Original article

Human rabies: evaluation of post-exposure prophylaxis prevalence in Ceará, Brazil, 2007-2015

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Kellyn Kessiene de Sousa Cavalcante[1] – orcid.org/0000-0002-7501-3995
Carlos Henrique Alencar[1]

[1]Universidade Federal do Ceará, Departamento de Saúde Comunitária, Fortaleza, CE, Brasil

Abstract

Objective: to analyze the prevalence of inadequate human anti-rabies post-exposure prophylaxis in patients attacked by animals in the state of Ceará, Brazil, 2007-2015. **Methods:** this was a study of the prevalence of inadequate prophylaxis procedures, using data on reported cases of accidents involving animals potentially capable of transmitting rabies registered on the Notifiable Diseases Information System (SINAN) from January 2007 to December 2015. **Results:** of the 231,694 reported cases, 95.8% were found to have inadequate procedures, especially in young people aged under 19 (37.6%), with no difference between the sexes (p=0.04); higher prevalence rate of inadequate procedures occurred with regard to exposure to bites (PR=1.03 – 95%CI 1.02;1.03), multiple injuries (PR=1.07 – 95%CI 1.06;1.07), accidents involving dead/missing animals (RP=1.05 – 95%CI 1.05;1.06), and vaccine treatments (RP=1.03 – 95%CI 1.02;1.03). **Conclusion:** high prevalence of inadequate procedures indicates the need for a better epidemiological evaluation of cases and compliance with the Human Rabies Prophylaxis Technical Standards, in order to ensure adequate anti-rabies prophylaxis procedures.

Keywords: Prevalence; Post-Exposure Prophylaxis; Rabies; Health Services; Epidemiological Monitoring.

Correspondence:
Kellyn Kessiene de Sousa Cavalcante – Rua Professor Costa Mendes, No. 1608, bloco didático, 5º andar, Rodolfo Teófilo, Fortaleza, CE, Brazil. CEP: 60430-140
E-mail: kellynveterinaria@hotmail.com

Introduction

Human rabies is a highly prevalent anthropozoonosis transmitted to humans by inoculation of the rabies virus present in saliva or secretions of an infected animal, mainly by biting.[1] This disease continues to be a public health problem due to its serious clinical consequences, high fatality and costs of post-exposure treatment and medical care.[2]

> *Whenever exposure to the virus is suspected, human rabies prophylaxis is the main control measure. In these cases, a Notifiable Disease Information System (SINAN).*

Between 2009 and 2011, there were 592,000 anti-rabies attendances per year in Brazil.[3] This frequency increased in the period from 2011 to 2016, with 3,628,549 human anti-rabies attendances reported in the country, especially in the Southeast and Northeast regions, where a greater number of cases were recorded: 1,433,773 and 998,008 notifications, respectively.[4]

Whenever exposure to the virus is suspected, human rabies prophylaxis is the main control measure. In these cases, a Notifiable Disease Information System (SINAN) human anti-rabies attendance notification form must be filled in.[5] The post-exposure prophylaxis regimen is composed of procedures that range from simply washing the wounded area with soap and water, to complete treatment with serum and vaccine.[6] Vaccine dosage is the same regardless of the patient's age, sex or weight.[7] The decision to initiate post-exposure prophylaxis should be made following complete and thorough anamnesis of the case in accordance with the Human Rabies Prophylaxis Technical Standards.[8]

Analysis of accidents caused by animals potentially capable of transmitting rabies enables the evaluation and improvement of health care and epidemiological surveillance services, thus informing secure and correct indication of prophylactic treatment and targeting of individual and collective prevention and control actions.[2]

Given the importance and the need to provide input to support human rabies epidemiological information and actions for its surveillance and control, we sought to analyze the prevalence of inadequate human anti-rabies prophylaxis among patients attacked by animals in Ceará, Brazil, between 2007 and 2015.

Methods

This was a prevalence study based on secondary data, using information taken from notification forms for accidents caused by animals potentially capable of transmitting rabies registered on the SINAN system by the Ceará State Health Department epidemiological surveillance sector from January 1st 2007 to December 31st 2015.

The state of Ceará is located in the Northeast region of Brazil. It has a population of almost 9 million inhabitants and an area of approximately 149,000 km², divided into 184 municipalities. Ceará's Public Health system is comprised of municipal and state hospitals, totaling 164 inpatient hospital units and 2,198 outpatient units, in addition to 652 primary health care units.[9]

According to the Brazilian Institute of Geography and Statistics (IBGE), in 2014 there were 944,000 households (35.2%) with dogs in Ceará, and 725,000 (28%) with cats. Of these households, 76.3% had had these animals vaccinated against rabies that same year.[9]

The study analyzed the following variables:

a) sociodemographic characteristics
- age group (in years: <1, 1-19, 20-39, 40-59, 60 and over);
- sex (male, female);
- ethnicity/skin color (brown, white, black, Asian, indigenous);
- level of schooling (illiterate, junior school, middle school, high school, higher education); and
- area of residence (urban, rural, peri-urban areas);

b) injury
- type of exposure (indirect contact, scratching, licking, biting, other);
- injury location (hands/feet, lower limbs, upper limbs, head/neck, torso, mucous membrane), injury presentation (single, multiple, without injury); and
- lesion depth (superficial, deep, lacerations);

c) characteristics of the animal involved
- species (dog, cat, bat, other); and
- animal condition (healthy, suspect, rabid, dead/missing); and

d) type of treatment (observation, observation and vaccine, vaccine, serum and vaccine, other).

To define whether case procedure was adequate or inadequate for the type of exposure suffered by the patient, the 'mild case procedure' and 'serious

case procedure' variables were created, based on the Human Rabies Prophylaxis Technical Standards.[8]

Mild cases were defined by the presence of superficial injuries covering a small area, usually only on the torso and limbs. Serious cases were considered to be: injuries to the head, face, neck, hand, digital pulp and/or sole of the foot; deep, multiple or extensive injuries to any region of the body; licking of mucous membranes; and deep wound caused by an animal claw.[7,10] As such, with the aim of evaluating the prophylactic case procedure adopted for each attendance, the 'adequate prophylactic procedure' variable was created, considered to be the outcome of this study, resulting from the characteristics of cases described as 'mild case procedure' or 'serious case procedure'. This classification included variables related to the type of injury, location and depth of lesion, type of exposure, species and condition of the animal involved, as well as whether or not vaccination treatment was initiated. Patient care that did not follow the Ministry of Health protocol or had records with blank or incomplete data was considered to be inadequate, whether because of lack of or excess treatment.

The prevalence coefficients for accidents caused by animals potentially capable of transmitting rabies were standardized using the direct method. The standard population used as the denominator was the population of Ceará state in 2010 as per the IBGE demographic census. Data on the resident population estimated for each year was obtained from the Brazilian Unified Health System IT Department (DATASUS) website.[9]

The data were exported and analyzed using Stata version 11.2 (Stata Corp LP, College Station, TX, USA). In order to test associations of interest, prevalence ratios (PR) were calculated with a 95% confidence interval (95%CI) and Pearson's chi-squared test or Fisher's exact test were carried out using a 5% significance level. The spatial distribution of the incidence coefficients was plotted using ArcGis version 9.2.

The study project was submitted to *Plataforma Brasil* and was approved by the Federal University of Ceará Research Ethics Committee on 6 April 2017 - Certification of Submission for Ethical Appraisal (CAAE) No. 64830316.0.0000.5054 – being in accordance with the principles of National Health Council (CNS) Resolution No. 466, dated 12 December 2012 (autonomy, non-maleficence, beneficence, justice and equity). The study was based on secondary data taken from the SINAN system with no identification of individuals surveyed.

Results

From 2007 to 2015, there were 231,694 registered cases of accidents caused by animals potentially capable of transmitting rabies in Ceará state. Of this total, 222,036 (95.8%) showed inadequate procedures regarding anti-rabies prophylactic treatment as recommended by the Ministry of Health. In addition, incompleteness was found on the forms used for the notification of accidents caused by animals potentially capable of transmitting rabies, with a total of 142,562 fields with no information or information unknown. A higher proportion of this missing information was found for the variables 'schooling' (32.9%) and 'lesion depth' (11.5%).

The period between 2010 and 2011 showed a greater increase in standardized coefficients of prevalence of inadequate procedure, from 24.64 (2010) to 36.54 (2011) per 10,000 inhabitants. The highest value of this coefficient was observed in 2015: 41.58 attendances per 10,000 inhab. (Figure 1).

The number of inadequate procedures was more frequent in the 1 to 19 years age range (n=82,545; 37.6%). There was no difference between the sexes, with PR=0.99 (95% CI 0.99; 1.00). With regard to ethnicity/skin color, only the Asian category had a slightly higher prevalence ratio of 1.02 (95%CI 1.01;1.02). People with complete primary school education had slightly higher prevalence than those with other levels of schooling and this was statistically significant (PR=1.01 - 95% CI1.01;1.02). Those living in urban areas had the largest amount of inadequate prophylaxis (n=143,691; 70.3%) and had prevalence 7% higher (95%CI 1.05;1.08) than those living in the peri-urban area of municipalities in Ceará (Table 1).

The wound characteristic with the highest prevalence of inadequate procedures was exposure to bites (PR=1.03 95% CI1.02;1.03). Wounds located in hands/feet - 86,169 notifications (38.4%) - were more frequent and 1.06 times more prevalent regarding inadequate procedures (95%CI 1.06;1.07) (Table 2).

Multiple injuries showed higher prevalence of inadequate procedure (PR=1.07 95% CI 1.06;1.07) when compared to single injuries. Another characteristic having more prevalent inadequate prophylactic procedure was deep wounds (PR=1.09 95% CI1.08;1.09). It should be noted that some patients have more than one type of exposure and lesion location (Table 2).

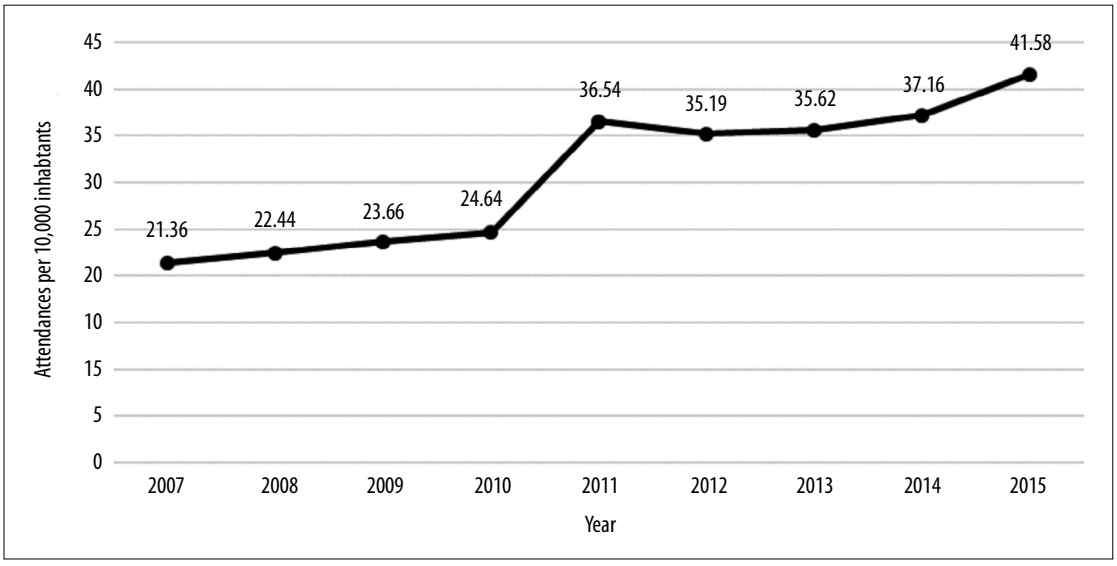

Figure 1 – Standardized prevalence coefficients for inadequate human rabies procedure attendances (per 10,000 inhabitants), per annum, Ceará, 2007-2015

Dogs were the main animals involved (n=162,243; 70.0%) and accidents caused by them were associated with a greater proportion of inadequate procedure (69.6%; 154.505/221.943); however, inadequate procedure was 1.05 times more prevalent among people attacked by other types of animals (PR=1.05 CI95% 1.04;1.05) when compared to those attacked by dogs. Other types of animals involved included primates, domestic herbivores, foxes, skunks, capybaras, pigs, cattle, horses, rabbits, lizards, donkeys, agoutis, boars and sheep.

The most frequent animal condition was that of healthy animals in relation to inadequate procedures found (71.3%). There was higher prevalence (PR=1.05 CI95% 1.05;1.06) of care provided to victims of animals classified as dead/missing when compared to cases involving healthy animals.

The treatment prescribed for the highest proportion of attendances (48.1%) was observation together with vaccination, although it had a lower inadequate procedure prevalence ratio (PR=0.95 – IC95% 0.94;0.95) when compared with to patients being advised just to keep the animal under observation for ten days. Treatment having the highest prevalence of inadequate procedures (PR=1.03 95%CI1.02;1.03) was vaccine prescription. Treatment was interrupted in 8,151 (6.1%) cases and these had a high prevalence of inadequate procedures (PR=1.05 95% CI1.04;1.05) (Table 3).

Serum was not prescribed in 85.2% of cases and inadequate procedures were 5% more prevalent (95% CI1.05;1.06) in these cases when compared to cases in which serum was prescribed as treatment.

The municipalities of Guaramiranga, Jijoca de Jericoacoara and Jaguaruana, located in the mid north, northwest and northeast regions of Ceará state, had the highest prevalence of attendances with inadequate procedures per 10,000 inhab.: 222.26, 131.45 and 115.05 respectively. A little more than half of the municipalities (54.3%) had low prevalence rates, with values between 0.10 and 29.88 for inadequate procedures per 10,000 inhab. The lowest values were recorded in the municipality of Poranga (2.83 per 10,000 inhab.) in the western region of the state, and Altaneira (2.91 per 10,000 inhab.) and Umari (6.05 per 10,000 inhab.) in the southern region of the state (Figure 2).

Discussion

Our study found that between 2007 and 2015 in the state of in Ceará, more than 90% of attendances for accidents caused by animals potentially capable of transmitting rabies involved inadequate procedures when compared to anti-rabies prophylactic treatment recommended by the Ministry of Health. Among cases involving inadequate procedures, indicators point to

Table 1 – Bivariate analysis of human rabies attendances according to sociodemographic characteristics and suitability of procedure adopted, Ceará, 2007-2015

Variables	Adequate Procedure	Inadequate Procedure	PR[b]	95% CI[c]
	n[a] (%)	n[a] (%)		
Age (in years)				
<1	100 (4.2)	2,295 (95.8)	1.00	–
1-19	4,015 (4.6)	82,545 (95.4)	0.99	0.99;1.00
20-39	2,238 (4.0)	54,158 (96.0)	1.00	0.99;1.01
40-59	1,842 (3.8)	46,542 (96.2)	1.00	0.99;1.01
≥60	1,395 (3.9)	34,232 (96.1)	1.00	0.99;1.01
Sex (231.679)				
Male	5,057 (4.1)	118,579 (95.9)	0.99	0.99;1.00
Female	4,601 (4.3)	103,442 (95.7)	1.00	–
Ethnicity/skin color (213,150)				
Brown	6,551 (4.1)	153,866 (95.9)	1,00	1.00;1.01
White	1,976 (5.0)	37,896 (95.0)	1.00	–
Black	459 (4.7)	9,332 (95.3)	1.00	0.99;1.01
Asian	66 (3.4)	1,897 (96.6)	1.02	1.01;1.02
Indigenous	51 (4.6)	1,056 (95.4)	1.00	0.99;1.02
Level of schooling				
Illiterate	439 (4.8)	8,754 (95.2)	1.00	–
Junior school	3,454 (3.8)	88,277 (96.2)	1.01	1.01;1.02
Middle school	1,410 (5.0)	26,955 (95.0)	0.99	0.99;1.00
High school	976 (4.6)	20,057 (95.4)	1.00	0.99;1.01
Higher education	225 (4.3)	4,977 (95.7)	1.00	0.99;1.01
Area of residence (213,946)				
Urban	6,007 (4.0)	143,691 (96.0)	1.07	1.05;1.08
Rural	3,200 (5.2)	58,942 (94.8)	1.05	1.04;1.07
Peri-urban areas	210 (10.0)	1,896 (90.0)	1.00	–

a) The numeric difference between the variables is due to blank and unknown records, which were excluded from all the analyses.
b) PR: Prevalence Ratio.
c) (95% CI): 95% confidence interval.
Source: Notifiable Diseases Information System– SINAN (updated on 4/10/2017).

biting as the most frequent exposure type, as well as prevalence of multiple deep injuries to the hands/feet, with prescription of vaccines being the type of post-exposure treatment adopted.

It is probable that inadequate procedures increased during the period studied due to the high turnover of physicians or nurses and absence of education actions. The findings of our study suggest the possibility of health professionals being insecure when prescribing treatment. In most cases, these professionals usually indicate more doses than necessary for the type of patient exposure, failing to take into consideration the epidemiological aspects of each case of accidents caused by animals potentially capable of transmitting rabies.[11]

These results are similar to those found in the United States, specifically in the municipality of Carolina, where indicated anti-rabies treatment was found to be inadequate in 98% of attendances between 1995 and 2003. Among cases receiving treatment, 40% did not need it, and among those not treated, 6.3% should have received treatment.[12] Inadequate and insufficient procedures can be propitious to the development of human rabies when the vaccine or serum regimen is not sufficient for proper treatment.[18]

Table 2 – Bivariate analysis of human rabies according to characteristics of the wound and suitability of the procedure adopted, Ceará, 2007-2015

Variables	Adequate Procedure n[a] (%)	Inadequate Procedure n[a] (%)	PR[b]	95% CI[c]
Exposure				
Indirect Contact				
Yes	334 (12.9)	2,259 (87.1)	0.91	0.89;0.92
No	9,306 (4.2)	212,075 (95.8)	1.00	–
Scratching				
Yes	1,861 (5.1)	34,578 (94.9)	0.99	0.98;0.99
No	7,782 (4.1)	180,323 (95.9)	1.00	–
Licking				
Yes	187 (4.1)	4,316 (95.9)	1.00	0.99;1.01
No	9,452 (4.3)	210,109 (95.7)	1.00	–
Biting				
Yes	7,728 (3.9)	189,521 (96.1)	1.03	1.02;1.03
No	1,928 (6.6)	27,381 (93.4)	1.00	–
Other				
Yes	35 (2.2)	1,587 (97.8)	1.02	1.01;1.03
No	9,581 (4.3)	212,045 (95.7)	1.00	–
Place of wound (234.834)[c]				
Hands/feet				
Yes	834 (1.0)	86,169 (99.0)	1.06	1.06;1.07
No	8,799 (6.9)	119,216 (93.1)	1	–
Lower limbs				
Yes	6,178 (7.7)	74,439 (92.3)	0.95	0.94;0.95
No	3,470 (2.6)	130,738 (97.4)	1	–
Upper limbs				
Yes	2,429 (6.5)	34,942 (93.5)	0.97	0.97;0.98
No	7,210 (4.1)	169,805 (95.9)	1	–
Head/neck				
Yes	71 (0.5)	14,139 (99.5)	1.04	1.04;1.05
No	9,563 (4.8)	190,337 (95.2)	1	–
Torso				
Yes	918 (7.3)	11,655 (92.7)	0.97	0.96;0.97
No	8,715 (4.3)	192,812 (95.7)	1	–
Mucous membrane				
Yes	78 (2.5)	2,982 (97.4)	1.02	1.01;1.03
No	9,562 (4.5)	201,252 (95.5)	1	–
Presentation of the injury (234.834)[c]				
Single	9,174 (7.1)	120,614 (92.9)	1	–
Multiple	448 (0.6)	77,890 (99.4)	1.07	1.06;1.07
Without injury	24 (1.9)	1,225 (98.1)	1.05	1.05;1.06

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Table 2 – Bivariate analysis of human rabies according to characteristics of the wound and suitability of the procedure adopted, Ceará, 2007-2015

Variables	Adequate Procedure	Inadequate Procedure	PR[a]	95% CI[b]
	n (%)	n (%)		
Depth of lesion (209,239)				
Superficial				
Yes	9,142 (8.8)	94,645 (91.2)	0.92	0.91;0.92
No	465 (0.5)	99,713 (99.5)	1	–
Deep				
Yes	471 (0.5)	95,905(99.5)	1.09	1.08;1.09
No	9,034 (8.7)	95,252 (91.3)	1	–
Lacerations				
Yes	78 (0.9)	8,998 (99.1)	1.04	1.04;1.05
No	9,378 (5.1)	175,853 (94.9)	1	–

a) PR: Prevalence Ratio.
b) 95% CI: 95% confidence interval.
c) The totals exceed the number of individuals analyzed due the fact of some people suffering more than one type of wound/injury, as well unknown and blank records.
Source: Notifiable Diseases Information System-SINAN (updated on 04/10/2017).

Table 3 – Bivariate analysis of human rabies according to species of attacking animal, type of treatment and suitability of procedure adopted, Ceará, 2007-2015

Variables	Adequate Procedure	Inadequate Procedure	PR[a]	95% CI[b]
	n (%)	n (%)		
Animal species (231,604)[c,d]				
Canine	7,738 (4.8)	154,505 (95.2)	1.00	–
Feline	1,902 (3.5)	53,020 (96.5)	1.01	1.01;1.02
Chiroptera	2 (0.2)	1,129 (99.8)	1.04	1.04;1.05
Other[e]	16 (0.1)	13,289 (99.9)	1.05	1.04;1.05
Condition of the animal (212,616)[d]				
Healthy	8,190 (5.4)	144,682 (94.6)	1.00	–
Suspect	1,391 (4.0)	33,055 (96.0)	1.01	1.01;1.02
Rabid	20 (1.0)	1,949 (99.0)	1.04	1.04;1.05
Dead/missing	32 (0.1)	23,297 (99.9)	1.05	1.05;1.06
Type of treatment (224,296)[d]				
Observation	400 (2.8)	14,038 (97.2)	1.00	–
Observation + vaccine	8,752 (7.8)	103,235 (92.2)	0.95	0.94;0.95
Vaccine	42 (0.1)	64,058 (99.9)	1.03	1.02;1.03
Serum + vaccine	357 (1.4)	25,931 (98.7)	1.01	1.01;1.02
Other[f]	77 (1.0)	7,406 (99.0)	1.02	1.01;1.02
Treatment interruption				
Yes	164 (2.0)	7,987 (98.0)	1.05	1.04;1.05
No	8,215 (6.6)	116,352 (93.4)	1.00	–

a) PR: Prevalence Ratio.
b) 95% CI: 95% confidence interval.
c) Variable with application of Fisher's exact test.
d) The numeric difference between the variables is due to blank and unknown records, which were excluded from all variables.
e) Other types of animals: primates, domestic herbivores, foxes, skunks, capybaras, pigs, cattle, horses, rabbits, lizards, donkeys, agoutis, boar and sheep.
f) Other types of treatment: pre-exposure, exemption from treatment and re-exposure regimen.
Source: Notifiable Diseases Information System– SINAN (updated on 4/10/2017).

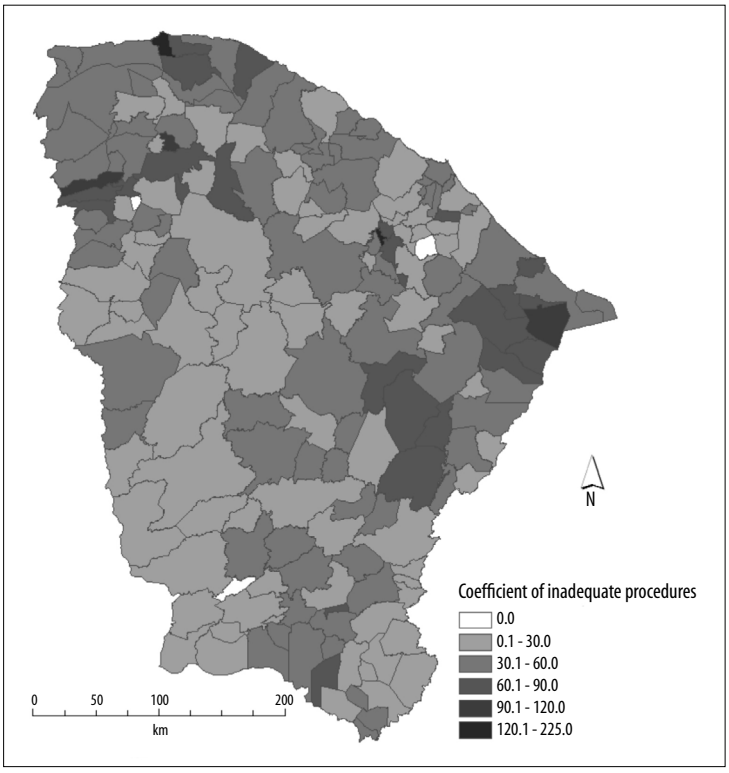

Figure 2 – Standardized prevalence coefficients for inadequate human rabies procedure attendances (per 10,000 inhabitants), per municipality, Ceará, 2007-2015

In contrast, some studies conducted in Brazil have suggested that the proportion of inadequate anti-rabies procedures varies between 3.8% and 24.7%. These studies found that 96.2%, 93.9% and 92.0% of the attendances had adequate procedures in the cities of Porto Alegre (2006), Curitiba (2010) and Maringá (1997), respectively, showing a low percentage of inadequate procedures.[1,10,11] In Southern Brazil, no human rabies cases have been reported since 1987, and Paraná was the first Brazilian state to control rabies.[11]

Prescription of anti-rabies treatment in excess of what is necessary may possibly be due to fear of patients becoming ill. However, adequate procedures ensure proper prevention of the disease. Considering the high risk of exposure to rabies, the approaches adopted in the state of Ceará related to cases of serious injury should use correct prophylaxis prescribed and monitored according to Ministry of Health standards.[8]

We emphasize the importance of completeness and consistency when filling out notification forms for accidents caused by animals potentially capable of transmitting rabies as this helps to indicate the most adequate prophylactic procedure for each case.[5]

In Campo Grande, capital of Mato Grosso do Sul state, in 2002, 49.4% of the 723 people attended to did not complete full anti-rabies treatment because the local health service did not undertake active tracing.[13] It is important to highlight that active tracing of people who fail to attend medical appointments is one of the actions recommended for surveillance of human rabies, in order to ensure treatment with better results and quality.[14] Failure to initiate treatment or failure to follow treatment correctly can result in patients being victims of rabies.[15]

Health professionals should be constantly trained and supervised as to the treatment procedures for accidents with animals potentially capable of transmitting rabies and protection of patients through the rational use of immunobiologicals, always performing a thorough epidemiological investigation of each case, as well as filling out all fields of the SINAN system notification from.[5,6,14]

There was a predominance of inadequate anti-rabies procedures among people with a low level of schooling, namely those in the illiterate and complete junior school categories[6,16] As well as facilitating the spread of the virus in a given area, social factors also reveal that the lower the level of local development, the greater the indiscriminate mixing between humans and animals and the lower the levels of hygiene.

In Ceará, the urban area stood out as the place of residence. This fact was also found in the states of Santa Catarina and Paraná between 2002 and 2007.[10] An increase in the animal population in public places can be considered to be a threat to public health, given the possibility of attack and zoonosis transmission.[9]

The control of urban rabies in cats and dogs in Ceará is done mainly by means of anti-rabies vaccination campaigns coordinated by the State Health Department in accordance with Ministry of Health recommendations. In the campaign held in 2016, Ceará achieved coverage of 89.5% of dogs vaccinated.[18] The recommended Brazilian Ministry of Health goal is that 80% of dogs should be immunized annually.[11,19] However, Ceará is still considered a state with a risk of rabies transmission to humans, because there is no homogeneity in canine vaccination among municipalities, nor are cases recorded: the last rabies case, which resulted in death, was recorded in October 2016 in the municipality of Iracema in the mid eastern region of the state (latitude -5.80, longitude -38.30).[20]

Vaccination of susceptible animals, control of the canine population and post-exposure prophylaxis are important strategies for reducing the risk of occurrence of rabies.[21]

The municipalities of Santana do Acaraú and Acarape, in mid north region of Ceará, had high incidence coefficients for attendances with inadequate procedures. This finding goes hand in hand with the lower rates of coverage of the 2016 animal anti-rabies vaccination campaign.[18] On the other hand, the municipalities of Pentecoste and Guaramiranga, although they had high incidence of inadequate prophylactic procedures, achieved vaccine coverage rates of 93.2% and 100.9%, 18 respectively, this being above the target recommended by the Ministry of Health. In these municipalities, control of the canine population is recommended in places where a high number of accidents involving animals potentially capable of transmitting rabies is recorded.[22]

Although dogs were the main animals to attack humans, higher prevalence of inadequate procedures occurred in relation to other animal species, possibly because some of the animals mentioned are not potential rabies transmitters, such as rabbits and hamsters, and do not require prophylactic treatment.[8,23] In Brazil, from 2000 to 2009, three cases of human rabies transmitted by herbivores were confirmed. In all three cases, transmission occurred by direct manipulation of saliva and not because of attacks by these animals.[24]

Inadequate procedures were most prevalent in relation to accidents involving animals in the dead/missing category. This is another finding of concern, because when accidents are caused by an animal in this condition they are considered to be serious and require complete post-exposure treatment with cell culture vaccines and/or administration of anti-rabies serum up until the third dose of the vaccine, according to the Human Rabies Prophylaxis Technical Standards published by the Brazilian Ministry of Health.[8]

Higher prevalence of inadequate procedures in the case of animals in the dead/missing category suggests that when health professionals indicate the prophylactic procedure to be used, they do not take into account the condition of the animal involved, as found in a study conducted in Southeast Brazil, where post-exposure prophylaxis was initiated based only on the characteristics of the wounds.[25]

In our study, the most common type of exposure was biting. According to research conducted in 2006 in the municipality of Porto Alegre, Rio Grande do Sul,[1] and in 2011 in the municipality of Primavera do Leste, Mato Grosso,[13] people recognize that this type of exposure represents a great risk of contamination by the rabies virus, due to there being several points for virus entry - which is not the case with scratches, licking or indirect contact.

Multiple injuries to the hands/feet[7,26,27] had the highest proportion of inadequate procedures. In these cases, wound location and lesion depth in nerve endings facilitate the virulence of the etiologic agent, potentiate the risk involved and impose the need for complete treatment with anti-rabies serum and vaccine.[8] Furthermore, we found that lacerations and deep wounds were considered protective factors against inadequate procedures, given that as they are usually caused by animals considered to be suspect,

such cases are characterized as serious accidents.[10] These characteristics of protection - place of injury and lesion depth -, which were also detected in a study conducted in the state of Paraná, decreased by 82% and 64%, respectively, the risk of inadequate procedure.[10]

There was a higher percentage of vaccine prescription for post-exposure anti-rabies treatment,[17] although it is a procedure indicated only in the case of dogs and cats that can be kept under observation, due to the rabies incubation period, or in cases of mild accidents[8,23] It is therefore not recommended for accidents classified as serious in our study.

Higher prevalence of inadequate procedures was related to indication of treatment with anti-rabies serum. Serum should only be used in the following cases: a serious accident in which the animal (dog or cat) has disappeared, died or become rabid; an accident involving an animal clinically suspected of having rabies at the moment of the attack; or a serious accident caused by a wild animal or by production.[7] However, lack of integration between health professionals who prescribe anti-rabies regimens and veterinarians, with regard to verification of the attacking animals, does not provide the security needed to contraindicate the administration of immunobiologicals.

Probably due to insecurity, health professionals who prescribe treatment administer anti-rabies prophylaxis without following the Ministry of Health protocol.[6,21] Indication of the type of treatment to be used should be in accordance with the characteristics of the accident, always taking into account the type of exposure, the injury and the condition of the attacking animal,[8,27] so that unnecessary treatments are not prescribed as, in addition to causing health risks, this can result in the inefficient use of public funds and even lead to acute shortages of immunobiologicals.[2,17]

This study can contribute to the human rabies control program in Ceará, given that it describes the characteristics of inadequate prophylactic procedures used, emphasizing that there is a need to improve care for people attacked by animals as well as the need to implement specific health education actions targeting health workers and the population in general.

This research has limitations related to the use of secondary data, mainly because of notification forms having fields with missing or incomplete information or not filled out adequately. However, these difficulties do not imply loss of information.

High indication of human anti-rabies treatments prescribing inadequate procedures suggests a need for better evaluation of the epidemiological profile of each case, careful observation of the attacking animal, as well as continuous adherence to the Human Rabies Prophylaxis Technical Standards, in order to improve the quality of records of accidents caused by animals potentially capable of transmitting rabies and favoring the decision of whether or not to initiate anti-rabies prophylaxis in an adequate and safe manner, without risk to the patient.

Authors' contributions

Cavalcante KKS contributed to data collection, conception and design of the study, analysis and interpretation of the results, preparation of the tables, graph and map, writing and critical review of the manuscript. Alencar CH contributed to data analysis and interpretation, writing and critical review of the manuscript. All authors approved the final version of the manuscript and declared themselves to be responsible for all aspects of the study, ensuring its accuracy and integrity.

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