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Rabies in Animals with Emphasis on Dog and Cat in Ethiopia

Abraham Haile Kidane[1], Dessalegn Sefir[1], Tesfaye Bejiga[2], Asefa Deressa[1] and Mahendra Pal[3]*

[1] *Ethiopian Public Health Institute (EPHI), P.O.Box 1242, Addis Ababa, Ethiopia*
[2] *Veterinary Drug and Feed Administration and Control Authority (VDFACA), Addis Ababa, Ethiopia*
[3] *College of Veterinary Medicine, Addis Ababa University, Ethiopia*
*Corresponding author`s Email: palmahendra2@gmail.com

ABSTRACT

Rabies is a major viral anthropozoonosis of public health significance. The animals play a crucial role in maintenance and circulation of the rabies virus. Determining the occurrence of rabies in animals was implicated as a fundamental step to guide prevention and control efforts. The study involved cross sectional study by retrieval previously recorded cases between September 2009 and January 2012, Ethiopia. Suspected animal rabies cases were quarantined for 10 days observation period and brain samples were tested for confirmation using direct fluorescent antibody test. The statistical analysis was performed using SPSS program and Chi-square and analysis of variance (ANOVA) was used to assess the significance difference. Domestic and wild animals were associated with human exposure and death cases. However, dogs were the culprit for the highest human fatal (97%) and human exposure cases (89.5%). Only 2% of human deaths were associated with cats and wild animals. Higher rabies positivity was noted in owned dogs 138 (74.2%) than ownerless ones 49 (25.8%). The difference was statistically significant (p=0.0001). Further, all positive cases in cats were apparent in those believed to be owned. Majority of positive results associated with dogs were aged above 12 months 70 (81.4%), 10 (11.6%) were from the age between 6 and 12 months followed by 3 to 6 months 6 (7%). Positive cases in cats were more common among those aged above 12 months (60%) followed by 6 to 12 (20%) and 3 to 6 months (20%) of age. Of the animals with positive results, 4 (1.6%) were vaccinated against rabies. Overall, majority of the dogs had no vaccination history 247 (96.1%), only 10 (3.9%) were found to have been vaccinated. On contrary, none of the cats were vaccinated against rabies. The number of submitted samples had a direct correlation with the number of positive results ($p<0.05$), however, no season variation was encountered. Five sub-cities that border with another region showed a significantly higher occurrence ($p<0.05$) of exposure and confirmed cases and post exposure prophylaxis. Thus, integrated implementation of compulsory animal management, immunization and creation of awareness is highly imperative.

Key words: Addis Ababa, Cat, Dog, Immunization, Rabies, Zoonosis

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INTRODUCTION

Rabies is a highly fatal zoonosis, which affects humans as well as a wide variety of animals (Pal, 2007), and is reported from many countries including Ethiopia (Pal, 1991 and Deressa et al., 2011). The disease is caused by a virus of the genus *Lyssavirus* of the family *Rhabdoviridae* (Pal et al., 2013). The disease is mainly transmitted from rabid animals to humans through close contact with infected saliva via bite or scratch and invariably results in death (Pal et al., 2013). Despite the preventable nature of the disease and existence of effective and economical control strategies (Lembo et al., 2010), rabies remains as one of the major public health problem resulting in an estimated loss of approximately 60000 lives worldwide each year which almost all of the cases belong to Africa and Asia (Pal et al., 2013; WHO, 2013 and Hampson et al., 2015).

Ethiopia was among the high burdened country where 10,000 people per annum were estimated to have died (Fekadu, 1997). In world rabies survey report, it was found the second leading country. In 2012, over 1400 deaths were estimated to occur due to rabies annually (Ali, 2012). A very recent global burden estimate showed over 2700 annual human lives are lost in the country (Hampson et al., 2015). Domestic and wild animals can potentially transmit the disease to humans mainly through biting (Pal, 1991). However, dog mediated rabies is known to account for over 90% of human exposure and death cases in Ethiopia and elsewhere (WHO, 2005; Ali, 2012 and WHO, 2013). Next to canine, feline species appears to be the second most affected animal in Ethiopia (Yemer et al., 2002; Deressa et al., 2010 and Ali et al., 2012). In some case, incidence of rabies in cats can exceed as compared to dogs. Further, the tendency of victims to visit health centers during a cat related incident is much lower than a dog inflicted incidents (Eidson and Bingman, 2010) making the animal vulnerable and a potential source of rabies to humans along with dogs. Meanwhile, rabies

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affects domestic animals and endangered animals like the Ethiopia Wolf (Deressa et al., 2016). Overall, rabies is a public health, animal health and livelihood concern in Ethiopia.

The general prevention of human exposure to rabies relies on taking Post Exposure Prophylaxis (PEP). Globally, close to 15 million people receive PEP annually which is considered as costly and not accessible for developing countries like Ethiopia (WHO, 2013 and Hampson et al., 2015). Whereas dog population management and dog mass vaccination are the shown be cost effective measures in rabies prevention and control (Escobar, 1988). In Africa, majority (98%) of dogs is believed to be owned and feasible strategies for successful mass dog vaccination were recommended (Jibat et al., 2015). However, the impetus towards the implementation of these strategies is highly hampered due to socio-economic and political factors in developing countries (WHO, 2005). Lack of information on the extent of the burden and risk factors significantly led to rabies being overlooked and thus, reduced collaboration including financing for implementation of successful intervention strategies such as mass dog vaccination (Hampson et al., 2015). In this regard, assessing the burden and risk factors and giving special emphasis to animals in diseases is imperative to act as a guide to cost effective intervention.

MATERIALS AND METHODS

The study was conducted in Addis Ababa city administration, the capital of the federal democratic republic of Ethiopia from October 2012 to March 2013. The city covers an area of 530.14 $km^2$and is subdivided into 10 sub-cites. Addis Ababa lies at an altitude of 2,500 meters above sea level, located between 9.03° North 38.74° east, latitude and longitude, respectively. All 10 sub cities under Addis Ababa city administration were included. The study population was animals residing in and around Addis Ababa and specifically those reported during the study period to the Ethiopian Public Health Institute (EPHI) rabies counseling and diagnostic center. The sample size was determined on the basis of previously reported incidents between September 2010 and August 2011. Furthermore, all admitted animals were subjected to quarantine for a 10 days period at EPHI and followed during the observation period for survival or death. Dead animals were tested for confirmation while those animals were given back to the submitter. In many cases, live animals are home quarantined by owners and the brain samples were submitted by local veterinarians to national rabies laboratory at EPHI. The laboratory diagnosis was applied using the direct fluorescent antibody test to confirm rabies cases in animals on brain sample impression using anti rabies conjugate.

The data collected was entered in a Microsoft excel sheet and analyzed with SPSS statistical package version 16. Descriptive statistics such as frequency were used where determined necessary. Chi-square and analysis of variance (ANOVA) was used to assess the significance difference. Additionally, linear regression was found relevant in assessing the correlation amongst the reported incident, the number of positive cases and Post Exposure Treatment (PEP). Dependent variables were exposure (incidents) and confirmed cases where independent variables were month and sub-city. Moreover, incidence was calculated using Microsoft excel. The statistically significance of P-value less than 0.05 was considered. The study considered secondary data and no animal was involved in any kind of medical procedure that may lead to suffering and all personal identifier were not used. Nevertheless, ethical clearance on scientific soundness and justification for the need to do the study was addressed by the Addis Ababa University College of Veterinary Medicine.

Ethical approval

The study considered secondary data and no animal was involved in any kind of medical procedure that may lead to suffering and all personal identifier were not used. Nevertheless, ethical clearance on scientific soundness and justification for the need to do the study was addressed by the Addis Ababa University College of Veterinary Medicine.

RESULTS

Of the human death cases reported from September 2009 to March 2013, from a total of 96 deaths reported, nearly all 93 (97%) fatal cases were attributed to dogs where only one (1%) was due to cats and the rest (1%) were due to wild animal. Of the suspected animals presented alive and dead to EPHI, 69 (20.7%) were from outside and 265 (79.3%) incidents were reported during 2010-2011 in Addis Ababa. Domestic animals such as dog, cat, cattle and wild animals like apes and foxes were associated with human exposure.

Of the laboratory examined animals, 246 (92.8%) and 15 (5.7%) were dogs and cats, respectively. The remaining 4 (1.6 %) were related to domestic animals such as bovine and equine and to wild animals such as apes. Subsequently, 186 (75.6%) canine and 9 (60%) feline brains were positive for rabies virus. Three (0.9%) of samples submitted were associated with invalid results. Higher proportion of owned 197 (80.1%) than stray dogs 49 (19.9%) was reported. In feline species, 2 (13.3%) and 13 (86.7%) stray and owned, respectively were reported. Higher positivity was noted in

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owned dogs 138 (74.2%) than ownerless 49 (25.8%). The difference was statistically significant (P=0.0001). Further, all positive cases in cats were apparent in those believed to be owned. Overall, majority of the dogs had no vaccination history 247 (96.1%), only 10 (3.9%) were found to have been vaccinated. Of these, four (1.6%) were positive for rabies despite immunization history. On contrary, none of the cats were immunized. The difference between vaccination status and positivity was statistically significance (P<0.05).

Higher number of male dogs 168 (78.5%) were submitted for laboratory examination than females 46 (21.5%). Although high proportion of males were found to be positive for rabies 123 (77.4%) than females 36 (22.6%), no significant difference (P>0.05) was noted amongst the gender and positivity. Male felines 3 (21.4%) were conversely outnumbered by females 11 (78.6%). Majority of positive results associated with dogs were aged above 12 months 70 (81.4%). 10 (11.6%) were reported from 6 to 12 months followed by 3 to 6 months 6 (7%). Positive feline cases were more common among those aged above 12 months (60%) followed by 6 to 12 (20%) and 3 to 6 months (20%) age categories.

The incidence of rabies in dogs and cats during 2010 and 2011 was calculated considering an estimated total population of 230000 to 300000, an average estimated population with 265000 both owned and stray dogs (Abegaz, 2012). Similar, estimate was used for feline species. A total of 186 positive canine cases were found over a year, hence 7 per 10000 population was calculated. A total of 9 feline brains were positive for rabies virus hereby the incidence was found 3.4 per 100000 of the population over year. According to this study, the annual incidence in dogs and cats indicated an increase between 2009 and 2012 (Figure 1). Of the 259 total confirmed cases in 2009 and 2010, 243(93%) was canine and 16 (7%) feline. In the consecutive year of 2010 and 2011, 246 (94%) and 15 (6%) of the total 261 reported cases, while in 2011 and 2012, 345 cases were reported from dogs and cats, 321 (93%) and 21 (7%), respectively.

Majority of cases between 2008 and 2012, were evident during April (10.5%) followed by February (10.2%), May (9.4%) and September (9%). The remaining months showed a slight variation indicating equal distribution as indicated in figure 2. Furthermore, significant variation was observed (F=29.7 P=0.0001, P < 0.05) between months. However, no seasonality was encountered.

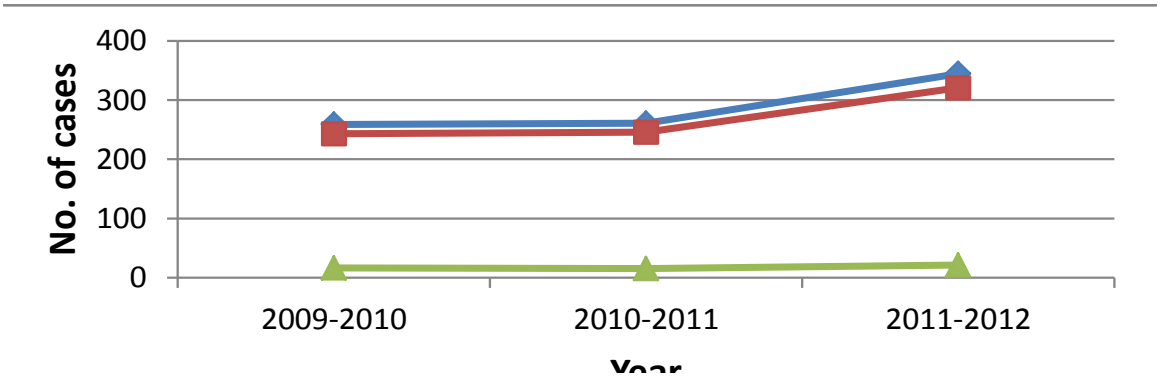

Figure 1. Pattern of confirmed dogs and cat cases between 2009 and 2012, Addis Ababa, Ethiopia

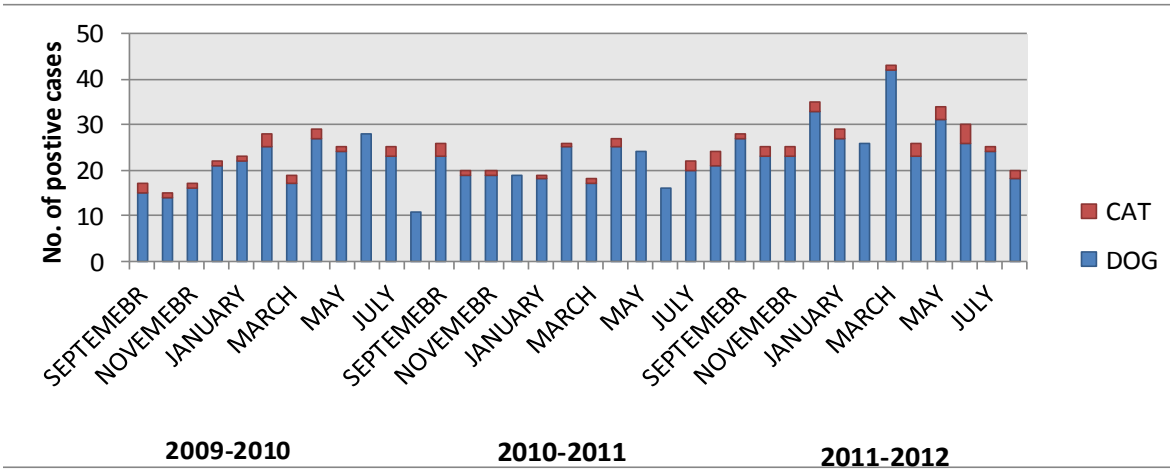

Figure 2. Annual incidences in canine and feline rabies and also monthly trends between 2009 and 2012, Addis Ababa, Ethiopia

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As shown in figure 3 and figure 4 the laboratory confirmed animal cases amongst the ten sub cities was revealed to be as Yeka 49 (18.5%), Kolfe 47 (17.7%), Gullele 42 (15.8%), and Lafto 34 (12.8%) reported the highest while Bole 22 (8.3%), Addisketema 18 (6.8%), Kirkos 16 (6%), Arada 16 (6%), Lideta 13 (4.9%), Akaki 8 (4%) constituted the remaining during the period of 2010 to 2012. Significance difference was noted (P=0.003, P < 0.05). Positive case distribution among sub-cities was analyzed where the highest positive cases 39 (20.3%) were found to have been at Yeka sub-city followed by KolfeKeranyo 35 (18.2%) and Gullele 32 (16.7%). Furthermore, the least cases were encountered from Akaki 6 (3.1%). The remaining moderate reported cases were 19 (9.9%) at NefasilkLafto, Bole 15 (7.8%), Kirkos 13 (6.8%), Addis Ketema 12 (6.2%), Arada 11 (5.7%) and Lideta 10 (5.2%). In the capital, suspected animals rabies cases were more common in sub cities namely, Gullele (17%), KolfeKeranyo (16.2%), Yeka (12.1%), NefasilkLafto (12%), Bole (10%), and AddisKetema (9.2%). Moreover, Arada (7.9%), Kirkos (6.9%), Lideta (5.5%), and AkakiKaliti (2.6%) were amongst the least reported. The number of submitted samples had a direct correlation with the number of positive results (t=20.962, P=0.0001, P<0.05).

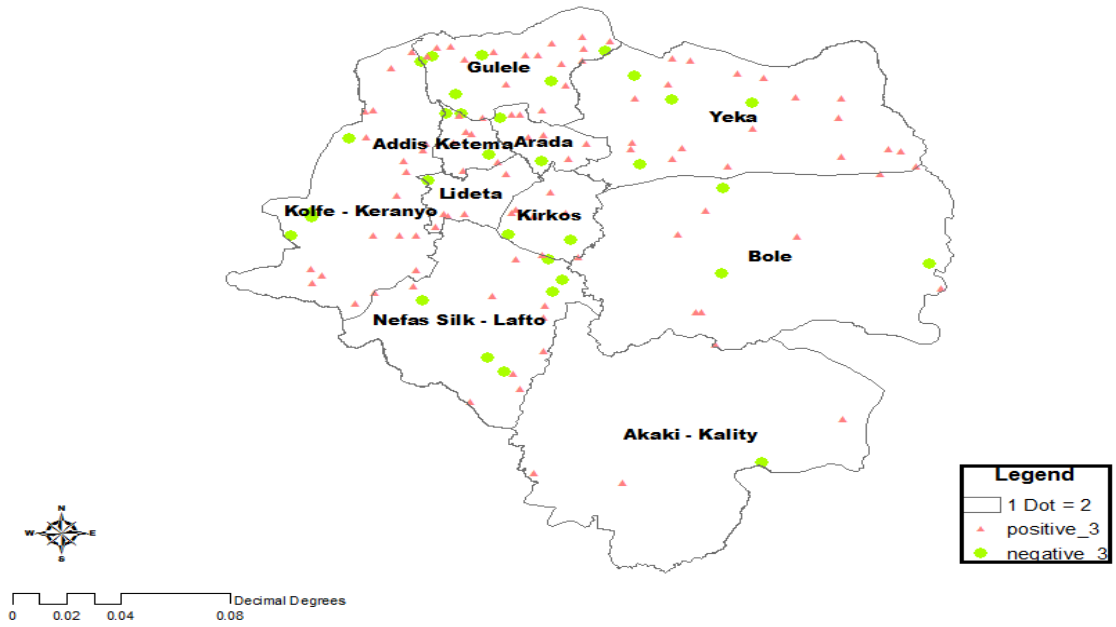

Figure 3. Laboratory confirmed animal rabies cases in the ten sub cities under Addis Ababa during 2010 and 2011, Addis Ababa, Ethiopia

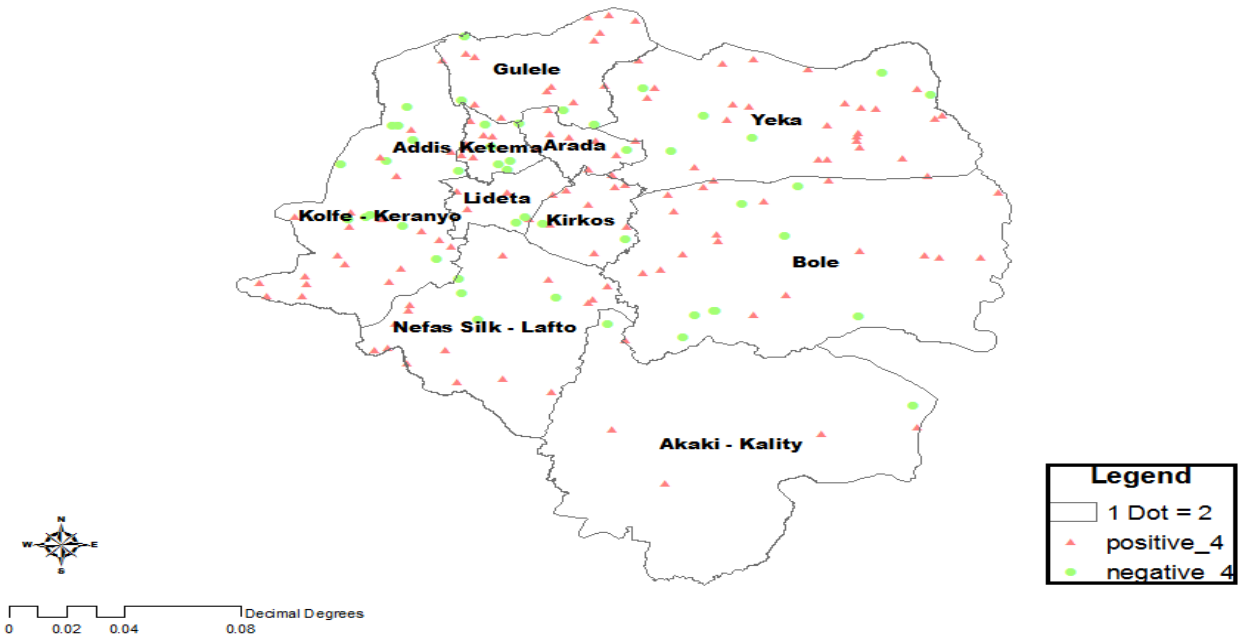

Figure 4. Laboratory confirmed cases in the ten sub cities under Addis Ababa, Ethiopia during 2011 and 2012

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DISCUSSION

According to this study, the annual incidences in dogs and cats indicated an increase between 2009 and 2012. This can be conjectured to the haphazard intervention strategy in the case of stray dog control and immunization (Ali et al., 2010). Likewise, lack of institutional contribution gave opportunity for the persistent prevalence. The need for inter-sectoral integration towards rabies elimination is indicated as the only alternative (Escobar, 1988). Herein, majority of animal owners failed to immunize their pets where only 4.2% of dogs were reported to have been immunized. According to global estimate, a very limited finace is allocated to the veterinary sector for dog vaccination (Hampson et al., 2015). Nevertheless, 1.6% was positive for rabies despite immunization history. Poor vaccination practice was described elsewhere (Ali et al., 2010). Eng et al. (1993) reported rabies in animals with prior vaccination history 3(1%) two cats and one dog. This is associated with factors such as the poor quality of vaccines due to inappropriate cold chain management. On the other hand, all cats were not subjected to immunization (Newayeselassie et al., 2012). The difference between vaccination status and positivity showed statistical significance ($P<0.05$). Legislation, education, and mass vaccination of dogs were ideal intervention strategies (Escobar, 1988). Moreover, consideration of mass immunization of 70% of dogs is believed to eliminate the disease by developing herd immunity (Mitmoonpitak et al., 1998). This study, however, found only 4% of dog owners practiced vaccination. This vaccination practice is much lower than reported by other studies (Jemberu et al., 2013 and Kitala et al., 2000). The differences could be due to the fact that present study was used retrospective whereas both studies were active surveys. Meanwhile, the free of cost accessibility of vaccine is believed to maximize the vaccination coverage close to 70% in Africa context (Jibat et al., 2015).

Animal brains submitted for laboratory test were mostly from dogs 92.8% and cats 5.7%. As a result 75.6% of canine and 60% feline brains were positive for rabies virus. This is supported by previous studies that indicated higher proportion of canine and feline (Yemer et al., 2002; Ali et al., 2010 and Deressa et al., 2010). Most (80.1%) brain samples from owned dogs were commonly submitted as opposed to stray ones 19.9%. As a result, higher positivity was noted in owned dogs 74.2% than ownerless 25.8%. This is complementary to Ali et al.,,(2010) where stray were indicated to higher positivity among owned dogs. Similarly, 13.3% and 86.7% stray and owned cats were reported where all under ownership were positive and none feral cats were positive. This could be due to the better chance of owned animals being available for diagnosis. The poor management of pets is conjectured to have a role in contracting the infection while roaming for food and for breeding. Additionally, this implicates the equal probability of acquiring risk in owned to stray dogs the latter was known as principal player for circulation where in our context animals are not leashed, properly sheltered, and immunized (Yemer et al., 2012).

Male dogs outnumbered female dogs in 78.5% and 21.5% of positive cases respectively. On the contrary, females were 78.6% outnumbered by counterpart 21.4%. This can be justified by the fact that the variation in ownership trend of canine and feline species among Ethiopian custom where male dogs are privileged for avoiding overpopulation. In line with this, Yemer et al. (2012) reported that 78.4% of informants were found to keep male dogs in majority of cases for the sake of security. About 81.4% of positive samples were from dogs aged above 12 months followed by among those age between 6 and 12 months (11.6%) and 3 to 6 months (7%). Similarly, cats aged above 12 months 60% was highly positive than 6 to 12 months 20% and 3 to 6 months 20% age categories. On contrary, higher incidence of rabies was reported in dogs less than 12 months of age (Morters et al., 2015). The discrepancy could be attributed to the fact that older dogs were usually reported perhaps due to their chance of being suspected to rabies in the study area while puppies were disregarded as if they might not contract the infection (Kaare et al., 2009). White et al. (2007) described that even clinicians were steered away from suspect and diagnosis of pups despite their higher vulnerability to infection than older dogs.

Seasonal variation was assessed, however no seasonal influence was observed to influence occurrence. Monthly variation was assessed where majority of cases were evident during April 10.5% followed February 10.2%, May 9.4% and September 9%. The remaining months had showed a slight variation. Similarly, Yemer et al. (2002) did not observe any seasonal association. On contrary, Ali et al. (2010) found rabies varying along season where an increase of positive cases was common from June to September. This paper however indicated the existence of rabies through whole year despite breeding influence. In country where the awareness level is very much limited, the issue of seasonality may significantly influence the treatment seeking behavior of individuals and thus, careful explanation on the seasonality of rabies is required while dealing with awareness raising efforts. Further, variation in rabies cases in sub-cities could be associated with several factors such as variation in dog population size; however, this study does not answer to actual burden in relation to animal population. The possibility of sample submission to the central rabies laboratory is significantly rare leaving the true burden is undisclosed.

As for limitations, the present study was retrospective and cases were subjected to under reporting since animals suspected of being rabid were brought to the EPHI by animal owners and in few cases by veterinarians. The Institute

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serves mostly Addis Ababa inhabitants and thus, the information was very much to be representative of Addis Ababa and its surrounding.

CONCLUSION

Rabies is still imposing a great risk to the animals. The lack of compulsory animal management, poor intersectoral and haphazard trend of dog control and immunization strategy are the associated factors described. Canines remain the scapegoat for almost all deaths and post-exposure treatment and felines to some extent were also part of the burden. Positive cases among vaccinated animals and both among owned and stray dogs were identified. Distribution of exposure, vaccine use and confirmed cases amongst those sub-cities were found border to other districts. A multisectoral and inter agency collaboration including funding for mass vaccination of dogs, and investigation of the actual burden and risk factors of rabies in animals and humans through an integrated surveillance system is recommended for efficient and effective rabies prevention and control in the country.

Competing Interests

The authors have declared that there are no competing interests exist.

REFERENCES

Abegaz Z (2012). Rabies legislation: best practice from Addis Ababa. Pp.121-123. Proceedings of the national workshop on rabies prevention and control in Ethiopia.Adama, Ethiopia, 18-19 October, 2012.

Ali A, Mengistu F, Hussen K, Getahun G, Deressa A, Yimer E and Tafese K (2010). Overview of rabies in and around Addis Ababa, in animals examined in EHNRI Zoonoses Laboratory between 2003 and 2009. Ethiopian Veterinary Journal, 14: 91-101.

Ali A (2012). National rabies survey preliminary report: household assessment. Proceedings of the National Workshop on Rabies Prevention and Control in Ethiopia. Adama, Ethiopia, 18-19 October 2012. Pp. 81-90.

Deressa A, Ali A, Beyene M, Newayeselassie NB, Yimer E, and Hussen K (2010). The status of rabies in Ethiopia: A retrospective record Review. Ethiopian Journal Health Development, 24: 127-132.

Deressa A, Tesfaye T and Pal M (2011). Application of fluorescent antibody technique for the diagnosis of rabies in cats and dogs. India Pet Journal, 3: 71-75.

Deressa A, Haile A, Sefir D, Getahun G, Mengistu GA and Pal M (2016). Laboratory Based Surveillance of Rabies Incidence in Ethiopian Wolf at Bale National Park, Ethiopia. Int. International Journal of Livestock Research, 6 (1): 15-20.

Eidson M and Bingman AK (2010). Terrestrial Rabies and Human Postexposure Prophylaxis, New York, USA. Emerging Infectious Diseases, 16: 527-529.

Eng TR, Fishbein DB, Talamante HE, Hall DB, Chavez GF, Dobbins JG, Muro FJ, Bustos JL, de los Angeles Ricardy M, Munguia A, Carrasco J, Robles AR and Baer GM (1993). Urban epizootic of rabies in Mexico: epidemiology and impact of animal bite injuries. Bull World Health Organization, 71: 615-624.

Escobar Cifuentes E (1988). Program for the elimination of urban rabies in Latin America. Reviews of Infectious Diseases, 10: 689-692.

Fekadu M (1997). Human rabies surveillance and control in Ethiopia. In: Proceedings of the Southern and Eastern Africa Rabies Group Meeting Nairobi, Kenya 4-6 March.

Hampson K, Coudeville L, Lembo T, Sambo M, Kieffer A, Attlan M, et al. (2015). Estimating the global burden of endemic canine rabies. PLoS Neglected Tropical Diseases 9: e0003709. doi:10.1371/journal.pntd.0003709.

Jemberu WT, Molla W, Almaw G and Alemu S (2013). Incidence of rabies in humans and domestic animals and people's awareness in North Gondar Zone, Ethiopia. PLoS Neglected Tropical Diseases, **7:**e2216.

Jibat T, Hogeveen H and Mourits MCM (2015). Review on Dog Rabies Vaccination Coverage in Africa: A Question of Dog Accessibility or Cost Recovery? PLoS Neglected Tropical Diseases, 9(2): 1-13.

Kaare M, Lembo T, Hampson K, Ernest E, Estes A, Mentzel C and Cleaveland S (2009). Rabies control in rural Africa: evaluating strategies for effective domestic dog vaccination. Vaccine, 27**:** 152–160.

Kitala PM, McDermott JJ, Kyule MN and Gathuma JM (2000). Community-based active surveillance for rabies in Machakos District, Kenya, Preventive Veterinary Medicine, 44:73-85.

Lembo T, Hampson K, Kaare MT, Ernest E, Knobel D, Kazwala RR, Haydon TD and Cleaveland S (2010). The feasibility of canine rabies elimination in Africa: dispelling doubts with data. PLoS Neglected Tropical Diseases, 4: e626.

Mitmoonpitak C, Tepsumethanon V and Wilde H (1998). Rabies in Thailand. Epidemiology and Infection, 120**:** 165–169.

Morters MK, McNabb S, Horton DL, Fooks AR, Schoeman JP, Whay HR, Wood JLN and Cleaveland S (2015). Effective vaccination against rabies in puppies in rabies endemic regions. Veterinary Record, pp. 1-5. doi:10.1136/vr.102975.

Newayeselassie B, Deressa A, Bekele Ya M and Pal M (2012). Assessment of Knowledge, attitude and practice (KAP) of canine rabies among inhabitants of Addis Ababa, Ethiopia. International Journal of Livestock Research, 2: 102-108.

Pal M (1991). Naturally occurring fatal rabies in a caged lion (Pantheraleo). VerhberErkrgZootier , 33: 213-215.

Pal M (2007). Zoonoses. 2nd Edition. Satyam Publishers, Jaipur, India, pp. 72- 75.

Pal M, Hailu A, Agarwal RK and Dave P (2013). Recent developments in the diagnosis of rabies in humans and animals. Journal of Veterinary Public Health, 11: 77-82.

White J, Taylor SM, Wolfram K L, and O'Conner BP (2007). Rabies in a 10-week-old puppy. Canadian Veterinary Journal, 48: 931–934.

WHO (2005). WHO Expert Consultation on Rabies. First Report. WHO Technical Report Series 931,World Health Organization, Geneva, Switzerland.

WHO (2013). World Health Organization Expert Consultation on Rabies Second Report. WHO Technical Report Series 982. Geneva, World Health Organization.

Yimer E, Neway B, Girma T, Mekonnen Y, Yoseph B, Badeg Z, Mekoro B and Abebe B (2002). Situation of rabies in Ethiopia: a retrospective study 1990-2000. Ethiopian Journal of Health Development, 16:105-112.

Yimer E, Arthuro M, Beyene M, Bekele A, Taye G, Zewdie B and Alemayehu T (2012). Study on knowledge, attitude and dog ownership patterns related to rabies prevention and control in Addis Ababa, Ethiopia. Ethiopian Veterinary Journal, 16: 27-39.

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