

Risk Mapping of Risk Factors Associated with Human Rabies Cases in Bali Province, Indonesia

Y. Yupiana

Directorate of Animal Health,
Directorate General of Livestock
and Animal Health Services,
Ministry of Agriculture, Jakarta,
Indonesia
yuniyupiana@gmail.com

C. Basri

Department of Animal Infectious
Diseases and Veterinary Public
Health, Faculty of Veterinary
Medicine, IPB University. Bogor.
Indonesia
chaerul@apps.ipb.ac.id

Ernawati

Directorate of Animal Health,
Directorate General of Livestock
and Animal Health Services,
Ministry of Agriculture, Jakarta,
Indonesia
ernawati_rahmatsyah@yahoo.com

S. Sihombing

Coordinating Ministry of Human
Development and Culture. Jakarta.
Indonesia
sisie.md@gmail.com

Farida C. Zenal

Food and Agriculture Organization
of the United Nations, Emergency
Centre for Transboundary Animal
Diseases, Jakarta, Indonesia;
Farida.Zenal@fao.org

C. Pfeifer

Faculty of Veterinary and
Agriculture Science, The University
of Melbourne, Victoria, Australia.
caitlin.pfeiffer@unimelb.edu.au

M. Stevenson

Faculty of Veterinary and Agriculture
Science, The University of
Melbourne, Victoria, Australia.
Mark.stevenson1@unimelb.edu.au

L. Schoonman

Food and Agriculture Organization
of the United Nations, Emergency
Centre for Transboundary Animal
Diseases, Jakarta, Indonesia;
Luuk.Schoonman@fao.org

J. McGrane

Food and Agriculture Organization
of the United Nations, Emergency
Centre for Transboundary Animal
Diseases, Jakarta, Indonesia;
James.McGrane@fao.org

F. S. T. Rasa

Directorate of Animal Health,
Directorate General of Livestock
and Animal Health Services,
Ministry of Agriculture, Jakarta,
Indonesia

Abstract – Since the emergence of rabies cases in human in 2008, there have been 174 humans affected by the disease in Bali. Eradication program implementing dog vaccination has seemed to decrease the incidence of rabies cases in human, however the human cases were still found. A lot of resources from local and national government as well as the international organisation has been spent on this program. There need to be a review on rabies control implementation in Bali in order to have an effective dan efficient control program. Our study investigated data on rabies in humans and dogs and vaccination program in Bali from 2016 to 2018. In this study we analysed the association between number of human cases and three factors that include number of dog cases, dog vaccination coverages and number of poor households using a zero inflated Poisson regression. A risk map was also built by mapping the unexplained spatial risk (residual) using R. From this study we found that dog rabies and social economy status have positive association with human cases. As expected, the higher the vaccination coverage in dogs the lower the human rabies. However, none of these factors were significantly associated with the human cases. In the risk maps we found that Kintamani has the largest residual. This could mean this area has a unique risk factors compare to other subdistricts. Investigation in the areas with relatively high residual e.g. Kintamani is needed to uncover the unique risk factors contributing to human cases.

Keywords— risk maps, rabies, human, Bali, Indonesia

I. INTRODUCTION

Rabies is one of the priority diseases in both animal and public health sectors in Indonesia. In total, there are 26 endemic and 8 free provinces of this disease. Despite the efforts of preventing the introduction of the disease into free areas, some new infected areas such as Bali, West Kalimantan and West Nusa Tenggara provinces were discovered. In Bali, the first cases of human and dog were detected in 2008 [1]. Since then, a large amount of resources has been allocated to this this province by central and local government as well international agencies.

Vaccination has been chosen as a main strategy of combating the disease in dogs with a primary goal eliminating rabies cases in humans. The decreasing of cases in humans have been observed but, after more than 11 years of the implementation of massive rabies control in Bali, the cases are still found in this province. A comprehensive understanding of rabies and the control is needed to effectively combat the disease in Bali province. There need to be a review on the existing situation in Bali in order to have an effective rabies control program. Our study investigated risk factors of rabies in humans in Bali province from 2016 to 2018.

II. MATERIAL AND METHODS

All data analyses were performed using R package. Data were derived from Bali Rabies control project of 57 subdistricts in 2016-2018. Using the number of human rabies as the outcome, district level risk factors that include dog vaccination coverage, dog rabies and number of poor households were analysed using Zero-inflated Poisson regression analysis. Human rabies data were collected from the Ministry of health, dog rabies data were collected from Ministry of agriculture, dog vaccination coverage data were collected from local government and social economic status (poor household) data were derived from the statistic of each 9 districts in Bali Province. A risk map was built by mapping the unexplained spatial risk (residual) in Choropleth map using ggplot.

III. RESULTS

Other study has shown that none of the variables being analysed significantly associated. However, when using a significance level of 0.05 two variables are approaching significance (vaccination coverage in dogs and number of dog rabies). This might be due to the small number of human cases recorded. When ignoring the P-value, the risk ratio showed a negative association between vaccination in dog and human rabies and positive association between dog rabies and poor households and human rabies (Table 1).

TABLE I. ESTIMATED REGRESSION COEFFICIENTS AND THEIR STANDARD ERRORS FROM A ZERO-INFLATED POISSON MODEL

Explanatory variable	Estimate	SD	Risk ratio (95% CI)
Intercept	-0.7832	4.6533	
Vaccination coverage in dogs (%)	-0.0122	0.0286	0.99 (0.94 to 1.05)
Number of dog rabies	0.0376	0.0421	1.04 (0.96 to 1.14)
Number of poor household	0.1467	0.4834	1.16 (0.47 to 3.18)

In the risk maps we found that Kintamani has the largest residual. This could mean this area has a unique risk factors compare to other subdistricts (Fig. 1).

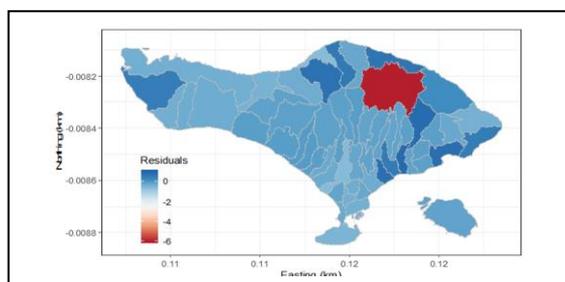


Fig. 1. Disease mapping of the risk residual of rabies in 2016-2018 in 57 subdistricts in Bali Province

IV. DISCUSSION

Mass vaccination is considered as the cornerstone in dog rabies eradication especially in an area where dogs roam free [2,3]. Even though challenging, the coverage of vaccination can be achieved in some regions in Bali provinces. As a result, a decreasing number of human incidences has been observed [4,5]. Despite the overall reduced in number of human incidences, the cases are still found. Many factors may contribute to the success of rabies eradication program in Bali that include the sensitivity of detection of dog rabies, level of response in human rabies (IBCM), vaccination coverage in dog rabies, and population structure of dogs and social economy status of people. In this study we were able to analyse some of those data that include dog rabies, vaccination coverage and social economic status.

As expected, dog rabies was positively associated with human rabies. Globally, it was recognized that more than 90% of human rabies were related with transmission from dogs. Similarly, most of human rabies in Bali were reported as the results of dog bites. That is the reason for choosing dogs as target of vaccination to prevent human cases. In this study, we also found that humans that live in regions with higher number of poor households are prone to experiencing rabies compared to humans living in regions with lower number of poor households. This might be due to the access to the post exposure prophylactic (PEP) and or knowledge of rabies.

After making an adjustment employing the risk factors, we found that some districts showed potential risk factors remained unmeasured (residual). From all districts, we found that Kintamani has the largest residual. This might reflect the unique characteristics of this district as oppose to the other districts.

REFERENCES

- [1] Clifton, M. (2010). How not to fight a rabies epidemic: a history in Bali. *Asian Biomedicine*, 4(4), 663-670. 10.2478/abm-2010-0086
- [2] Townsend, S. E., Sumantra, I. P., Pudjiatmoko, Bagus, G. N., Brum, E., Cleaveland, S., Hampson, K. (2013). Designing Programs for Eliminating Canine Rabies from Islands: Bali, Indonesia as a Case Study. *PLoS Neglected Tropical Diseases*, 7(8) 10.1371/journal.pntd.0002372
- [3] Corrieri, L., Adda, M., Miklosi, A., & Kubinyi, E. (2018). Companion and free-ranging Bali dogs: Environmental links with personality traits in an endemic dog population of South East Asia. *PLoS ONE*, 13(6) 10.1371/journal.pone.0197354
- [4] Arief, R. A., Hampson, K., Jatikusumah, A., Widyastuti, M. D. W., Sunandar, Basri, C., Unger, F. (2017). Determinants of Vaccination Coverage and Consequences for Rabies Control in Bali, Indonesia. *Frontiers in Veterinary Science*, 3 10.3389/fvets.2016.00123
- [5] Putra, A. A. G., Hampson, K., Girardi, J., Hiby, E., Knobel, D., Mardiana, I. W., . Scott-Orr, H. (2013). Response to a Rabies Epidemic, Bali, Indonesia, 2008-2011. *Emerging Infectious Diseases*, 19(4), 648-651. 10.3201/eid1904.120380.