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Evaluation of the behavior of rabies main indicators in the province of Chucuito, Puno, Peru

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ABSTRACT

Rabies, by definition, is an acute and fatal encephalomyelitis that affects man and a large number of domestic and wild animals. The present research aims to evaluate the main rabies indicators in Chucuito, a province of the Puno-Peru Region; the analysis of the data registered in the forms of the zoonosis sanitary strategy has been carried out in the Environmental Health Unit of the Health network, Chucuito. It is concluded that, during the evaluated years, there was only one outbreak of human rabies in 2010, coinciding with a low coverage of canine rabies vaccination (53%), and with a case of canine rabies in the same year. On the other hand, three cases of canine rabies were reported in unvaccinated dogs, the bitten people were treated for the most part, along with adequate control of the dogs.

KEYWORDS: Bitten people; canine bite; indicators of rabies; rabies; vaccination.

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Evaluación del comportamiento de los principales indicadores de la rabia en la provincia de Chucuito, Puno, Perú

RESUMEN

La rabia, por definición, es una encefalomielitis aguda y mortal que afecta al hombre y a un gran número de animales domésticos y salvajes. La presente investigación tiene como objetivo evaluar los principales indicadores de rabia en Chucuito, una provincia de la Región de Puno-Perú; se ha realizado el análisis de los datos registrados en los formularios de la estrategia sanitaria de zoonosis en la Unidad de Salud Ambiental de la red de Salud, Chucuito. Se concluye que, durante los años evaluados, solo se produjo un brote de rabia humana en 2010, coincidiendo con una baja cobertura de vacunación antirrábica canina (53%), y con un caso de rabia canina el mismo año. Por otro lado, se reportaron tres casos de rabia canina en perros no vacunados, las personas mordidas fueron atendidas en su mayor parte, junto con un adecuado control de los perros.

PALABRAS CLAVE: Personas mordidas; mordedura canina; indicadores de rabia; rabia; vacunación.

Introduction

Rabies, is considered a zoonotic disease by definition (Wilkins & Del Piero, 2013), is an acute and fatal encephalomyelitis that affects man and a large number of both domestic and wild animals caused by rabies virus, which is usually transmitted by an animal bite (Hemachudha et al., 2002; Jackson, 2014), being transmitted by a transdermal bite or scratch, or salivary contamination of mucosa or skin wounds andit kills 30 000 to people a year, mainly in developing countries and especially where unvaccinated stray dogs are common (Morgan & Palmer, 2007; Pounder, 2005).

The Greeks called this disease "lyssa" (madness) and the Romans "rabere" (rage), from which the current terminology derives. The Lyssavirus genus is one of six genera in the family Rhabdoviridae [Greek: Rhabdos (rod)], a family of elongated bullet-shaped viruses within the order Mononegavirales. Different members of the Rhabdoviridae family, apart from sharing similar morphology, structure, and replication mechanisms, infect a wide range of hosts varying from mammals, birds, fish, plants, arthropods, and other invertebrates (Tordo et al., 2005).

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Lyssaviruses are the etiological agents of rabies, one of the oldest viral diseases known to man and a disease that has persisted over many centuries (Nel & Markotter, 2007).

Within the group of the main zoonoses in our country; It is rabies, who constitutes one of the most serious problems in Public Health, whether due to its magnitude and importance, seriousness and social impact since it leads to death for people exposed to the rabies virus, mainly due to the lack of post-exposure prophylaxis translating directly into human deaths (Devaux et al., 2019; WHO et al., 2004). Epidemiological surveillance of rabies is totally insufficient (mainly due to economic limitations in the Chucuito-Puno Region) in many developing countries (as is the case in our country and mainly in our region) and the reporting of cases is incomplete and underreported (Taylor et al., 2017; World Health Organization, 2013).

The importance of rabies for Public Health does not lie in the relatively small number of cases, as can be seen in the data presented in rabies control programs by the ministries of health of countries, but in the high case fatality rate that reaches almost 100% of sick with human rabies, since there is no cure at present. On the other hand, no less important is the psychological and emotional impact, suffering and anxiety of people bitten in fear of contracting the disease. The economic damage due to the man/hours lost in the anti-rabies preventive treatment must also be considered, therefore It has an effect on the local and national economies directly or indirectly (Regea, 2017).

Rabies transmitted by dogs is still a public health problem in the least developed countries in the world (Hampson et al., 2015), is a fatal viral infection that can infect all mammals, but domestic dogs cause over 99% of all human deaths from rabies (World Health Organization, 2013), however, most industrialized countries have eliminated rabies from domestic dog populations, but, in most developing countries, rabies remains endemic in domestic dog populations and poorly controlled (Coleman et al., 2004), however, four countries in Latin America and the Caribbean are the only ones in the region where canine rabies is still active today (Sánchez et al., 2019; Vigilato et al., 2013); as it is, in this case, Puno, one of the poorest and least developed regions of Peru, despite the greats efforts made by all the countries of Latin America and the Caribbean (LAC), to decrease in canine and human rabies made in the last three decades to interrupt of the circulation of the rabies virus among dogs and,

consequently, dog-mediated transmission to humans (Schneider et al., 2011; Vigilato et al., 2013). Animal bites to people include dogs, constitute a serious global public health problem, affecting children and adults of all ages and socio-economic levels in a transversal way. These bites for human health depend on factors related to the characteristics of the biting animal and the bitten person being able causes a large number of wounds that require medical attention and/or surgical plus preventive rabies therapy such as vaccination (Morgan & Palmer, 2007; Palacio et al., 2005). On the other hand, how rabies is almost always fatal, even, apparently minor bites in high-risk countries should be taken seriously (Morgan & Palmer, 2007; Pounder, 2005), and all the more so in endemic countries and regions such as Puno and its provinces. Therefore, it must attend to all the people who suffer bite accidents, since they present a high risk of contracting rabies.

Faced with the constant and recurrent cases of rabies in the country, the Ministry of Health has a national strategy to control zoonoses and within it rabies, for which there is the technical health standard No. 131-MINSA for surveillance, prevention, and control of human rabies in Peru (MINSA, 2017).

Peru is one of the few countries in Latin America, where canine rabies is actually active and Puno is a Region with permanent reports of rabies cases, so it is extremely important to carry out an evaluation of the behavior of rabies main indicators in the Chucuito province of the Puno Region.

1. Materials and methods

Information from the Environmental Health Unit of the Chucuito Health Network, Puno Health Region of the Ministry of Health of Peru has been reviewed, specifically from the zoonosis health strategy, from 2003 to 2019.

The Chucuito health network has as its center of operations the city of Juli, district capital of the Chucuito province, its jurisdiction being the entire province that encompasses Juli, Pomata, Zepita, Desaguadero, Kelluyo, Pizacoma and Huacullani districts. It is located in the south of the Puno Region; it shares border with the Republic of Bolivia (figure 1).

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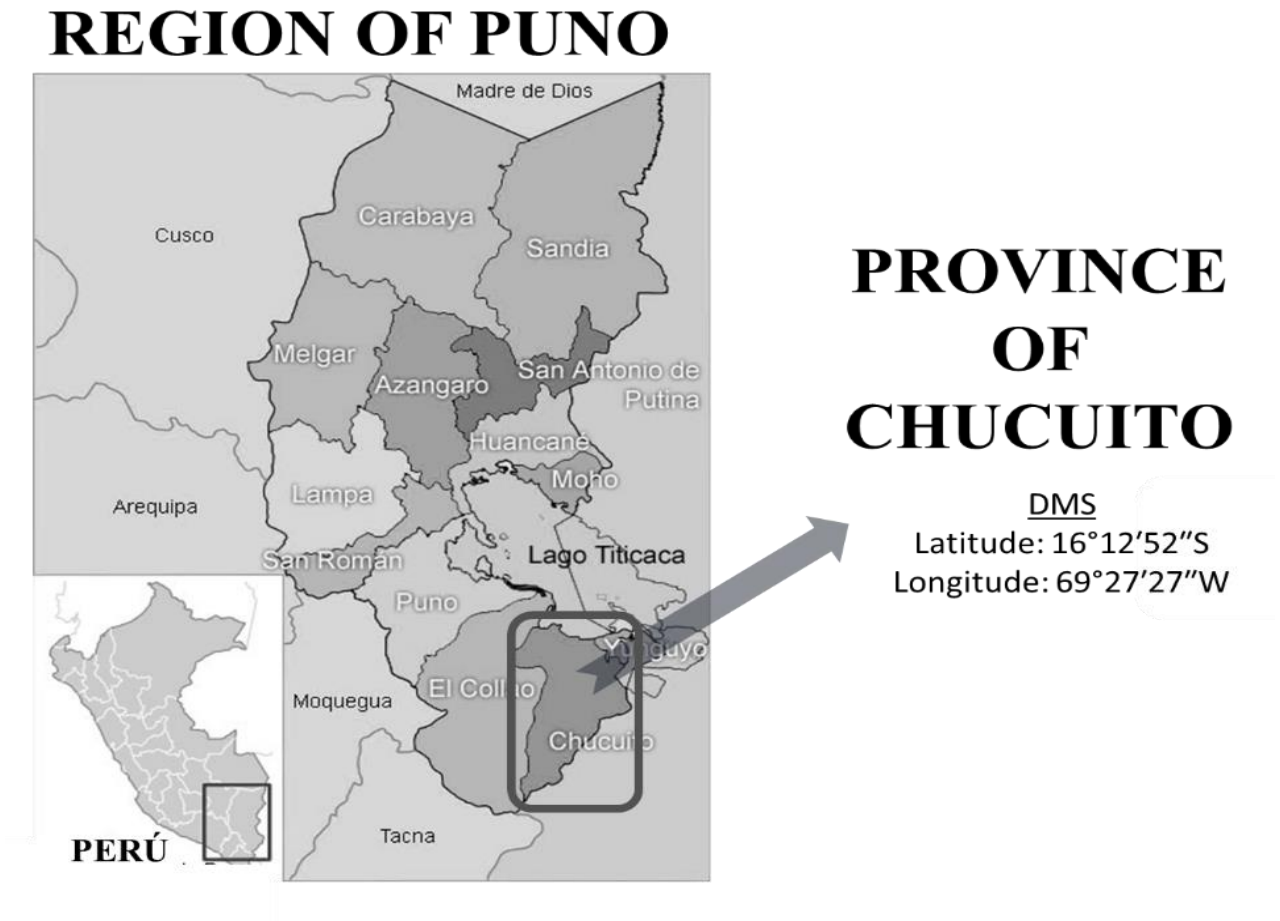

Figure 1. Geographical location of the Chucuito province in Puno, Peru.

For the determination of indicators and the way of calculation (see Table 1), they have been carried out based on the technical health standard (NTS) for the surveillance, prevention, and control of human rabies in Peru: NTS No 131-MINSA/2017/DGIESP. V. 01. Approved with Ministerial Resolution (RM) 024-2017/MINSA (MINSA, 2017).

1.1. Statistical analyses

The main indicators of the behavior of rabies were compared based on the parametric test T-student or the non-parametric tests Kolmogorov-Smirnov, depending on if the results followed or not a normal distribution. All the statistical analyses were performed with the SPSS software package, version 25.0 (IBM SPSS software, Chicago, IL).

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Table 1. Indicators

Indicator	Description	Formula
Bitten people treated	This is an indicator of structure of human rabies.	$\frac{Number\ of\ bitten\ people\ treated}{Total\ human\ population} * 100$
Reported outbreaks of human rabies	This is also an indicator of structure of human rabies.	$\frac{Number\ of\ reported\ outbreaks}{Total\ expected\ outbreaks} * 100$
People bitten controlled	This is an indicator of process of human rabies.	$\frac{Number\ of\ people\ bitten\ controlled}{Total\ of\ people\ bitten\ treated} * 100$
People who start rabies vaccination	This, like the previous one, is an indicator of the process of human rabies.	$\frac{Number\ of\ people\ who\ start\ vaccination}{Number\ of\ people\ bitten\ treated\ that\ require\ vaccination} * 100$
People who did not complete the vaccination scheme	This is also a process indicator of human rabies.	$\frac{Number\ of\ people\ who\ did\ not\ complete\ the\ vaccination\ scheme}{Number\ of\ people\ starting\ the\ scheme} * 100$
Urban human rabies	This is an indicator of outcome of human rabies.	$\frac{Number\ of\ urban\ rabies\ cases}{Total\ human\ population} * 100$

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Samples sent to the laboratory	This is an indicator of structure of rabies in animals.	$\frac{Number\ of\ canine\ samples\ sent\ to\ the\ laboratory}{Estimated\ canine\ population} * 100$
Dogs vaccinated against rabies	As in the previous case, this is an indicator of structure of rabies in animals.	$\frac{Number\ of\ vaccinated\ dogs}{Estimated\ canine\ population} * 100$
		*The dog population was estimated using the ratio man 10: dog 01
Notified biting dogs	This is also an indicator of the structure of rabies in animals.	$\frac{Number\ of\ biting\ dogs\ notified}{Number\ of\ biting\ dogs\ expected} * 100$
Controlled biting dogs	This is an indicator of rabies process in animals.	$\frac{Number\ of\ biting\ dogs\ controlled}{Number\ of\ attended\ dogs} * 100$
		*Dogs with 03 observation
Rabies in vaccinated dogs	This, is also an indicator of rabies process in animals.	$\frac{Number\ of\ rabies\ cases\ in\ vaccinated\ dogs}{Total\ vaccinated\ dogs} * 100$
Canine rabies	This is an indicator of animal rabies outcome.	$\frac{Number\ of\ cases\ of\ canines\ rabies}{Estimated\ canine\ population} * 100$

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2. Results

Table 2. Parameters evaluated

Year	Bitten people treated**	Reported outbreaks of human rabies*	People bitten controlled	People who start rabies vaccination	People who did not complete the vaccination scheme*	Urban human rabies*	Samples sent to the laboratory**	Dogs vaccinated against rabies**	Notified biting dogs**	Controlled biting dogs	Canine rabies*
2003	0.0908	0.0000	100.0000	4.4444	25.0000	0.0000	0.1311	86.1753	60.0000	98.8889	0.0000
2004	0.0799	0.0000	99.1071	2.6786	33.3333	0.0000	0.1141	95.1658	80.0000	95.3704	0.0000
2005	0.0785	0.0000	99.0291	0.9709	100.0000	0.0000	0.1296	80.5930	73.5714	95.2830	0.0000
2006	0.0884	0.0000	100.0000	0.0000	0.0000	0.0000	0.0758	59.6008	75.0000	99.0476	0.0000
2007	0.1228	0.0000	100.0000	1.3793	0.0000	0.0000	0.1101	62.9975	103.5714	97.5758	0.0000
2008	0.0293	0.0000	100.0000	8.8235	0.0000	0.0000	0.1378	56.4491	34.0000	94.1176	0.0000
2009	0.0532	0.0000	100.0000	1.7544	0.0000	0.0000	0.0933	67.0866	63.3333	94.7368	0.0000
2010	0.1396	50.0000	99.3243	3.3784	20.0000	0.0009	0.1981	60.5772	53.2374	97.9021	0.0094
2011	0.1097	0.0000	100.0000	2.6087	0.0000	0.0000	0.1717	93.7148	41.5162	97.3913	0.0000
2012	0.1303	0.0000	98.3871	6.4516	25.0000	0.0000	0.1962	76.3927	56.8807	97.3118	0.0000
2013	0.1288	0.0000	96.2567	13.3690	28.0000	0.0000	0.1446	102.6450	66.7857	88.6486	0.0000
2014	0.1129	0.0000	97.6048	16.7665	14.2857	0.0000	0.1893	101.0819	55.6667	86.8263	0.0000
2015	0.0972	0.0000	96.5753	21.9178	15.6250	0.0000	0.2130	84.8223	45.6250	87.6712	0.0133
2016	0.1015	0.0000	97.4026	18.8312	13.7931	0.0000	0.2044	82.3553	45.2941	89.6104	0.0000
2017	0.1094	0.0000	96.4072	21.5569	16.6667	0.0000	0.2097	85.2883	46.3889	89.2216	0.0000
2018	0.1281	0.0000	97.1910	16.8539	16.6667	0.0000	0.2950	75.7608	49.4444	97.7528	0.0000
2019	0.1298	0.0000	93.8547	35.7542	12.5000	0.0000	0.1305	70.4995	49.7222	93.8547	0.0000

* Significant diferences, non-parametric tests Kolmogorov-Smirnov.
** Significant diferences, parametric tests T-student.

2.1. Bitten people treated

Throughout the seventeen years evaluated, it is observed that this indicator has been increasing each year, with very significant differences ($p < 0.05$), especially during the years 2010 to 2013 (table 2 and figure 2).

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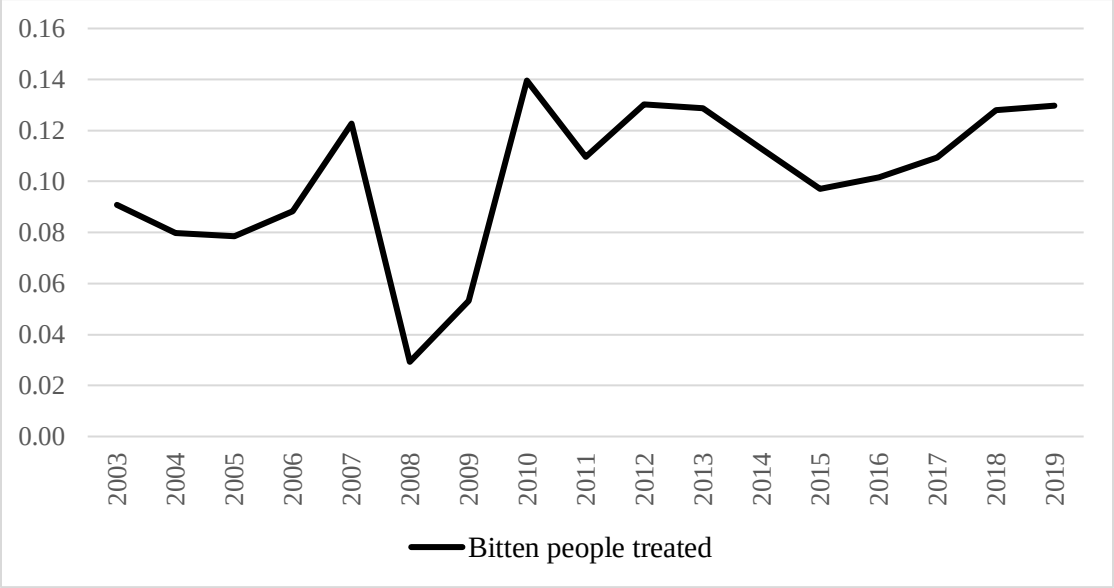

Figure 2. Bitten people treated.

2.2. Reported outbreaks of human rabies

Only in 2010 a case of human rabies was presented, differing significantly ($p<0.05$) from the rest of the years evaluated, in which no case of human rabies was reported (table 2 and figure 3).

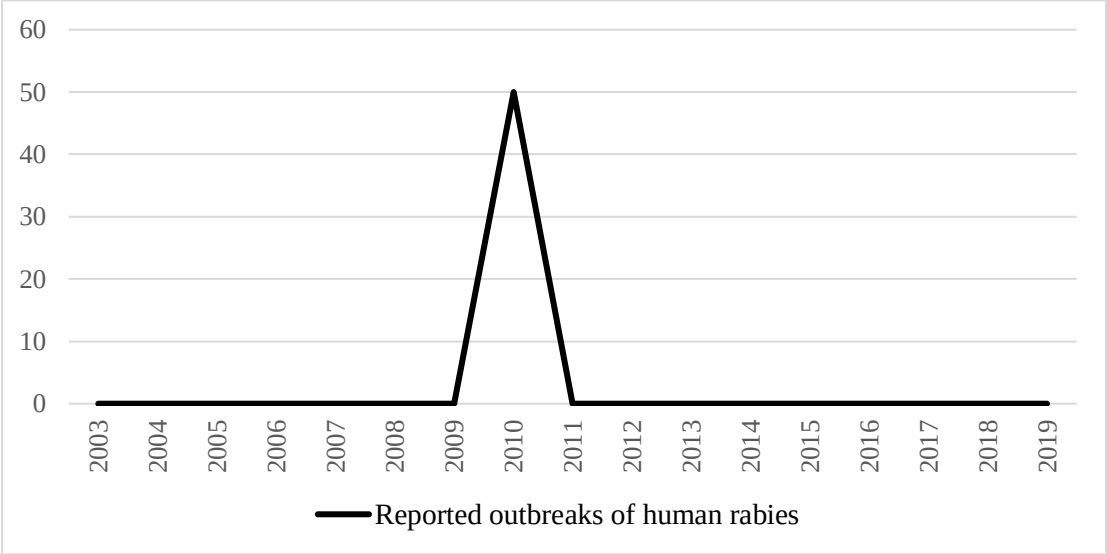

Figure 3. Reported outbreaks of human rabies

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2.3. People bitten controlled

Most of the people bitten were attended in the health establishment, since this indicator mostly reached 100%, with very few people who stopped being treated, with no differences between the years evaluated (table 2 and figure 4).

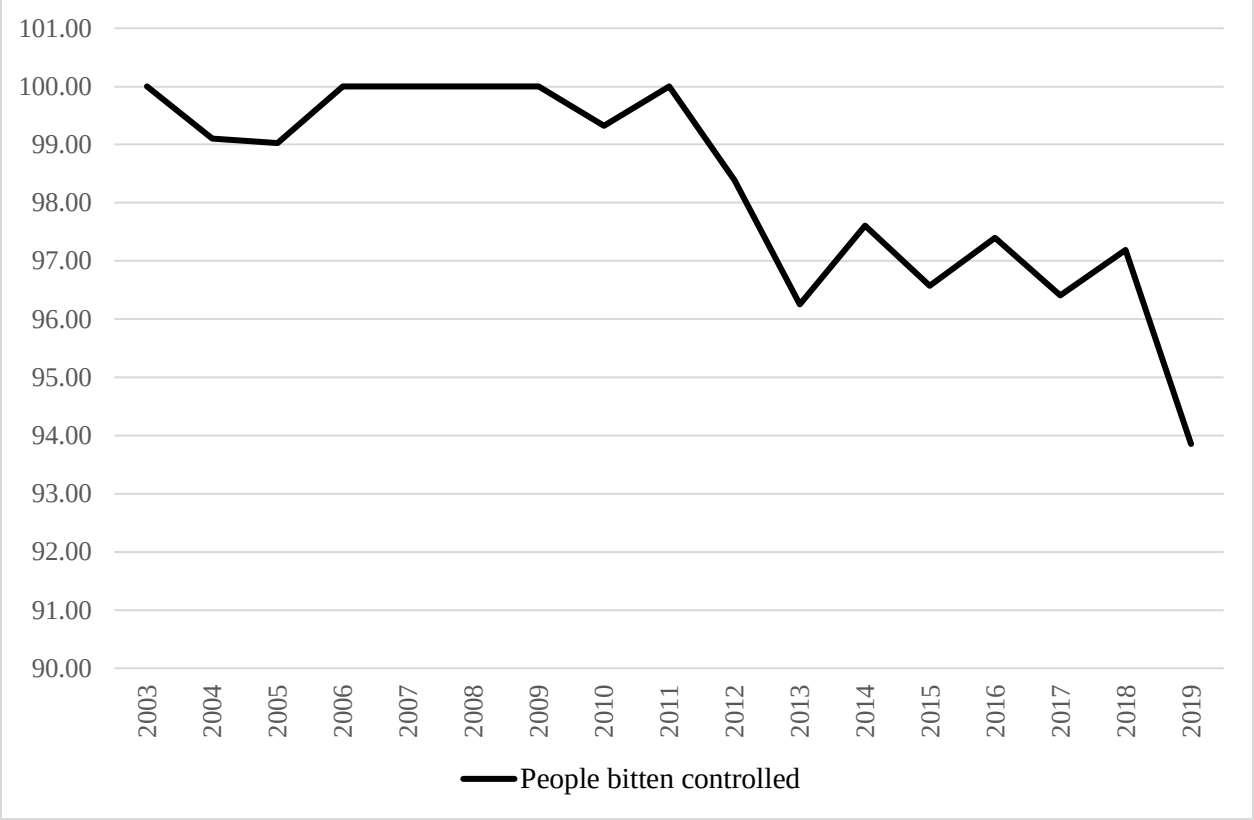

Figure 4. People bitten controlled

2.4. People who start rabies vaccination

The percentage of people who start vaccination is increasing over the years during the years evaluated, without differences significant, being a minimum percentage with respect to the number of people bitten attended (table 2 and figure 5).

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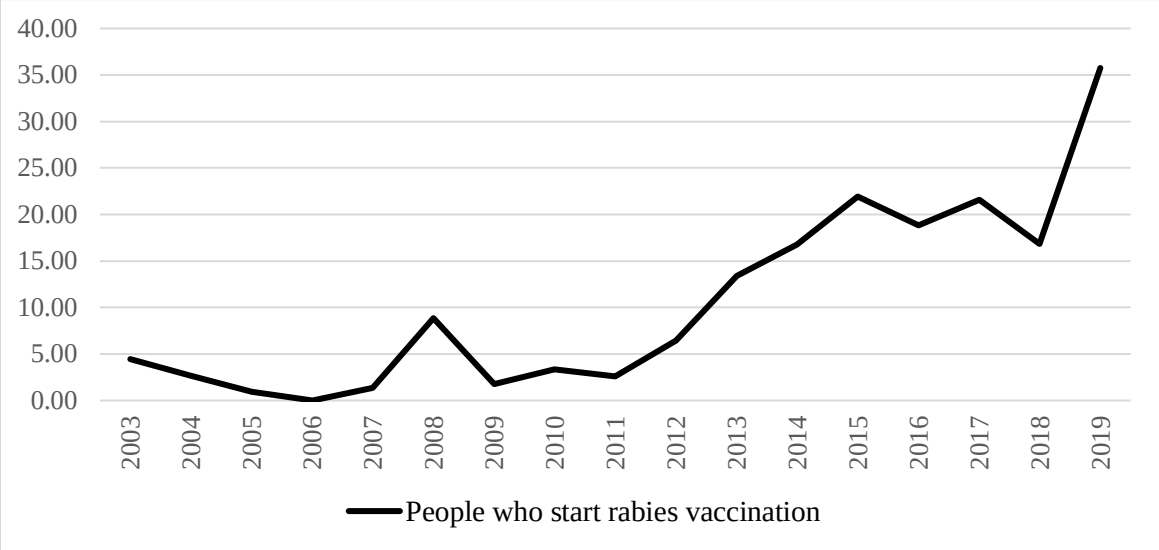

Figure 5. People who start rabies vaccination

2.5. People who did not complete the vaccination scheme

As in the previous case, of all the people who start rabies vaccination, a majority percentage do not complete the vaccination schedule, there are significant differences ($p<0.05$) between each year, given that in some years no person bitten with started vaccination completes rabies treatment (table 2 and figure 6).

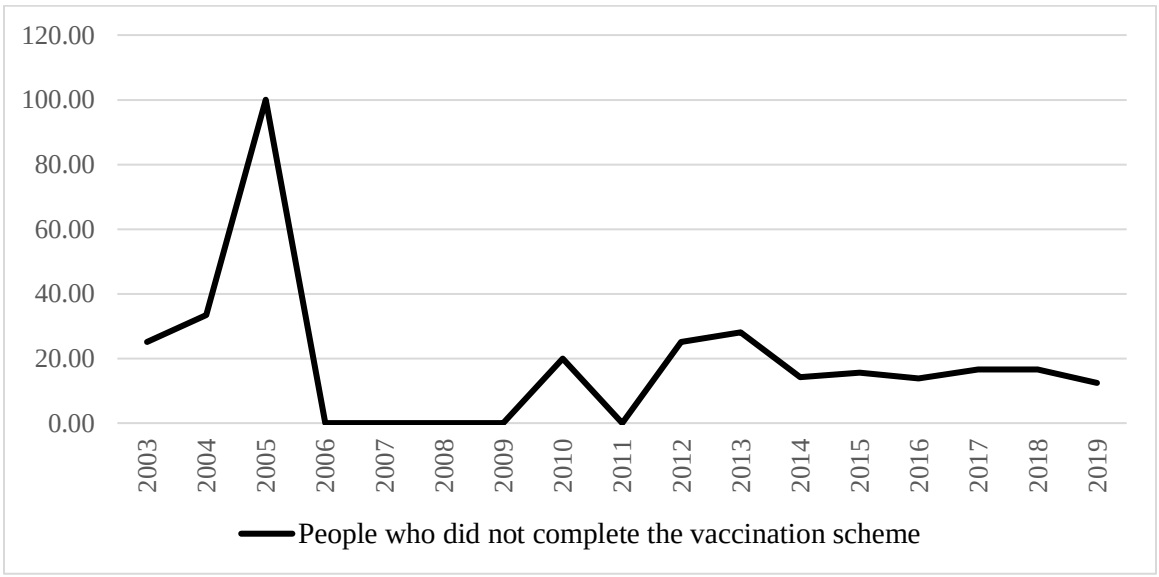

Figure 6. People who did not complete the vaccination scheme

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2.6. Urban human rabies

There was only one case of human rabies in 2010, very significantly different (‹0.05) from the rest of the years evaluated (table 2 and figure 7).

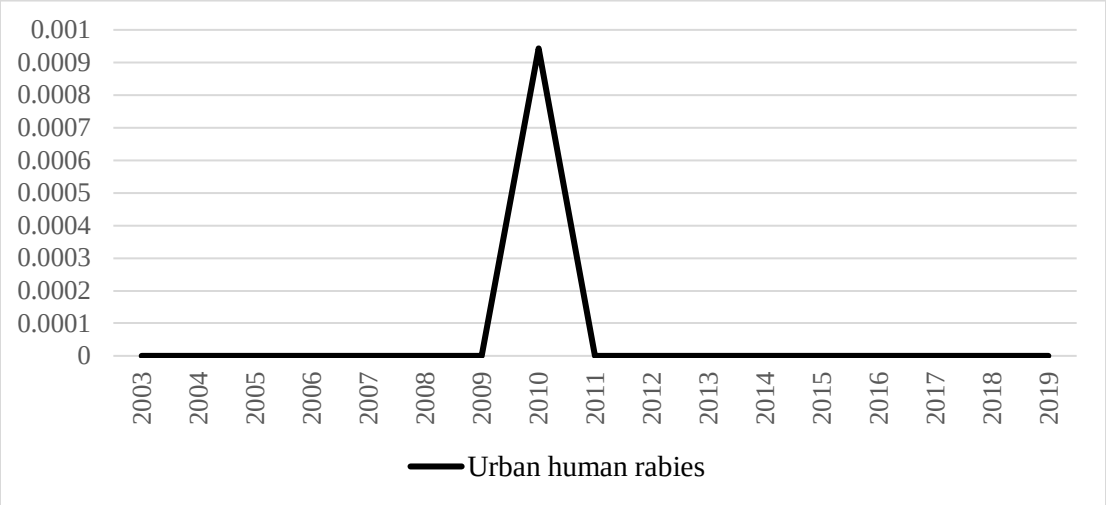

Figure 7. Urban human rabies

2.7. Samples sent to the laboratory

The sending of samples to the laboratory for epidemiological surveillance for the diagnosis of rabies increased mostly significantly irregularly (‹0.05) each year, with the exception of 2019, which decreased markedly (table 2 and figure 8).

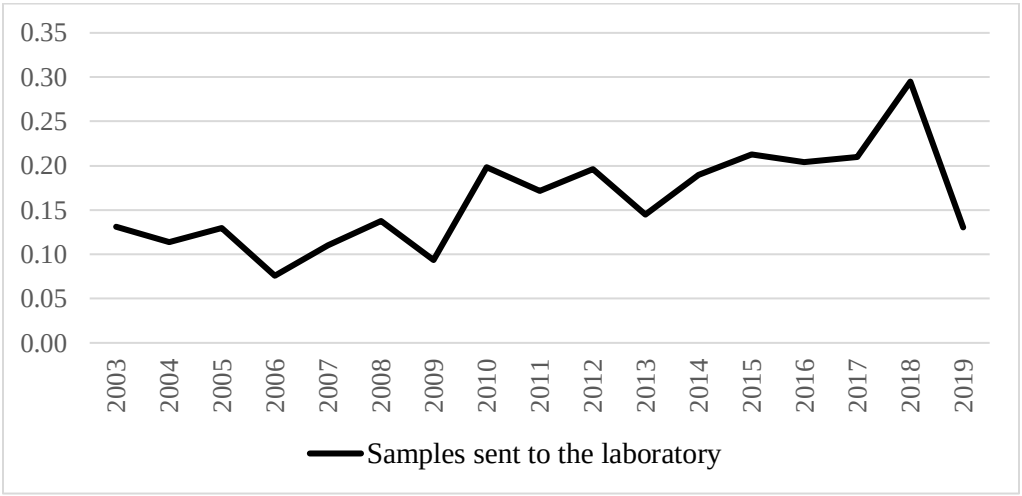

Figure 8. Samples sent to the laboratory

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2.8. Dogs vaccinated against rabies

The percentage of dogs vaccinated against rabies is between 60-102%, with very significant differences ($p<0.05$) between each year evaluated (table 2 and figure 9).

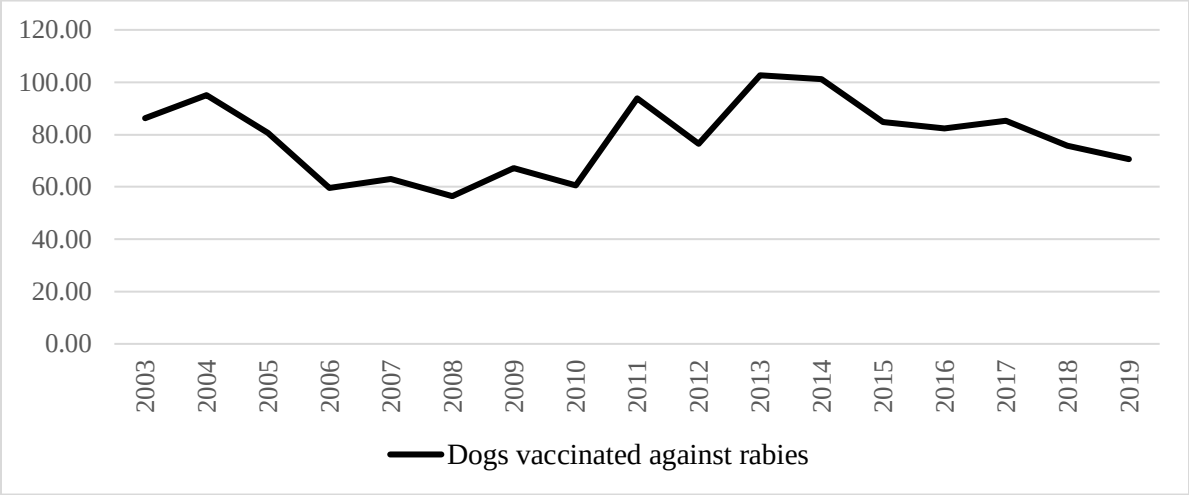

Figure 9. Dogs vaccinated against rabies

2.9. Notified biting dogs

The percentage of reported biting dogs are between 34 and 103%, with marked differences ($p<0.05$), of the total number of expected bites (table 2 and figure 10).

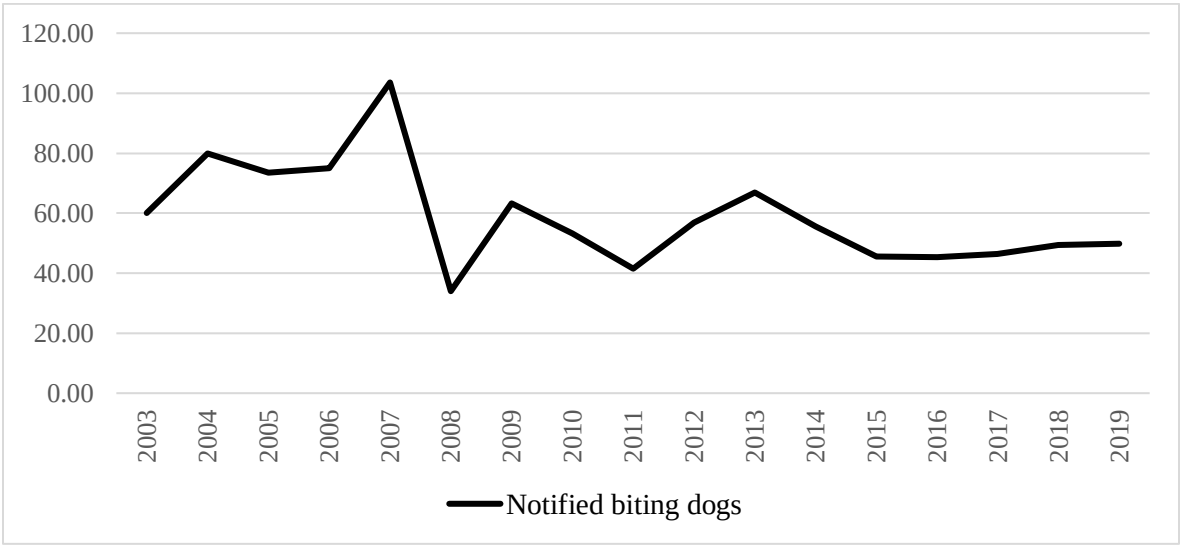

Figure 10. Notified biting dogs

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2.10. Controlled biting dogs

Almost 100% of biting dogs were controlled, maintaining it during the evaluated years without statistical differences between each year (table 2 and figure 11).

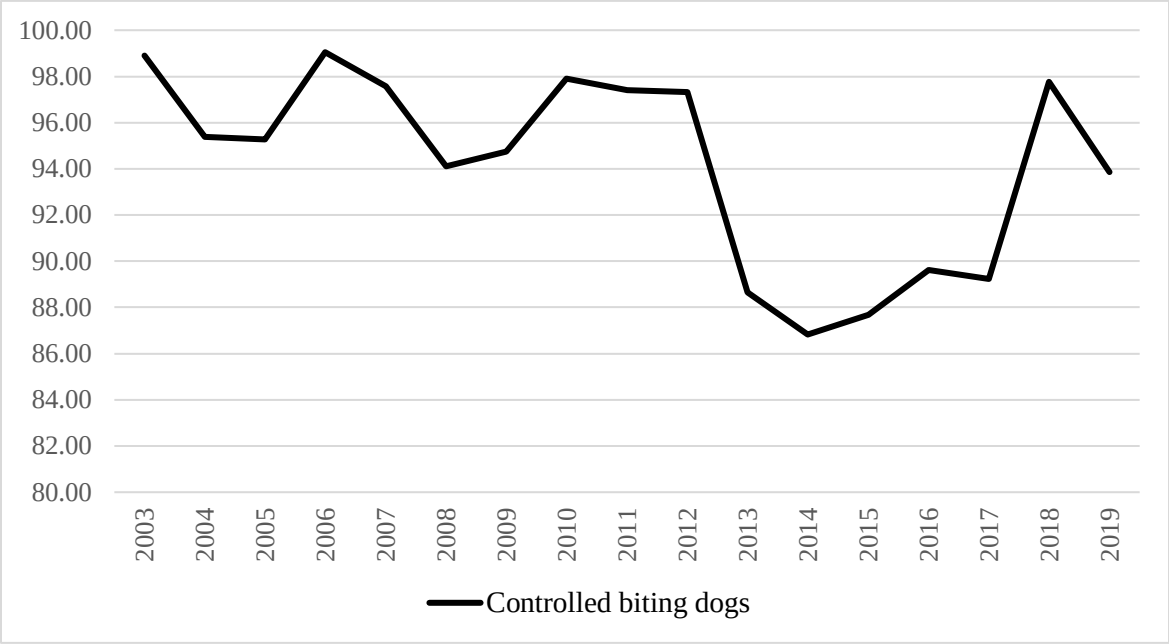

Figure 11. Controlled biting dogs

2.11. Rabies in vaccinated dogs

No case of rabies was reported in dogs vaccinated against rabies (table 2 and figure 12).

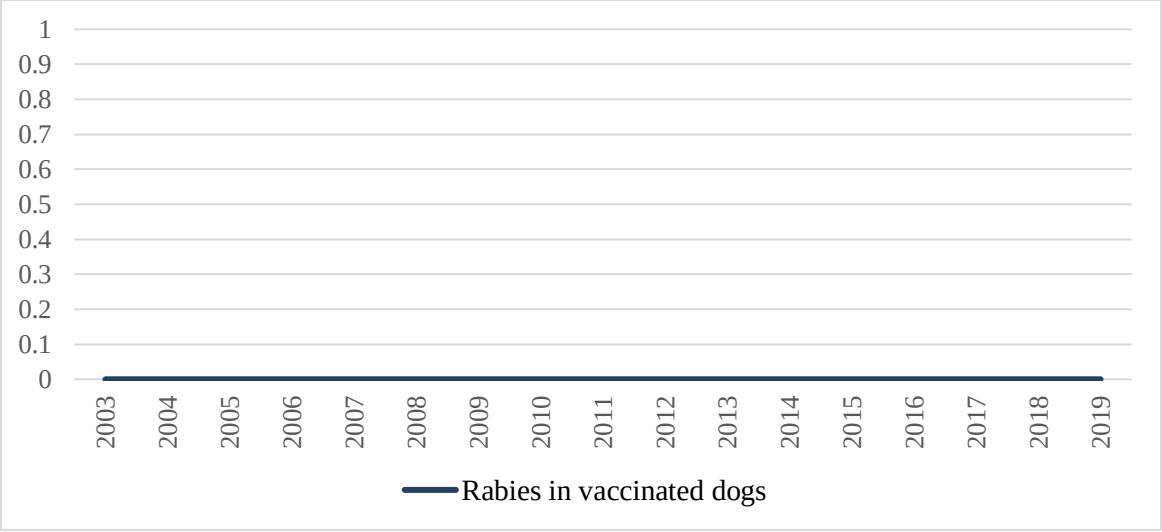

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Figure 12. Rabies in vaccinated dogs

2.12. Canine rabies

During the years evaluated, only in the years 2010 and 2015 were laboratory confirmed cases of canine rabies, one and two cases respectively very different ($p<0.05$) from the rest of the years in which no cases of canine rabies were reported (table 2 and figure 13).

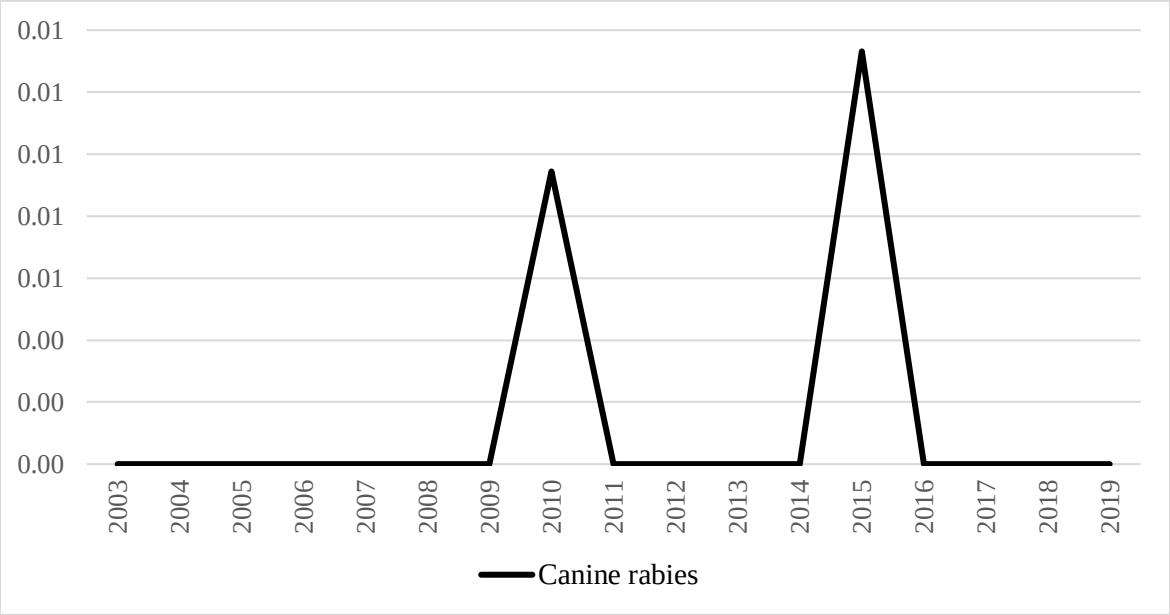

Figure 13. Canine rabies

3. Discussion

The percentage of people bitten increased over the years similar to that reported by Fontes-Pereira et al., (2012), the majority of which were controlled in almost 100% (table 1, figures 1 and 3) as recommended, providing care to 100% of the exposed population at risk with postexposure (Schneider et al., 2011), above that reported by Hampson et al., (2008), who point out that at least 20% of all rabies exposures do not seek medical attention, which undoubtedly contributes to reducing cases of human rabies and/or eradicating them. This is the main objective of rabies control programs both in Peru and in the rest of the world.

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People who started rabies vaccination due to the severity of the injuries were increasing, due to the availability of rabies vaccines for human use, however, very few people did not complete the complete vaccination schedule, for reasons of treatment suspension due to adequate control of biting animal (table 2 and figures 5 and 6), however, this finding is compatible with what was stated by Hemachudha et al., (2002).

The only reported case of human rabies was in 2010, caused by a dog bite and reported too late to the health establishment, it was considered the only epidemic outbreak, caused by an unvaccinated dog since during the time evaluated the only three cases of canine rabies occurred in unvaccinated dogs, Coinciding in that the cases of human and canine rabies have been reduced by nearly 90% over the past 20 years since the inception of a Regional elimination program (Schneider et al., 2011).

The outbreak of human rabies coincides with the low coverage of canine rabies vaccination obtained and with the report of a case of canine rabies the same year in the entire province of Chucuito (Table 2, figures 3, 9 and 12), this being the cause probable of the presence of human rabies since as do not have protection coverage (between 70 and 80%) the risk of cases of human rabies is high (Bourhy et al., 2008; Kuzmin et al., 2012; MINSA, 2006, 2017; OIE, 2015; Sánchez-Soriano et al., 2020; Schneider et al., 2011; World Health Organization, 2013; Zinsstag et al., 2009), this association has already been reported by Cediel et al., (2010), besides we are also an endemic region for rabies, this result coincides with that indicated by several authors that the dog is the main transmitter of human rabies (Fontes-Pereira et al., 2012; World Health Organization, 2013), for example, 90% of the cases of human rabies in the world are due to the bite of sick dogs, although infection can also occur through contact of the saliva with the mucosa and by injuries caused by scratches (Galán Torres, 2012).

Taking into account that the annual canine rabies vaccination campaigns confer extraordinary value and dramatically reduce the health burden of rabies (Fitzpatrick et al., 2014; Hampson et al., 2009), vaccination is carried out annually in the province of Chucuito, the percentage of dogs vaccinated during the years evaluated varied greatly based on the estimated dog population, coinciding with that reported by Freire de Carvalho et al., (2018), keeping in the sustained safety range of 70-80% (Bourhy et al., 2008; Kuzmin et al., 2012; MINSA, 2006, 2017;

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OIE, 2015; Sánchez-Soriano et al., 2020; Schneider et al., 2011; World Health Organization, 2013; Zinsstag et al., 2009), with the exception of the years 2007 to 2010, with the lowest coverage (table 2 and figure 9), but still well above the vaccination coverage reported by Kallo et al., (2020); coinciding with the efforts of LAC countries to maintain sustained efforts in the area of dog vaccination by providing an understanding of the baseline effort required to reduce the incidence of dog-mediated rabies (Freire de Carvalho et al., 2018), considering, that infection can be eliminated at source through sustained mass vaccination of reservoir populations (Hampson et al., 2009), doing mass vaccination should aim for coverage as high as possible (Zinsstag et al., 2009).

Galán Torres (2012) recommends that the vaccination schedule should be unique, such recommendation in the country and the Puno region should be adopted in order to achieve more adequate coverage. However, the registration and/or notification of biting dogs it was quite irregular (figure 10), being controlled almost 100% (figure 11), contrary to what was reported in Haiti, where 50% of the dogs involved in a bite event are unknown (Ma et al., 2020); in addition, was reinforced with the sending of samples for the diagnosis of canine rabies as epidemiological surveillance, reaching an adequate percentage (Cediel et al., 2010; MINSA, 2006, 2017; Schneider et al., 1996) with the exception of the year 2019 where it declined a little (table 2 and figure 8), considering that adequate and fair investment in dog vaccination (despite the fact that in this case, the investment has been scarce) could bring down costs in medical treatment demonstrating the need for intersectoral coordination (Fitzpatrick et al., 2014; Hampson et al., 2015; Zinsstag et al., 2009).

Conclusions

During the years evaluated, only one outbreak of human rabies occurred in 2010, coinciding with low coverage of canine rabies vaccination and a case of canine rabies the same year. Three cases of canine rabies were reported in unvaccinated dogs. The most of the bitten people were controlled. There was an adequate control of the biting dogs with a minimum of three controls. Sending samples to the laboratory for rabies diagnosis as epidemiologic.

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