RABIES ; AN EPIDEMIOLOGICAL STUDY OF HUMAN EXPOSURE IN BRAZIL

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by

A. J. Belotto

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Department of Tropical Hygiene
London School of Hygiene and Tropical Medicine
University of London

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D E D I C A T I O N

To my wife and daughters, the main sources of my motivation, for their tolerance and encouragement throughout this year's course abroad.

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S U M M A R Y

An epidemiological analysis of the circumstances surrounding 15,057 cases of human exposure to potentially rabid animals was carried out. The data were obtained from individual routine reports of people who used the health units network of the Public Health Services Foundation (SESP), in Brazil, during 1984. The SESP Foundation is a federal organization, linked to the Ministry of Health, in charge of primary health care in special areas of the interior of the country.

The incidence rate of possible cases of exposure to the rabies virus reported in the area of this study was lower than that observed for the country as a whole (144 versus 288/100,000 population, respectively). The highest incidence was observed in the Northern region (Amazonian states). An increase in the frequency of exposures occurred in the second half of the year, reaching a peak in September. The majority of exposures were in persons below 15 years. The incidence rate in this age group was almost double that observed for the other groups. Young males (4 - 14 years) had a particularly high incidence rate (263/100,000). Most reports of accidents with potentially rabid animals came from people living in urban areas. The great majority of injuries (78 %) occurred on the extremities of the body. Most occurred at home, and the incidence rate for urban areas was higher than for rural areas. 94 per cent of the cases were caused by domestic animals, 85 per cent being due to dog injuries. In 42 per cent of cases of dog-related exposures, the animal was reported to have been vaccinated against rabies. At the time of exposure, the animal was reported as healthy in 58 per cent of cases, and in 2 per cent it was considered rabid. The author concludes that reduction of both exposures and post-exposure prophylaxis could be possible through better understanding of dealing with animals and rabies control. Suggestions to achieve these objectives are given.

INTRODUCTION

Human exposure to potentially rabies-infected animals is a public health problem worldwide. Although the control of rabies in domestic animals, especially in dogs, reduces dramatically the risk of transmission of the rabies virus to man, it does not affect the number of animal bites (Currier III et al 1975). Thus, the threat of rabies remains because of the uncertainty about the presence or absence of the virus in the saliva, in each case of human exposure to animal. This uncertainty brings a serious dilemma regarding the decision whether to initiate rabies postexposure prophylaxis (PEP). As a consequence, even in areas where rabies has been controlled, the maintenance of a complex and expensive scheme to provide advice and prophylaxis on rabies is required. However, the importance and priority given to this problem, within the health system as a whole, is lower than its actual magnitude, particularly in tropical countries, where the risk of rabies is highest. Insufficient concern in many countries about the problem of injuries caused by animals could be explained on the following grounds: 1) scarcity of information about incidence of rabies in humans and animals; 2) lack of data concerning animal bites and numbers of persons receiving postexposure treatment; 3) following the absence of such data, there is no estimate of the medical and economic cost due to exposure to animals. Finally, in addition to the above factors, awareness about rabies in general does

not stimulate interest in the media and in the community, except for short periods when human cases of the disease occur. In order to improve the public's concern about the problem, a better epidemiological understanding, in a broad sense, including social, economic, and medical aspects, is thus highly desirable, in any country.

THE PRESENT STUDY

The present study is an epidemiological analysis of the circumstances surrounding human exposures to possibly-rabid animals. It is limited to those cases reported by the health units network of the Public Health Services Foundation (SESP), in certain areas of the interior of sixteen states in Brazil, during 1984. This is not a pre-planned study investigation, in that there was no prior study design. The goal is to provide an insight into the epidemiology of exposures to animals by analysing the data obtained from routine procedures at the local level.

We hope that the results of the present study can help in planning and evaluating rabies control activities as a whole in the SESP areas. In particular, we hope that the study can contribute towards reducing the number of persons receiving postexposure prophylaxis, by indicating safe ways of avoiding unnecessary prophylatic vaccination.

OBJECTIVES OF THE STUDY

The objectives of the present study are:

1) To describe the epidemiological features of human exposures to potentially rabid animals, by analysing data on those cases registered at the health units of the SESP Foundation in Brazil, during 1984,

2) To identify risk factors for exposure to potentially rabid animals in the areas covered by SESP Foundation,

3) To suggest measures to reduce the risk of exposure to possibly rabid animals and to reduce the number of persons receiving antirabies prophylaxis.

Chapter 1

BACKGROUND

1.1. History

Rabies is a serious disease caused by a neurotropic virus belonging to the group of Rhaddoviridae, genus Lyssavirus. It affects warm blooded animals species. Man becomes infected nearly always by a bite of animal containing virus in the saliva (Warrel 1977).

The association between exposure to animals (in particular dog bites) and rabies transmission was established as long ago as 2,300 BC, in ancient Babylon. It was then and there decreed that if a dog were mad, and the authorities informed the owner accordingly, and if he failed in keeping the animal tied and it bit someone and caused his death, a specified fine became payable - 40 shekels of silver for a freeman and 15 shekels of silver for a slave (West 1972). In some cultures the fear of rabies was such that persons suspected of hydrophobia were at times killed like wild animals, shot, poisoned, strangled, or suffocated. In 1810, in France, legislation was introduced in the following terms: "It is forbidden under penalty of death to strangle, suffocate, bleed to death, or any other way murder individuals suffering from rabies, hydrophobia, or any disease causing fits, convulsion, furious and dangerous madness" (Wiktor, 1986).

The latin word rabies comes from the Sanskrit rabhas which means "to do violence" Canine rabies was first described by Democritus 500 years B.C.. The transmission of rabies from dog to other animals was noted by Aristotle in the fourth century B.C.. He wrote in his Natural History of Animals that dogs suffering from madness become very irritable and all animals they bite become diseased. Erroneously he stated that man was exempt from contracting rabies from the bite of a mad dog. The infectiousness of the saliva of rabid dogs was described by Cardanus, a Roman writer. The Roman writers described the infectious material as a "virus" which means poison in latin. Celsus, a Roman physician of the first century A.D., made rabies his particular field of study. He was convinced that the bites of all animals that contained virus were dangerous to man and beast. The fact that the saliva contained the poisonous agent was fully recognized by Celsus and his contemporaries. About the disease itself, Celsus wrote: "The Greeks call it hidrophian a most sad disease, in which the sick person is tormented at the same time with thirst and the fear of water, and on which there is but litle hope" (Steele, 1975).

Celsus recommended local wound treatment of mad dog bites with various caustic and corrosive substances and by burning with a hot iron, a practice that persisted for many centuries. In 1852, when the French Governement offered a reward to anyone with a remedy for hydrophobia, it was widely believed that cauterization of the wound was the only prophylatic treatment for hydrophobia. Thus,

after centuries had passed and countless remedies had been tried, no progress had been made, and nothing better than cauterization, as proposed by Celsus in the first century, had been found. Slowly, a better understanding of the disease emerged. In 1804 the german physician G. Zinke demonstrated that the disease is infectious by inoculating normal dogs with saliva from rabid dogs. In 1879, Victor Galtier, professor at the Veterinary School in Lyon, transmitted rabies from dog to rabbit and from rabbit to rabbit. He subsequently used intravenous injections of rabid material to immunize sheep and goats (Wiktor, 1985). In 1881 Francois Megendie and Gilbert Breschet infected dogs with human saliva.

Pasteur and human rabies vaccination

In 1880 Louis Pasteur, already famous for his research on fermentation, silkworm disease, anthrax, and chicken cholera, became interested in the study of rabies. After 5 years of study together with his collaborators, Roux, Chamberland and Thullier, Pasteur immunized dogs by injecting suspensions of tissues obtained from infected rabbits. Fifty dogs immunized in this way resisted rabies infection when injected intracerebrally with virulent virus. At about this time occurred the first opportunity to Pasteur to apply his rabies vaccine in man. A boy of 9 years, Joseph Meister, who had been bitten 14 times by a rabid dog, arrived in Paris. Doctors Vulpian and Grancher examined the boy and thought that he had received a fatal

inoculation of rabies virus. Facing the problem Pasteur said "The death of this boy seemed inevitable, and I decided not without lively and cruel doubt, as one can believe, to try in Joseph Master the method which had been successful in dogs." Consequently on July 6, 1885 the first rabies vaccine was inoculated into a human being. The little boy never developed rabies (Wiktor, 1985). The prophylactic method of rabies developed by Pasteur rose to great interest in medical circles and, despite some initial disagreement it was rapidly accepted. In 1888 the Pasteur Institute of Paris was founded and within a decade Pasteur Institutes were established throughout the world, with primary focus on rabies control.

In Brazil, rabies has been considered as a public health problem since the last century. In 1867 the "Gazeta Medica da Bahia" published an article concerning the recognition of rabid dogs, and antirabies treatment following dog bites. The Emperor Pedro II was amongst the foreign governors who made a personal donation for rabies research to the Pasteur Institute in Paris. In 1892, the Pasteur Institute of Rio de Janeiro was founded and in the following years several branches were set up in other states.

One of the more important events of the twentieth century for the understanding of the epidemiology of rabies was the discovery of rabies in bats, first in Brazil and later in several other countries in the Americas. In 1911, Carine found Negri bodies in brain

tissue of cattle bitten by bats in areas in southern Brazil free of dog rabies (Baer, 1975). Nowadays, bats are the most important wild vector of rabies in Latin America, and the third most commom animal found rabid in the USA (CDC, 1984)

1.2. Current situation

1.2.1. General

Few areas in the world are currently free of rabies. According to the latest world survey on rabies carried out by the World Health Organization (WHO) during the years 1984/1985, the following countries or areas reported that rabies was not present in their territory; Mauritius in Africa; Bahamas, Jamaica, Surinam, and Virgin Islands in the Americas; Bahrain, Brunei Darussallan, Kuwait, Malaysia (Sabah), Maldives, Oman, and Singapore in Asia; Bulgaria, Cyprus, Finland, Gibraltar, Iceland, Ireland, Malta, Norway, Portugal, Spain, Sweden, and United Kingdon in Europe. There was no report of rabies in Oceania (WHO, 1987). Table 1.1 shows the number of cases of rabies in animals reported to WHO in 1975, by continent. These data came from 106 countries which had answered the WHO questionnaire. Rabies occurred in all continents except Oceania. Domestic animals accounted for 53 per cent of the total cases reported and they were predominant in all continents but Europe. Rabies in dogs represented 73 per cent of the total cases in domestic animals and 38 per

Table 1.1

Reported cases of animal rabies in the world, by continent - 1985.

Animal species	Continent (1)				
	Africa	Americas	Asia	Europe	Total
Total	2,478	15,785	11,665	18,042	47,970
Domestic	2,219	8,641	11,665	2,962	25,310
Dog	1,720	5,640	10,666	396	18,422
Cat	82	490	427	687	1,686
Farm animals	417	2,511	395	1,897	5,202
Wild	194	2,216	84	13,581	16,075
Foxes, wolves and jackls	37	1,211	80	13,570	14,898
Bats	-	920	-	11	931
Mongoose	157	85	4		246
Others	65	4,928	93	1,499	6,585

(1) There were no cases reported from Oceania.

Source: WHO, World survey of rabies XXII (for years 1984/85)

cent of the total cases reported in the world in 1985. In Europe, in the United States, and in Canada, cats were the most common domestic pet animal found rabid.

Worldwide, rabies has two distint patterns. In developing countries the disease appears to be predominant in urban areas with dogs as the main reservoir. In industrialized countries, where rabies in urban areas has been controlled, most of the reported cases came from wild animals. Despite these patterns, the dog remains as the main source of exposure leading people to receive postexposure vaccination in all parts of the world (WHO, 1987).

In France, 66 per cent of persons who sought rabies prophylaxis advice during 1986 reported exposure to dogs. Amongst those receiving specific systematic treatment 52 per cent had been exposed to dogs. In the same year however, of the total number of animals found to be rabid, only 2 per cent were dogs. (Institute Pasteur Paris 1986). In Europe as a whole dogs were the source of exposure of 46 per cent of people receiving antirabies prophylaxis, although they account for only 2 per cent of animal rabies reported. (WHO 1987). A survey carried out in the USA in 1980-1981, showed that although rabies in dogs represented only 0.7 per cent of all laboratory confirmed rabid animals, 33 per cent of persons receiving postexposure prophylaxis reported dog exposure as the reason for vaccination (Helmick 1983). The table below gives the number of persons receiving post exposure prophylaxis and the number of cases of rabies in humans reported to WHO in

1985, by continent.

Table 1.2

Frequency distribution of cases of Postexposure prophylaxis and cases of rabies in humans, reported to WHO in 1985, by continent.

Continent	No. of persons receiving PEP	No.of cases of rabies in humans
Africa	58,445	152
Americas	320,765	168
Asia	623,110	25,280 (*)
Europe	33,741	4
Oceania	–	–
Total	1,036,061	25,604

(*) Exactly 25,000 cases were reported by India !

Source: WHO, World survey of rabies XXII.
WHO/Rabies/87.198

It is recognised that these figures are far from complete. Many countries did not send information and even those which did, did not always send data representing the whole country. Taking India as an example, approximately

three million people are reported to receive postexposure prohylaxis every year (Lakhanpal et al, 1985), although in 1985 only 500,000 such cases were reported to WHO. For the other hand, 25,000 out of 25,280 cases of human rabies in Asia, were reported by India.

In Africa, due to inadequete reporting and poor recording systems, the incidence of rabies can only be estimated from a few government reports and from individual studies. Such studies have concluded that rabies is endemic throughout the continent (Alonge and Abu, 1984).

Reports from 11 countries of the Americas in 1984 indicate that 1,400,000 persons were bitten by animals and antirabies treatment was provided to over 350,000 individuals in that year (Cifuentes, 1986).

Valid and reliable epidemiological information on rabies is lacking in most countries. Cases in both humans and animals are grossly underreported or not reported at all (Fernandes M V and Arambulo III P V, 1985)

1.2.2. Brazil

Despite significant improvement in the control of the disease, rabies continues to be an important public health problem in Brazil. Its importance is reflected in the high number of persons receiving post exposure treatment and in the number of human cases that still occur in the country. Table 1.3 gives information about numbers of persons seeking rabies prophylaxis and the numbers of persons

receiving treatment from 1980 to 1985.

Table 1.3

Number of persons seeking rabies postexposure advice and number of persons receiving postexposure prophylaxis. Brazil, 1980-1985.

Year	Postexposure prophylaxis (PEP)			
	No.of persons seeking PEP	Rate*	No.of persons. receiving PEP	Rate*
1980	311,349	261.3	176,825	148.5
1981	366,132	300.2	208,544	170.9
1982	344,450	275.4	191,626	153.2
1983	375,443	292.6	208,885	162.8
1984	376,611	285.2	202,469	153.8
1985	388,976	286.9	182,386	134.5
Total	2,162,961	283.8	1,170,735	153.6
Mean	360,494		195,123	

* per 100,000 population.

Source: SESP Foundation

During the period 1980-1985 an average of 360,000 persons (rate of 283.8/100,000) sought antirabies prophylaxis each year because they had been bitten or had

been in contact with a potentially rabid animal. (SESP 1987). Due to lack of an appropriate routine reporting system and survey studies, the actual number of animal bites is unknown as well as its importance as a source of severe injuries, disabilities, and deaths.

1.2.3. SESP Area

In 1984, 11 cases of human rabies were reported in the SESP areas. This represented 12.6 per cent of the total cases reported in the country, whereas the population of the SESP areas represents only 8 per cent of the total country's population.
The number and species of animals reported rabid in 1984 is given in table 4.13 chapter 4.

1.3. Control

1.3.1. The national rabies control programme in Brazil

With the purpose of planning and coordinating rabies control activities at the Federal level, the national rabies control programme (NRCP) was lauched in 1973 by the Ministry of Health. A national rabies committee made up of representatives of the Ministries of Health, Agriculture, and Social Security, and the regional office of the Pan American Health Organization (PAHO) was established in the same year. The national coordination of the programme has

been delegated to the SESP Foundation, since 1973. The programme was gradually implemented throughout the country, reaching all the states in 1977 (SESP 1984). Similarly states and municipal committees were established by the state and local programmes.

Considering that dogs are the source of approximately 85 per cent of animal bites and are responsible for most of the rabies transmission to man in Brazil (Fig. 1.1) the control of rabies in animals has been directed primarily to these animals. Massive vaccination campaigns have been preferred instead of stray dog elimination as the chief measure to control rabies (Belotto 1986).

The dog population for the country as a whole is estimated on 10 per cent of the human population (Belotto, 1986). The overall rabies vaccination coverage of the dog population was 44 and 62 per cent for 1980 and 1985, respectively.

Elimination of dogs in Brazil is a supplementary measure of dog rabies control. It is carried out in selected areas considered at high risk of rabies transmission. Its purpose therefore is to enhance rabies control and not to solve the problem of stray dogs. Table 1.4 shows the number of dogs vaccinated against rabies, the number of dogs eliminated, and the reported numbers of cases of rabies in dogs and in humans, by year, during the period 1980-1985, in Brazil. A dramatic decline in both canine and human cases of rabies can be observed.

Table 1.4

Number of dogs vaccinated, number of dogs eliminated, and number of reported cases of rabies in dogs and in humans.

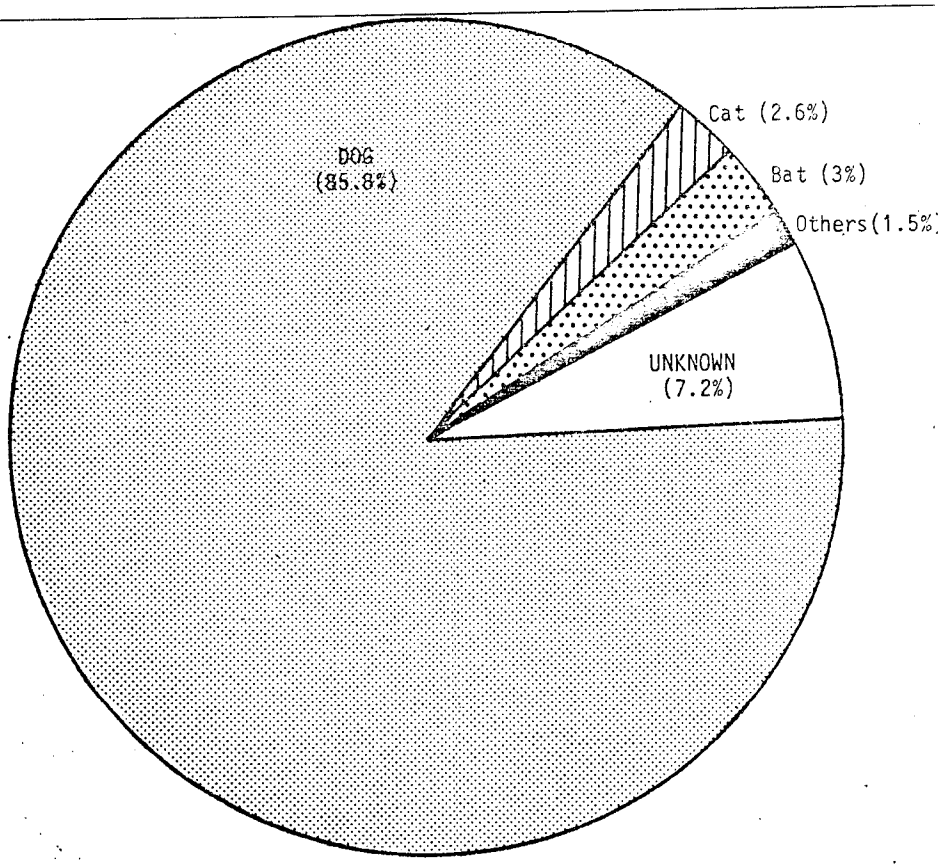
Brazil, 1980-1985

Year	No. dogs vaccinated	No. dogs eliminated	No. rabid dogs	No.Human cases
1980	5,258,750	122,491	4,570	168
1981	6,971,703	108,807	2,955	139
1982	7,545,718	75,527	2,283	125
1983	7,802,193	85,415	1,216	101
1984	7,665,493	85,999	874	87
1985	8,382,563	86,905	496	52

Source: SESP Foundation

Through the policy control recommended by the programme, rabies has been controlled in most urban areas of the country. In the rural areas however, the activities need to be implemented and better coordination betwen health and agriculture services is required to meet rabies control.

Fig. 1.1
Source of human rabies by animals species,Brazil 1980-85



Source : NRCP - SESP Foundation

Chapter 2

JUSTIFICATION, PUBLIC HEALTH IMPORTANCE, AND DEFINITIONS

2.1. Implications of epidemiology of human exposures to animals

An understanding of the epidemiology of factors which represent potential risk to individual or community health is the first step to be achieved if rational control measures are going to be launched. In the particular case of human exposure to animals, the knowledge of its epidemiological features is crucial as a guide not only for rabies control activities, but also for reducing painful physical injuries caused by animal bites, which themselves represent a serious problem in medical care delivery. Studies on the epidemiology of exposures to animals are indispensable for the specific purpose in rabies control such as:

1) Planning, execution, and monitoring local activities in a given area.
2) Defining rabies control strategies and priorities in terms of facilities, equipment, and personnel.
3) Defining specific activities for the different government departments such as health and agriculture.
4) Indicating priority areas for carrying out animal rabies vaccination, stray animal control, and health education activities.
5) Providing background information for the management of

rabies postexposure prophylaxis.

6) Estimating costs of medical care related to antirabies prophylaxis and treatment of injuries, including costs of drugs, immunobiologics, and time for both health staff and patients.

2.2. Public health importance of human exposure to potentially rabid animals

Injuries caused by potentially rabid animals may result in three kinds of health problem:

a) transmission of rabies virus,

b) trauma (physical and psychological)

c) transmission of other pathogenic microorganisms.

a) Transmission of rabies virus

Perhaps the most important issue arising from human exposure to animals is that the possibility of rabies virus transmission should always be considered. The risk of acquiring rabies through animal bites has a hold on the human imagination which can be explained by the following:

1) rabies is one of the most terrifying and agonizing of all diseases and death after a few days is almost inevitable.

2) It is caused by a neurotopic virus which causes intense disturbance in the behaviour of affected individuals.

3) The virus can affect many species of warm blooded

animals and as a consequence most animals are potential transmitters of the infection to men.

4) Transmission of rabies to man can occur by tooth and claw of an furious animal or softly and stealthily at night, when a vampire bat takes blood from the toe of a sleeping man

5) In most cases rabies infection is frightening and painful, usually caused by attack from a mad carnivourus animal.

6) The traditional rabies prophylaxis is associated with discomfort, risks, and uncertainties.

7) The incubation period is unpredictable and sometimes very long. It brings anxiety to the exposed individuals and to the whole family, who may have to endure a wait of several months or even years before they have escaped the threat of rabies (Warrel 1977, West 1972, WHO 1981).

b) Trauma

Injuries caused by animals, particularly bites, outnumber most accidents and infectious diseases (Beck et al 1975). Dogs are the most common biting animal in all parts of the world. It has been estimated that the incidence of dog bites in the world ranges between 200 and 880 bites 100,000 population per year (Bernard and Hattwick 1985). It appears that the incidence of animal bites is increasing, particularly in urban areas. In St. Louis (USA) the rate of dog bites reported from 1963 to

1973 almost doubled. In a hospital-based survey it was found that aproximately 1 of every 50 emergency room admissions was a dog bite injury (Beck, 1975). Several studies have shown that around 50 per cent of animal bites occur in individuals under 15 years. This fact makes the problem of animal bites still worse, considering the severity, sometimes life threatening, of animal attacks on children. Not infrequently animal bites require expensive medical care and even plastic surgery intervention. Studies have suggests that at least 10 percent of all bites required some suturing (Beck et al 1975). The same authors studied the ecology of dog bite injury in St. Louis, Missouri, and found 3.4 per cent of all bites classified as serious, and that generally the victims were young. About 9.2 per cent of all bites were multiple injuries. In Sao Paulo, Brazil, 51 per cent of persons seeking rabies postexposure advice at the Pasteur Institute in 1966/67, had suffered multiple injuries (Ribeiro Netto and Machado 1970). Although more difficult to evaluate, the psychological trauma caused by animal attacks should be considered seriously in assessing its public health implications.

d) Transmission of other pathogenic microorganisms

In addition to rabies, the transmission of the following diseases have been related with animal bites, scratches, or licks:

- Pasteurellosis (Pasteurella multocida and P.

haemolytica, transmitted by cat and dog bite or scratch)

- Cat-scratch disease or cat scratch fever

- Herpes B virus (herpesvirus simiae)

- Encephalites (especially due to other rhabdovirus, Mokola and Duvenhagen for example)

- Tularemia (bites of wild animals, especially rabbits and hares)

- Rat-bite fever

- Tetanus

- Pyogenic infections (Benenson 1980).

Despite these facts, animal injuries are not widely appreciated as a major public health problem, probably because the lack of adequate register and reporting system.

2.3. Definitions

We define below a number of terms which arise frequently in discussion of rabies, and which will be important in the context of the present study.

2.3.1. Exposure

Exposure to rabies is defined as any penetration of the skin by the teeth of a potentially rabid animal, or the contamination of scratches, abrasions, open wounds or mucous membranes with saliva or other potentially infectious material (such as brain tissue) of a potentially rabid animal (Helmick, 1983).

2.3.2. High risk exposure

Those exposures consisting of licks of mucosa, and major bites (multiple, or on face, head, neck, or finger) impart a particularly high risk of disease. They are considered as high risk exposures because those anatomical sites can facilitate the invasion of the nervous system by the virus. It has been oberved that the incubation period subsequent to such exposure is generally shorter than when subsequent to other sorts of exposure (usually between 30 and 60 days).

2.3.3. Indirect contact

Defined as the possible exposure to rabies virus such as may occur when a person shares the environment of a suspected rabid animal without having actual physical contact with the animal. For this type of exposure rabies treatment is not recommended (WHO 1984). However, complete physical examination should be carried out when young children are involved, to eliminate the possibility of any direct exposure to rabies virus (minor bite, scratch, lick of wounds).

2.3.4. Potential rabid animal = potentially rabies transmitter animal = potential rabies infected animal = animal which may carry rabies virus.

As a general rule, individual animals of any species in which rabies has been diagnosed in a given area are considered potentially rabid. In this sense the

quantitative importance of the species as rabies transmitter to man is not taken into consideration. The point to be considered is the possibility, however remote, of the animal being rabid at the moment of exposure. The same basic procedures i.e. evaluation of the circumstances surrounding exposure and of the epidemiological situation of the area in terms of the prevalence of rabies and the animal species known to be rabid, should be taken into consideration in case of exposure by a dog or by a rodent, before deciding on rabies postexposure prophylaxis. In spite of the huge difference in the role played by these animals as sources of transmission of rabies to man, both are susceptible to rabies infection and therefore both are at least potentially rabid animals.

Animals more commonly found rabid worldwide are: domestic and wild carnivores, domestic and wild ruminants, domestic and wild equines, domestic swine and wild porcine, bats, rodents and lagomorphs, and non-human primates. However the animal hosts reponsible for maintaining the rabies virus in nature are carnivores and bats. Herbivores, other non-biting animals, rodents, and lagomorphs do not appear to play an important role in the epidemiology of the disease (Acha and Szifres 1980).

2.3.5. Human rabies postexposure prophylaxis = antirabies prophylaxis = rabies postexposure treatment = antirabies treatment = antirabies vaccination = human rabies prophylaxis etc.

All these terms have been used to describe the

medical care dispensed to patients exposed to a potential rabid animal. They consist of a combination of physical, chemical and immunological methods applied after the exposure in an attempt to inactivate rabies virus.

In Brazil, human rabies prophylaxis follows the general recomendations given by WHO, using reduced vaccination scheme. (WHO 1984). The vaccine used is the suckling mouse brain vaccine (SMBV) and the serum is from equine origin. Both are produced in the country. Two basic schemes are recommended by the Ministry of Health:

1) For exposure considered as high risk - Serum plus 1 daily dose of vaccine during 10 days plus 3 booster doses of vaccine on days 10, 20, and 30 after the end of the primary series.

2) For mild exposures - 1 daily dose of vaccine during 7 days plus 3 booster doses 10, 20, and 30 days after the end of the primary series (Ministerio da Saude 1985).

Chapter 3

MATERIALS AND METHODS

3.1. Study area

The area of study is that covered by the health units network of the SESP Foundation in 16 states of 4 regions, in Brazil. In 1984 the network numbered 732 units (Fig.3.1). The estimated population of the study area for 1984 was 10,438,764 inhabitants, which represents 7.9 per cent of the total population of the country (SESP 1984).

The SESP Foundation is a federal organization in charge of primary health care in special areas in the interior of Brazil. It is linked to the Ministry of Health. SESP started its activities in 1942 in the Amazonian region with the specific purpose of providing health care for workers extracting rubber in the jungle. Later the activities were expanded to other regions and howaday the institution provides medical care and sanitation facilities in special areas of 4 out of 5 regions of the country. Table 3.1 shows the total population of Brazil, the population covered by SESP, and the number of SESP health units, by region, for 1984.

The special areas refered to above are: 1) those receiving new settlements; 2) areas where large projects such as roads, hydroelectric stations, and mineral extraction fields are being implemented; 3) areas affected by endemic diseases; 4) rural areas without health

services structure; and 5) any area considered particularly important by the Federal Government policy.

Table 3.1

Population of Brazil, SESP Foundation area population and number of SESP health units, by region - 1984

Region	Brazil popul.*	SESP area pop. (%of reg.pop.)	No.SESP health units(column %)
North	7,258,387	1,865,024 (16)	107 (15)
North-East	38,137,303	6,594,552 (17)	487 (66)
South-East	57,596,847	819,933 (01)	60 (08)
Central-West	8,771,836	1,159,255 (13)	78 (11)
South	20,290,664	-	-
Total	132,055,037	10,438,764 (08)	732 (100)

* Source : Brazilian Institute of Geography and Statistics (IBGE)

Source : SESP Foundation

3.2. Study population

The study population consists of 15,057 persons who sought advice regarding rabies prophylaxis at the SESP's health units in 1984. The individuals went to the health units voluntarily because they had considered themselves at risk of acquiring the disease after having been exposed

to a potentially rabid animal. Although the actual number of people exposed to possibly rabid animals is unknown the figure above should represent the great majority of persons who sought post-exposure advice, because usually other public health services are not widely available in the SESP areas. It is possible that in some ocasions people go to other places to seek rabies advice. Human rabies vaccine in Brazil is entirely controlled and distributed to the State Health Departments, free of charge, by the Ministry of Health. Therefore no post-exposure rabies vaccination is available in the private health sector. The exeption are a few private specialized immunization clinic located in large cities which provide rabies vaccination using human diploid cell culture vaccine for high income people.

3.3. Source of information

Individual reports about the circumstances surrounding the exposure of 15,057 cases of rabies prophylaxis consultancies. Annex 3.1 is a copy of an original report form showing the information collected.

As a routine, for each person that seeks rabies prophylaxis advice at the SESP health units, a report like that mentioned above is filled in. It is completed by the staff member in charge of the interview. Usually this job is done by a physician or a nurse, but in health units with shortage or absence of physician and nurse the job is delegated to ancillary health workers under medical

supervision. These individual forms are filed at the unit level in order to have the information readily accessible in case an individual is re-exposed. A monthly report with numerical data of rabies prophylaxis activities is sent to the SESP's Regional Office in the state capital city. The latter join the information of the units under their jurisdiction and send a consolidated report to the central epidemiology unit of the organization.

For the purpose of this study the health units were asked to send the individual reports to the epidemiology unit, through the state regional offices. The decision to ask for this information was taken in 1985 and the reports were collected at the begining of 1986. Therefore anyone filling out the forms did not know that the information would be used in this way. The variables and categories listed below were coded for computer entry and processing.

No.	Variable	Categories
1	Age groups (in years)	0-4; 5-9; 10-14; 15-19; 20-29; 30-44; 45 -
2	Sex	Male; female
3	Area of residence	Urban; rural
4	Previous rabies vaccination	Yes; no
5	Month of exposure	January to December
6	Kind of exposure	Bite; scratch; lick; indirect contact

7	Site of exposure	Head/neck; hand; trunk, upper limbs; lower limbs
8	Kind of wound	Single; multiple
9	Severity of wound	Superficial; deep
10	Place of occurrence of exposure	Home; street; other
11	Area of occurrence of exposure	Urban; rural
12	Animal species causing exposure	Dog; cat; cattle; horse; pig; fox; bat; rat; other
13	Rabies vaccinal status of the animal	Vaccinated;not vaccinated
14	Condition of the animal	Health; suspected; rabid; wild; death; disappeared

Each case was entered on a computer (Cobra model C-540 with SOD operating system) at the SESP Foundation computer centre in Rio de Janeiro. The information was recorded on magnetic tape.

3.4. Analyses

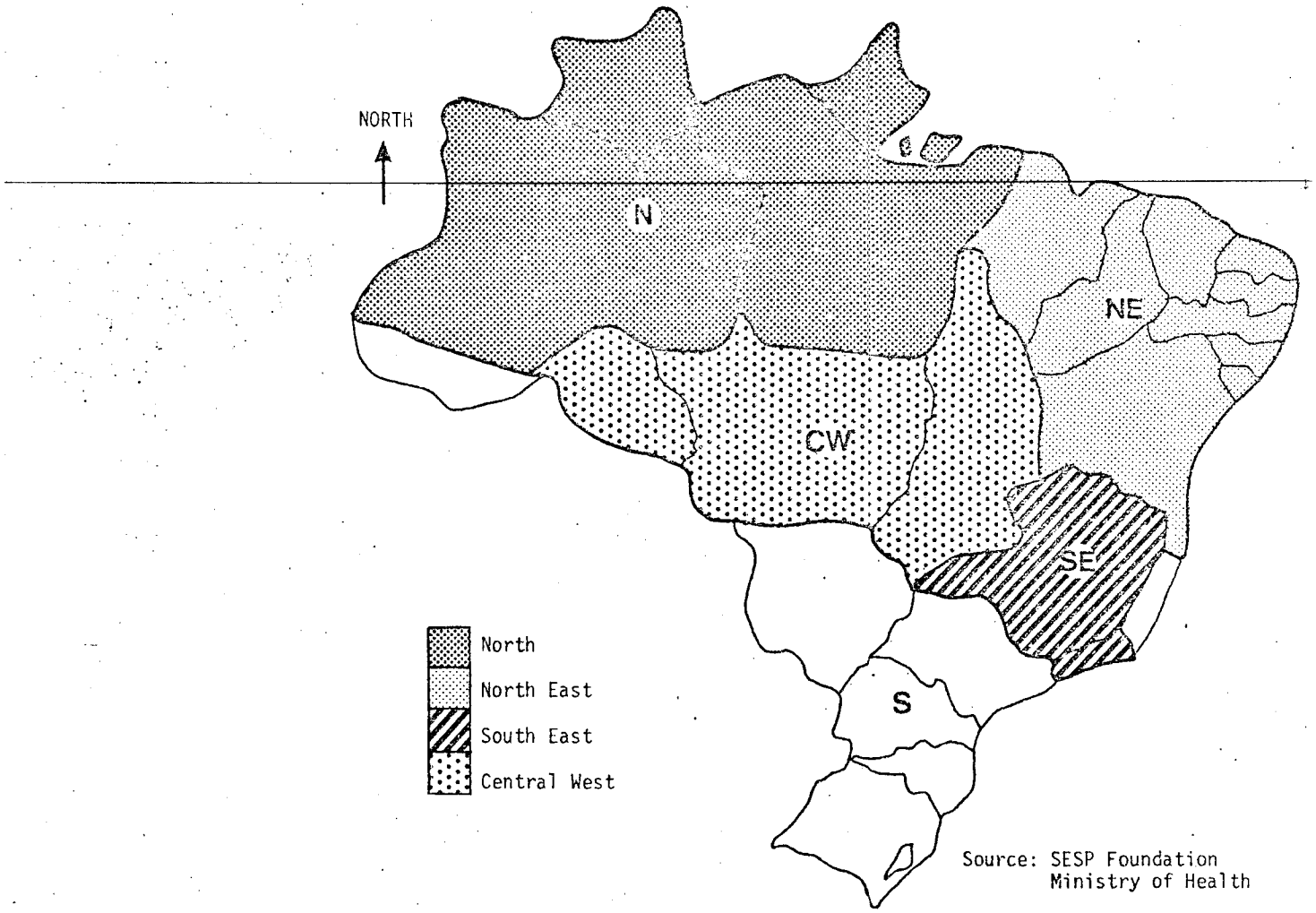
The analysis consisted of the following tabulations which were prepared by the SESP computer center and were available to this author for this study,

1. Site of exposure by age group,
2. Area of occurrence by age group and sex,
3. Area of residence by age group,

4. Previous rabies prophylaxis course by state,
5. Month of occurrence by state,
6. Kind of exposure by site of exposure,
7. Site of exposure by kind and severity of wound,
8. Place of occurrence by site of the exposure,
9. Place of occurrence by age group and sex,
10. Animal species causing exposure by age group and sex,
11. Animal species causing exposure by area of occurrence and age group,
12. Rabies vaccinal status of the animal by animal species,
13. Condition of the animal causing exposure by animal species,
14. Place of occurrence of exposure by condition of the animal,
15. Area of occurrence of exposure by condition of the animal.

The distribution of the SESP area population by age groups, sex, and area of residence was based on the distribution of the population of each state given by the national census of 1980. (IBGE, 1981)

Fig. 3.1 Number of SESP's health units and population covered by region 1984



Source: SESP Foundation
Ministry of Health

REGION	No.OF HEALTH UNITS	POPULATION (x 1,000)
North	107	1,865
North East	487	6,594
South	60	820
Central West	78	1,160
TOTAL	732	10,439

Chapter 4

RESULTS

4.1. Incidence

Table 4.1 shows the number of persons seeking help on account of exposures to potentially rabid animals, the population at risk, and the incidence rates in SESP area in 1984, by region and state. During this year 15,057 persons sought rabies advice at the SESP Foundation's health units because they had considered themselves at risk of acquiring rabies through some kind of exposure to a possibly rabid animal. The overall incidence rate of such exposure for the area covered by SESP in sixteen states was 144.2 per 100,000 population. The incidence of human exposure to animals for the country as a whole for the same year was 287.8/100,000 inhabitants (SESP 1984).

4.2. Geographical variation

There is great variation in incidence of exposure between the different states. The rate varies from 8.3 per 100,000 population in Mato Grosso, to 334.7 in Paraiba. In terms of region the highest incidence was seen in the North, represented by the Amazonian states. Although that region contributes only 17 per cent of the total SESP's area population, 29 per cent of the exposures had been reported there. The North-East region, where 63 per cent of people using SESP's health facilities live, contributed

58 per cent of the total exposures. In the Central-West region the incidence rate was only half of the overall incidence.

4.3. Time of exposure

The average number of exposures to potentially rabid animals per month was 1,255 cases. The absolute number per month was below the mean during the first semester of the year, except for May. In the second semester the occurrence of cases was above the mean for all months. From July onwards the number of cases rose continuosly, reaching a peak on September when 1,572 cases were registered (Fig.4.1). There were no important differences between states in the monthly distribution.

4.4. Age and sex

The study population was broken into 7 groups by age. The number of recorded exposures by age and sex are given in table 4.2. As reported in other studies elsewhere (Cochavi and Davies 1960, Tornero and Shibayama 1974) the highest incidence rate was observed in the age group 5-14 yars. For both sex in this age group the rates were almost double of that observed for the other groups. Within this age group, the incidence was particularly high in males (263/100,000). The rate in females was 114/100,000 population. There was a significant difference in the incidence rate between sexes. The overall rates for each sex were 158 and 122/100,000 for male and female, respectively. Only in the age group above 45 years was

the incidence rate higher in women than in men. The lowest incidence rate (98/100,000) occurred in the age group 20-29 years. After the age 30 the incidence rises again.

4.5. Previous rabies vaccination course

In 436 cases (3%) the exposed person had received a previous rabies postexposure prophylaxis treatment. The distribution of such cases was almost even between states.

4.6. Area of residence

Table 4.3 shows the frequency distribution of cases of exposure and incidence rates by area of residence, and by region. Most reports of accidents with potentially rabid animals came from urban areas. The incidence rate for urban areas is more than twice that for rural areas. In all regions except the South-East, the incidence rate was higher in urban areas. The North region presented the highest rate of exposed people living in urban areas while the lowest urban rate was observed in the Central-West region.

4.7. Kind of exposure

From the 15,070 people seeking rabies prophylaxis advice, 97 per cent had received animal bites and/or scratches, and 1 per cent were only licked by the animal (Table 4.4). The remaining, 0.8 per cent had indirect contact, and in 180 cases (1.2%) the kind of exposure was not reported.

4.8. Site of exposure

Table 4.5, gives details of the frequency distribution of the 14,929 exposures reported, by site and age groups. The great majority of the exposures occurred in the extremities of the body: more than half (52%) were situated on the lower limbs, and 26 per cent on the upper limbs. Of the latter, 48 per cent had occurred on the hands. The lower limbs were the main site of exposure for all age groups, except those 0-4 years, for whom the head was the main site of exposure. The proportion of exposures on the head decreases with age while on the lower limbs it increases until 10 years and from this age onwards it remains stable. Exposures in more than one site accounted for 5.7 per cent of the total, and cases without record of exposure site 1.8 per cent. In 128 cases, the patient reported indirect contact.

4.9. Severity of wound

Table 4.6 gives the percentage of wounds by site for each severity classification. Bites and/or scratches had occurred in 14,775 cases. (The rest were 154 cases of licks and 128 indirect contact). However, due to lack of report or not clear report, 1,148 cases (7.6 % of the total) were excluded from the analyses of this variable. From the remaining 13,627 cases, 57 per cent were single injuries and the rest multiple. Regarding profundity, 30 per cent of wounds were classified as deep. Of the total bites and scratches entering in these analyses, single superficial injury on the lower limbs appear most

frequently (24%), while severe exposure like multiple and deep bites on the head/neck, and on the hands were observed in 357 cases (2.6%).

4.10. Place of occurrence

Table 4.7 shows the frequency distribution of all exposures by place of occurrence, sex, and age. The most frequent place of occurrence of exposures was the dwelling of the exposed person, which accounted for 56 per cent of the total incidents. 31 per cent of the exposures had occurred in streets and other public places. Eight per cent of the exposures occurred in other places such as schools, friend's houses etc., In 808 cases (5%) the place was not entered in the form. The same pattern was observed for all sixteen states.

Although the overall proportion of males in the population of the SESP area is 49.6 per cent (it ranges from 48 per cent in the age group 15-29 years to 51 per cent in the age group 30-44 years), there were more reports of males than females exposed in public places and places classified as "others". This excess is found in all age groups. In the age group 5-14 years, the number of males exposed in public place is nearly twice that of females. At home however, exposures were more common in men only until 15 years. From this age onwards the number of exposures at home is higher in women than in men.

4.11. Area of occurrence

Table 4.8 shows the distribution of reported

exposure in urban and rural areas by species of animal involved. The incidence rates of exposures per 100,000 population for urban and rural areas were 147 and 63 respectively. For this calculation 3,719 cases, in which the area of occurrence was not entered or was misclassified, were excluded. Analyzing animal species causing exposure for area of occurrence, the following comments can be made: exposure to dogs, cats, and rats was more frequent in urban areas; accidents with cattle, horses, and foxes were more common in rural areas. Surprisingly, exposures caused by both pigs and monkeys were higher in urban than in rural environments. Exposures due to bats were sligtly higher in rural than in urban areas. Incidence rates of exposures caused by dogs and cats in urban areas were more than twice of those for rural areas.

4.12 Animal causing exposure

Domestic animals were the most important sources of exposure, contributing 94 per cent of the total cases reported in the SESP's area in 1984. If the exposures caused by pet monkeys and by rats are included, the proportion reaches almost 98 per cent. Dogs alone were responsible for 85 per cent of the total exposures. Cats, involved in 8 per cent of exposures, came in second place. Amongst wild animals other than monkeys, foxes and bats had been involved most frequently in accidents involving human exposure. All 162 exposures caused by foxes had occurred in the North-East region, except 1 registered in

Minas Gerais state. Most fox exposures (75%) were reported by Ceara, Sergipe, and Paraiba states. Regarding the sex of persons exposed (table 4.9), females were found more frequently exposed to cats (60%). The frequency was particularly high in adult women (20 years onwards). This group suffered 64 per cent of all exposures reported in females caused by cats. The number of exposures caused by rats was slightly higher in women, also affecting predominantly the age group above 20 years. In all states, farm animals - cattle, horses, and pigs - caused more exposure in men than in women. The frequency fell more in certain age groups, as follows: 53 per cent of the total bovine-linked exposures were in males between 20 and 44 years old; boys aged 5 to 14 years were involved in 40 per cent of exposure caused by horses; and 48 per cent of pig-associated incidents were in men above 20 years.

4.13. Rabies vaccinal status of the animal

Because the case report forms do not provide information concerning the number of exposures caused by the same animal, we assume that each exposure represents one animal. Thus, regarding rabies vaccination, 37 per cent of the animals causing exposure were reported to have ben vaccinated and 36 per cent were recorded as non vaccinated. In 25 per cent of cases the person interested did not know the vaccinal status of the animal, and in 3 per cent the item in the form had not been entered. 42 per cent of dogs causing exposures were reported as vaccinated. In second place came monkeys with 16 per cent

being reported vaccinated. Only 10 per cent of cats had apparently received rabies vaccine (Table 4.10) Analyzing vaccinal status of dogs separately, no important differences can be find between states except for Rio de Janeiro and Mato Grosso states (Table 4.11.). However, those states had contributed so small a number of cases that they have very little effect on the analysis.

4.14. Condition of the animal causing exposure

Table 4.12 shows the frequency distribution of exposures by condition of the animal and place of occurrence. In this context , condition of the animal refers to the status judged for the purpose of rabies prophylaxis, in the moment of the exposure. There was no follow-up information available on the evolution of the condition. From the total of accidents, in 8,759 cases (58%) the animal involved was reported as healthy. Within this group in 59 per cent of cases the exposure had occurred at home; 37 per cent in public places and other places; and in 4 per cent of cases the place of the accident was not reported. Exposures caused by animals reported as rabid - 2 per cent of the total - occurred most frequently at home (60%) The same proportion of exposure at home was observed for those cases in which the animal was killed after the accident. The predominance of exposures caused by "wild" animals at home (54%) was due to presence of monkeys kepted as pets. In 10 per cent of overall cases the animal had disappeared after exposure. This happened most in exposures occurred in public places

(55%). Table 4.13 gives the number of animals reported to be rabid and its proportion in the total number of exposures, by species.

Rabid animals in this study are defined as those declared or considered as such during the interview with the exposed person for the purpose of postexposure prophylaxis. The diagnosis was based on the behaviour of the animal, or on lay examination, or on veterinary examination. Some of these cases may have been discarded later on the basis of observation of the animal or negative laboratory test. Information of the follow-up results of these cases was not available to this study.