display during oestrus. In the canine species some types of aggression are more frequent in males than females. For example, one of the most frequent types of canine aggression towards people is dominance aggression, which occurs mainly in males, being less common in females (Manteca 2002). However, cats do not display this type of aggression.

In our study, 69% of cats were owned cats and 31% stray cats. Stray cats are frequently involved in feline aggression (Wright 1990, Knobel Freud et al 1997, Hensley 1998, Moore et al 2000). Probably the large number of stray cats that exist in cities is responsible for the high incidence of feline acts of aggression. It is also likely that a large number of stray cats exist in the Valencian Region, although we do not have official data. On the other hand, it is possible that aggressive incidents with stray cats are reported more often, due to the unknown sanitary state of these animals.

Most aggressor cats were known by the victim and mainly attacked their own family according to other studies (Kizer 1979, Knobel Freud et al 1997, Matter and Arbeitsgemeinschaft 1998, Moore et al 2000).

Thirty-eight percent of cats were vaccinated against rabies as previous studies carried out in Spain reported (Knobel Freud et al 1997). In the Valencian Region rabies vaccination of cats is not compulsory. Other reviewed studies (Hensley 1998, Moore et al 2000) present similar results. Nevertheless, these studies are made in countries like the United States where domestic mammals represent an important risk of rabies transmission (McQuiston et al 2001). Additionally, cats are domestic animals with a greater risk of acquiring the disease, although paradoxically they are vaccinated less frequently (Hoff et al 1993, García 1997).

The observation period was carried out in 51% of aggressive cats. The observation was made only in 10% of the unowned cats, which represents quite a low number due to the difficulty in locating and capturing this type of animals. In Barcelona (Spain), unowned cats were not placed under the observation period (Knobel Freud et al 1997).

Context under which aggressions take place

Provoked aggressions were described in a large number of episodes, the majority corresponding to a defensive response by the cat (38%). Actions like feeding, petting or manipulating the cat somehow represented 15% of contexts, although some of the defensive responses were probably also produced in these contexts. The bibliography agrees that most acts of feline aggression are provoked (Dire 1991, Patrick and

O'Rourke 1998, Quiles Cosme et al 2000) mainly because people approach the animal to carry out some of the actions described above (Wright 1990, Patrick and O'Rourke 1998).

Aggression is the second most reported behaviour problem in cats and aggression towards other cats is more frequent than aggression towards people (Ford 1992, Landsberg et al 1998, Manteca et al 2000, Manteca 2002). Of the contexts studied in our research, some of them are related to categories of feline aggressions described as play (9%), fear (38%) or pain-induced aggression (16%). Another type of aggression is induced by petting and in some studies, this type is regarded as the most frequent (Blackshaw 1988). This aggression occurs when a cat tolerates the physical interaction for a while and then, it suddenly bites or scratches (Chapman 1991). Over 15% of the acts of aggression were related to this context. In our study we related other observed contexts with redirected aggression (6%) and some studies have found that this type is the most frequent (Chapman and Voith 1990). This aggression occurs when a cat that is aroused by one stimulus, attacks another irrelevant person or cat. This type of aggression may have been underreported in our study, as our definition regards as stimulus only other cats, or due to the difficulty for the owner to identify the arousing stimulus. In the bibliography, unprovoked acts of aggression, which do not correspond to the above types, have also been described (Chapman 1991, Ford 1992) but these incidents occur less frequently.

In general, the information obtained in this section is quite incomplete because each case should be submitted to a history taking to categorise and to define exactly the type of aggression displayed by the cat. Moreover, some of the types described here, agree with the main context stated by the victim, so some cases could display more than one type of interaction (for example, grabbing the cat can cause pain).

Conclusions

The average incidence of feline aggression in the Valencian Region was 6.36 feline acts per 100,000 habitants per year and although this incidence is smaller than the incidence estimated in other areas, it is not negligible. The distribution of the aggression was clearly seasonal. Women, children and owners were the population sectors most affected by feline aggression. Cats involved were mainly females and Siamese. Cats attacked because victims provoked them mainly in defensive contexts.

Much feline and animal aggression towards people may be prevented. It is necessary to inform and to educate the population, mainly the risk population, with regard to the safe handling and behaviour of cats. The control of stray cats, the education of health centres' staff, the improvement of notification systems and the correct vaccination of pets are key factors in the prevention of these public health incidents.

Acknowledgements

This work was supported by a grant from the Cardenal Herrera-CEU University. The support of the General Office of Public Health is gratefully acknowledged.

References

August JR (1988) Dog and cat bites. *Journal of the American Veterinary Medical Association* **193**, 1394–1398.

Berzon DR, Farber RE, Gordon J, Kelley EB (1972) Animal bites in a large city—a report on Baltimore, Maryland. *American Journal of Public Health* **62**, 422–426.

Blackshaw JK (1988) Abnormal behavior in cats. *Australian Veterinary Journal* **65**, 395–396.

Canosa P, Minguell F (2002) Niños y animales de compañía: Sí, Pero…. Madrid: Debate.

Chapman BL (1991) Feline aggression. Classification, diagnosis, and treatment. *Veterinary Clinics of North America. Small Animal Practice* **21**, 315–327.

Chapman BL, Voith VL (1990) Cat aggression redirected to people: 14 cases (1981–1987). *Journal of the American Veterinary Medical Association* **196**, 947–950.

Chomel BB, Trotignon J (1992) Epidemiologic surveys of dog and cat bites in the Lyon area, France. *European Journal of Epidemiology* **8**, 619–624.

Chun YT, Berkelhamer JE, Herold TE (1982) Dog bites in children less than 4 years old. *Pediatrics* **69**, 119–120.

Dahl E (1998) Animal bites at the casualty department of the Oslo City Council. *Tidsskrift for den Norske Laegeforening* **118**, 2614–2617.

Dire DJ (1991) Cat bite wounds: risk factors for infection. *Annals of Emergency Medicine* **20**, 973–979.

Ford RB (1992) Signos clínicos y diagnóstico en pequeños animales. Bogotá: Editorial Médica Panamericana.

Gálvez Vargas R, García Martín M, Guillén Solvas J (2001) Epidemiología general de las zoonosis. Brucelosis y rabia. In: Gil Piédrola (ed), *Medicina Preventiva y Salud Pública* (10th edn). Barcelona: Masson, pp. 589–600.

García VF (1997) Animal bites and *Pasturella* infections. *Pediatrics in Review* **18**, 127–130.

Gasser I, Osset J, Olarte I, Olsina M, Arcalís L (1993) Infecciones en heridas por mordedura: estudio de 22 pacientes hospitalizados. *Enfermedades Infecciosas y Microbiología Clínica* **11**, 482–486.

Goldstein EJ (1999) Current concepts on animal bites: bacteriology and therapy. *Current Clinical Topics in Infectious Diseases* **19**, 99–111.

Gracia Romero J, Labarta Aizpun JI, Monreal Gálvez MJ, Elías Pollina J (1992) Mordeduras de perro en la infancia. Estudio epidemiológico y clínico de 144 casos. *Anales Españoles de Pediatría* **37**, 287–290.

Harris D, Imperato PJ, Oken D (1974) Dog bites—an unrecognized epidemic. *Bulletin of the New York Academy of Medicine* **50**, 981–1000.

Hensley JA (1998) Potential rabies exposures in a Virginia county. *Public Health Reports* **113**, 258–262.

Hoff G, Mellon G, Thomas M, Giedinghasen D (1993) Bats, cats, and rabies in an urban community. *Southern Medical Journal* **86**, 1115–1118.

Kizer KW (1979) Epidemiologic and clinical aspects of animal bite injuries. *Journal of the American College of Emergency Physicians* **8**, 134–141.

Knobel Freud H, López Colomés JL, Serrano Sáinz C, Hernández Vidal P (1997) Mordedura por animales. Estudio de 606 casos. *Revista Clínica Española* **197**, 560–563.

Kravetz JD, Federman DG (2002) Cat-associated zoonoses. *Archives of Internal Medicine* **162**, 1945–1952.

Landsberg G, Hunthausen W, Ackerman L (1998) Manual de problemas de conducta del perro y gato. Zaragoza: Acribia.

Manteca X (2002) Etología Clínica Veterinaria. (2nd edn) Barcelona: Multimédica.

Manteca X, Palacio J, Fatjó J, García-Belenguer S (2000) Seminario de Etología Clínica Veterinaria. Barcelona: Asociación de Veterinarios Especialistas en Pequeños Animales (AVEPA).

Matter HC, Arbeitsgemeinschaft S (1998) The epidemiology of bite and scratch injuries by vertebrate animals in Switzerland. *European Journal of Epidemiology* **14**, 483–490.

McQuiston JH, Yager PA, Smith JS, Rupprecht CE (2001) Epidemiologic characteristics of rabies virus variants in dogs and cats in the United States, 1999. *Journal of the American Veterinary Medical Association* **218**, 1939–1942.

Méndez Gallart R, Gómez Tellado M, Somoza Argibay I, Liras Muñoz J, Pais Piñeiro E, Vela Nieto D (2002) Mordeduras de perro. Análisis de 654 casos en 10 años. *Anales Españoles de Pediatría* **56**, 425–429.

Moore DA, Sischo WM, Hunter A, Miles T (2000) Animal bite epidemiology and surveillance for rabies postexposure prophylaxis. *Journal of the American Veterinary Medical Association* **217**, 190–194.

Palacio J, García-Belenguer S, Sanjulián JR, Fatjó J, Manteca X (1998) Agresividad canina dirigida a personas en la provincia de Huesca, 1995–1996. Proceedings of the Asociación de Veterinarios Especialistas en Pequeños Animales. Santiago de Compostela.

Patrick GR, O'Rourke KM (1998) Dog and cat bites: epidemiologic analyses suggest different prevention strategies. *Public Health Reports* **113**, 252–257.

Podberscek AL, Blackshaw JK, Nixon JW (1990) The incidence of dog attacks on children treated at a city hospital. *Australian Veterinary Journal* **67**, 79–80.

Quiles Cosme GM, Pérez-Cardona CM, Aponte Ortiz FI (2000) Estudio descriptivo sobre ataques y mordeduras de animales en el Municipio de San Juan, Puerto Rico, 1996–1998. *Puerto Rico Health Sciences Journal* **19**, 39–47.

Rochlitz I (2000) Feline welfare issues. In: Turner C, Bateson P (eds), *The Domestic Cat. The Biology of its Behaviour* (2nd edn). Cambridge: University Press, pp. 208–226.

Rufino González JF (1990) Prevenir las mordeduras caninas. *Revista de Enfermería* **13**, 15–21.

Sacks JJ, Kresnow M, Houston B (1996) Dog bites: how big a problem? *Injury Prevention* **2**, 52–54.

Sandora TJ, Bernstein HH (2001) Neonatal jaundice, animal-induced injuries, and immunizations. *Current Opinion in Pediatrics* **13**, 377–385.

Thrusfield M (1999) Veterinary Epidemiology. (2nd edn) Oxford: Blackwell Science.

WHO (1996) WHO Recommendations on rabies post-exposure treatment and the correct technique of intradermal immunization against rabies. (Part 1) 1–13. WHO/EMC/ZOO/96.6.

Wright JC (1990) Reported cat bites in Dallas: characteristics of the cats, the victims, and the attack events. *Public Health Reports* **105**, 420–424.