P-ISSN: 2304-3075; E-ISSN: 2305-4360
International Journal of Veterinary Science
www.ijvets.com; editor@ijvets.com
Research Article https://doi.org/10.47278/journal.ijvs/2022.189

Community Empowerment for Prevention and Management of Rabies in Dogs in Carangsari Village, Petang District, Badung Regency, Bali, Indonesia

Ida Bagus Ngurah Swacita[1]*, I Wayan Masa Tenaya[1], I Wayan Suardana[1], Kadek Karang Agustina[1], I Made Sukada[1], Romy Muhammad Dary Mufa[1], Ida Ayu Pasti Apsari[2], Ni Made Adinda Arya Ningrum[3], Maharani Lisna Wulandari[3], Made Ade Pranartawan[3], Agatha Arai Jubilia[3], I Made Nanda Wahyudi[3] and Meiliani Herna Suprihatin[3]

[1]Department of Veterinary Public Health, The Faculty of Veterinary Medicine, Udayana University, Denpasar, Bali, Indonesia
[2]Department of Biopathology, The Faculty of Veterinary Medicine, Udayana University, Denpasar, Bali, Indonesia
[3]Faculty of Veterinary Medicine Udayana University Denpasar, Bali, Indonesia
***Corresponding author:** ibnswacita@unud.ac.id

Article History: 22-636 Received: 22-Jun-22 Revised: 03-Jul-22 Accepted: 20-Jul-22

ABSTRACT

Rabies, which was first reported in Bali in 2008, is now endemic and cannot be eradicated properly due to many related factors. An important factor in successfully eradicating this disease on the island is the full involvement of the local community. Therefore, this study aims to determine the knowledge and attitudes of the local community in controlling rabies in three out of ten randomly selected villages from the Carangsari sub-district. Although the village was previously considered a red zone, the number of rabies cases reported has greatly decreased. In this observational study, a census of all surveyed household heads on how to handle rabies was used to ensure the sustainability of local communities to carry out good practices in dealing with the disease. Three local officers were selected from each village and trained in basic knowledge related to dog management, rabies control, and animal welfare. They were then asked to conduct a survey and practice their knowledge by better controlling the local community. The collected data were analyzed qualitatively and descriptively and presented in tabular form. In the selected villages, 234 households were found, but only 74 (32.1%) kept dogs, with a total of 153 consisting of 110 locals and 43 mixed/breed dogs. Most of the villagers surveyed have general knowledge about rabies management and the application of animal welfare principles, which will be beneficial for reducing disease in the area. Furthermore, villagers' involvement is considered an important factor applicable in other places where rabies is still a problem. However, government funding for vaccines and relevant technical support is required.

Key words: Rabies, Carangsari, Animal welfare, Dogs.

INTRODUCTION

Rabies is probably the oldest recorded infection of mankind, causing an acute, progressive and nearly always fatal effect on humans and animals (Murphy et al. 2009; Fischer et al. 2013). The disease is caused by viruses in the family Rhabdoviridae, Genus Lyssavirus, that targets warm-blooded vertebrates. Dogs are one of the global reservoirs beside wild carnivores, including raccoons, foxes, skunks, mongooses, and many others. Rabies was first reported in the Southern Peninsula of Bali in November 2008. Subsequently, it spread quickly to all districts, and now it is endemic to the island (Supartika et al. 2009; Santhia and Sudiasa 2019). During the last ten years (2008-2019), over 2000 heads of dogs died due to rabies based on FAT test, although it fluctuated annually (Supartika 2020). More rabies cases were reported by the middle of 2022 due to limited vaccination during the COVID-19 outbreak. Recently, the scarcity of vaccines anti-rabies (VAR) for humans has increased the risk of fatalities (unpublished data). This condition was reported in several African and Asian countries; thus, a better strategy and evaluation are required for a better outcome (Knobel et al. 2005; Hiby et al. 2018; Utami et al. 2019).

Cite This Article as: Swacita IBN, Tenaya IWM, Suardana IW, Agustina KK, Sukada IM, Mufa RMD, Apsari IAP, Ningrum NMAA, Wulandari ML, Pranartawan MA, Jubilia AA, Wahyudi IMN and Suprihatin MH, 2023. Community empowerment for prevention and management of rabies in dogs in Carangsari Village, Petang District, Badung Regency, Bali, Indonesia. International Journal of Veterinary Science 12(2): 260-267. https://doi.org/10.47278/journal.ijvs/2022.189

Several significant strategies have been applied to control rabies, such as dogs owners' education for animal welfare, vaccination strategies, dog population management, and a local community participatory approach (Taylor et al. 2017; Utami et al. 2019; Philpotts et al. 2019; Baatz et al. 2020; Garde et al. 2022). Furthermore, combination types, parenteral, and oral vaccines were considered more effective in getting high coverage of vaccination in areas with a high stray or free-roaming dog population (Yale 2022; Lugelo et al. 2022).

Since the first rabies incidence, the Indonesian government has worked hard to protect Bali as a tourist destination. Following a significant rabies outbreak in 2010, a widespread campaign was initiated to control the spread of the virus (Balogh 2018). However, in 2014 both human and animal rabies cases increased rapidly, mainly associated with the low coverage of rabies vaccination. The FAO project was conducted in Indonesia to support government efforts for mass dog vaccinations. Furthermore, a pilot project of a comprehensive dog population management strategy worked together with government agencies, the private sector, and local stakeholders. This project aimed to develop the technical capacity for effective rabies control and to help bring its eradication campaign back on track (Balogh 2018).

Over 50,000 dogs were vaccinated through sweeping vaccination in districts and villages with high rabies incidence. This effort reduced nearly 80% of rabies cases, but a sporadic increase was reported after the project was terminated. One of the most common difficulties in handling rabies in Bali was associated with a high dog population, estimated at 500,000 heads, with the majority being free-roaming stray dogs, and the lack of animal welfare implementation (Broom 1991; Hewson 2003; Hiby et al. 2018). Cultural factors in keeping dogs, low community participation, and limitations on animal welfare were also crucial.

A study to investigate the involvement of the local community in Sanur, a sub-district of Bali Province, in handling rabies showed that most dog owners had a positive attitude in understanding animal welfare, management, and increasing coverage of vaccination leading to a significant reduction of human cases (Hiby et al. 2018; Utami et al. 2019). Therefore, this study focused on the involvement of the local community in handling rabies in the Carangsari district, with lower reported cases than other places in Bali, despite being within the rabies red zone.

MATERIALS AND METHODS

Ethical Approval

This study has been approved by the Ethical Commission of the Faculty of Veterinary Medicine Udayana University, Indonesia, with Ref. No. B/63/UN.14.2.9/PT.01.04/2022.

Location and Time of Study

This study was conducted from April to August 2022 in three out of ten villages (Banjar) randomly selected, namely Anggungan, Telugtug, and Sangut, which belonged to the Carangsari sub-district, Badung regency of Bali Province, Indonesia. These villages had quite similar demographical and geographical conditions to the others in the region. They were considered relevant as a representative of a red rabies zone due to their proximity to the monkey forest, a tourism object of Sangeh. Before the study was conducted, three local officers from each village were selected and trained in the basic knowledge associated with dog management and animal welfare. The trained officers were assigned to carry out a survey in the selected region and were expected to continuously control the local people in practicing the knowledge.

Sample Size, Sampling Techniques, and Scoring System

A total of 234 family leaders were surveyed in Br. Anggungan, Br. Telugtug, and Br. Sangut. The survey was conservatively conducted by means of a door-to-door census of all the family leaders to ascertain the community knowledge and attitudes toward dog management, handling rabies, and animal welfare. The study combined a questionnaire (n=234; CL=95%; error margin=5%) and check listing systems. The questionnaire data were assessed using scoring systems and Linkert scales. For the knowledge assessment, three points were assigned for a correct answer, while zero was assigned for wrong and uncertain answers. Similarly, in the attitude assessment, three and two points were assigned respectively for positive and negative answers. The respondents' knowledge was categorized as advanced, medium, and low, with scores of ≥ 40, 20-40, and ≤ 20, respectively, based on a maximum total score of 60. Meanwhile, the attitudes were scored in three points between 13 and 39, namely ≥ 26 for positive, 13-26 for neutral, and ≤ 13 for negative scores.

Data Analysis

The surveyed data containing relevant issues regarding the attitudes toward dog management, handling rabies, and animal welfare were manually analyzed by coding methods and demonstrated in tabular form.

RESULTS AND DISCUSSION

The three local selected officers from each village were successfully trained in understanding and implementing the basic knowledge of dog management, rabies, and animal welfare. They also conducted a successful door-to-door census of all the family leaders. Based on the designed scoring system and Likert scales associated with general knowledge ranging from 20 to 60, the respondents scored 48, indicating they had advanced knowledge regarding rabies and animal welfare. Meanwhile, their attitudes were scored 38, indicating they had favorable positive attitudes toward managing rabies.

In dealing with dog management, as shown in Table 1, only 75 of the 234 family leaders looked after dogs. Each family leader looked after two dogs with an average population of 153. Most of the villagers accounting for 83.7%, obtained their dogs from other people in the village with the main reason for keeping these animals as housekeepers and hobbies. Only 1.3% chained their dogs, while 78.4% liberated theirs naturally. Furthermore, dog owners understood the general aspect of rabies prevention, as evidenced by the fact that 89.5% of the dogs in the region had been vaccinated regularly against rabies, suggesting a coverage rate of more than 70%. Most of the local community committed and agreed to register their dogs,

Table 1: Analysis of data for dog management in the three selected villages

Variable	Br. Anggungan Total (%)	Br. Telugtug Total (%)	Br. Sangut Total (%)	Total (%)
Family leaders	56	103	75	234 (100)
Dog owners	18 (32.14)	36 (34.95)	21 (28)	75 (32.1)
Dog population	48	67	38	153
Males	37 (77.1)	59 (88)	30 (78.9)	126 (82.4)
Females	11 (22.9)	8 (11.9)	8 (21.1)	27 (17.6)
Dog races				
Local	27 (56.3)	58 (86.5)	25 (65.8)	110 (71.9)
Pure bread/mixed	21 (43.8)	9 (13.4)	13 (34.2)	43 (28.1)
Dog ages				
Adult	46 (95.8)	54 (80.6)	31 (81.6)	131 (85.6)
Puppies	2 (4.2)	13 (19.4)	7 (18.4)	22 (14.4)
Dog origins				
To buy	-	16 (23.9)	4 (10.5)	20 (13.1)
From other people	45 (93.8)	51 (76.1)	32 (84.2)	128 (83.7)
Without owner	3 (6.2)	-	2 (5.3)	5 (3.3)
Maintenance model				
Caged	3 (6.2)	1 (1.5)	-	4 (2.6)
Liberated	30 (62.5)	62 (92.5)	28 (73.7)	120 (78.4)
Tied	-	2 (2.9)	-	2 (1.3)
Keep in the yard	5 (10.)	2 (2.9)	1 (2.6)	8 (5.2)
Combination	10 (20.8)	-	9 (23.7)	19 (12.4)
Reasons for having dogs				
Culture	-	-	-	-
Housekeepers	-	7 (19.4)	-	7 (9.3)
Hobby	1 (5.6)	4 (11.1)	4 (19.1)	9 (12)
Combination	17 (94.4)	25 (69.4)	17 (80.9)	59 (78.7)

Values in parenthesis indicate percentage.

Table 2: Public attitude toward rabies

Variable	Br. Anggungan Total (%)	Br. Telugtug Total (%)	Br. Sangut Total (%)	Total (%)
Vaccination to rabies				
Vaccinated	18 (100)	53 (79.1)	36 (94.7)	107 (89.5)
Not vaccinated	-	14 (20.9)	2 (5.3)	17 (11.1)
Reporting dog bites				
Strongly agree	18 (100)	-	5 (23.8)	23 (30.7)
Agree	-	36 (100)	16 (76.2)	52 (69.3)
Disagree	-	-	-	-
Annoyed by stray dogs				
Strongly agree	-	10 (27.8)	11 (52.4)	39 (52)
Agree	18 (100)	26 (72.2)	10 (47.6)	36 (48)
Disagree	-	-	-	-
Dog elimination				
Strongly agree	-	35 (97.2)	1 (4.7)	36 (48)
Agree	18 (100)	1 (2.8)	3 (14.3)	22 (29.3)
Disagree	-	-	17 (81)	17 (22.7)
Sterilization to control dog population				
Strongly agree		35 (97.2)	11 (52.4)	64 (85.3)
Agree	18 (100)	1 (2.8)	10 (47.6)	27 (14.7)
Disagree	-	-	-	-

report any human bite cases to the local medical officers and ensure sterilization to control their populations. However, only 22% agreed to practice elimination to control the dog population and 85% strongly agreed to sterilization (Table 2).

Public knowledge in understanding the nature and serious risks of rabies was good enough, as demonstrated in Table 3. More than 70% of the respondents understood that dogs were the predominant transmitter of rabies which can be prevented by proper vaccination. Fortunately, all the respondents were aware of the need for VAR, SAR, and the immediate elimination of suspected rabid and sent the brain sample to the Disease Investigation Center of Denpasar for diagnostic using FAT, as recommended by the OIE. Regarding animal care, over 80% of the respondents had implemented basic knowledge of animal welfare. However, almost 90% did not provide good quality food, which may be associated with their limited economic capacity and knowledge (Table 4).

Table 1 shows 234 families from the three banjars in Carangsari Village. Those who keep dogs are 75 families, while those that do not are 159, accounting for 32.1% and 67.9%, respectively. The total dog population from 75 households was 153 consisting of 126 males and 27 female dogs, representing 82.4% and 17.6%, respectively. Compared with Sanur village, which consists of eight

Table 3: Public knowledge of rabies

Variable	Br. Anggungan Total (%)	Br. Telugtug Total (%)	Br. Sangut Total (%)	Total (%)
Animals targeted for rabies				
Dogs	18(100)	36(100)	21(100)	75(100)
Cats	-	-	-	-
Monkey	-	-	-	-
Rabies transmission				
Through dog bites	18(100)	35(97.2)	21(100)	74(98.7)
Unknown	-	1(2.8)	-	1(1.3)
Typical of rabid dogs				
Abnormal behavior	3(16.7)	25(69.4)	3(14.3)	31(41.3)
Aggressive	7(38.9)	2(5.6)	1(4.8)	10(13.3)
Biting things/people	7(38.9)	5(13.9)	3(14.3)	15(20)
Afraid of water	1(5.6)	3(8.3)	10(47.6)	14(18.7)
Extensive salivation	-	1(6.7)	4(19)	5(6.7)
Can rabies be prevented				
Yes	18(100)	35(97.2)	21(100)	74(98.7)
No	-	1(2.8)	-	1(1.3)
The human victim should get a vaccine anti-rabies (VAR) or serum anti-rabies (SAR)				
Yes	18(100)	36(100)	21(100)	75(100)
No	-	-	-	-
Are rabid dogs that bite human should be killed?				
Yes	18(100)	36(100)	21(100)	75(100)
No	-	-	-	-

Table 4: Knowledge in understanding Animal Welfare

Variable	Br. Anggungan Total (%)	Br. Telugtug Total (%)	Br. Sangut Total (%)	Total (%)
Understanding healthy dogs				
Yes	17 (94.4)	30 (83.3)	17 (80.9)	64 (85.3)
No	1 (5.6)	6 (16.7)	4 (19.1)	11 (14.7)
Provide Food and water for dogs				
Yes	18 (100)	36 (100)	36 (100)	75 (100)
No	-	-	-	-
Provide clean environment				
Yes	15 (83.3)	30 (83.3)	19 (90.5)	64 (85.3)
No	3 (16.7)	6 (16.7)	2 (9.5)	11 (14.7)
Provide good pen				
Yes	16 (88.9)	36 (100)	18 (85.7)	70 (93.3)
No	2 (11.1)	-	3 (14.3)	5 (6.7)
Provide good quality food				
Yes	-	-	1 (4.8)	1 (1.3)
No	18 (100)	36 (100)	20 (95.2)	74 (98.7)
Let the dogs act naturally				
Yes	14 (77.8)	36 (100)	13 (61.9)	63 (84)
No	4 (22.2)	-	8 (38.1)	12 (16)

banjars, the number of families was 1036, and those who keep dogs are 951, while 85 do not, with a percentage of 91.79 and 8.21%, respectively. The number of dogs in Sanur Village was 1962, consisting of 1036 males representing 52.80% and 926 female dogs accounting for 47.20% (unpublished data). Based on these conditions, it can be seen that people in Carangsari Village (rural) have fewer households that keep dogs than those in Sanur, with percentages of 67.9% and 91.79%, respectively. Furthermore, the differences in the interest of keeping a dog are closely related to the purpose and economic limitations. For rural areas such as Carangsari Village, the community's economic capacity is relatively lower than in Sanur, an urban area; hence, the interest in keeping dogs is lower. The purpose of raising a dog in rural areas varies greatly from being a house guard due to culture and fun/hobbies. Based on the survey results in Carangsari Village, 78.7% of dogs were kept for house guards and fun. According to Wicaksono et al. (2018), 62.4% kept dogs for hunting, a distinctive characteristic of the Sukabumi people, who are mostly hunters. Another reason to keep a dog is to guard the house and the farm, accounting for 34 and 0.7%, respectively.

The result showed that there are 110 locals and 43 purebred/mixed dogs, with percentages of 71.9 and 28.1%, respectively. Based on the type kept in Carangsari Village, 71.9% are local dogs, presumably because they are relatively easy to obtain and are often used as house guards. There were 131 adult dogs, and 22 were puppies, with percentages of 85.6% and 14.4%, respectively, judging from their age. Based on their origin, 20 tails at 13.1% were purchased, 128 at 83.7% were given to others, and 5 tails at 3.3% were obtained from other villages. Furthermore, 13.1% of people purchased dogs because of their hobbies/interests in certain breed types, especially purebred. The dogs obtained from other villages can

potentially transmit disease to those in Carangsari. Poor environmental conditions significantly affect their health; hence, those obtained outside the village should be considered. It is also important to determine whether the dog came from a village infected with a certain disease outbreak. This is important because dogs are carriers of diseases that can infect other animals and humans. According to the disease mapping conducted by Batan et al. (2014), rabies has spread to all districts and cities, covering 281 out of 722 villages. Based on this, there is a high possibility of dogs being infected with rabies from outside the village. In terms of dog keeping methods in Carangsari village, only 4 are locked up at 2.6%, 120 at 78.4% are allowed to roam, 2 tails at 1.2% are tied, 8 tails at 5.2% stay in the house/yard, and 19 tails at 12% combined all the previously mentioned method. Kakang et al. (2017) reported that dogs are kept in Denpasar City by being released and tied up, accounting for 46.77 and 53.33%, respectively. The number of released dogs in Carangsari village was more than in Denpasar, with 78.4 and 47.77%, respectively. According to Suwartama et al. (2018), 76.4% of dogs in Gianyar Regency were released, and 23.6% were tied/caged, which is still lower than in Carangsari village. Furthermore, the spread of rabies in Indonesia is closely related to the community's knowledge, awareness, participation, and behavior. According to Sindawati et al. (2021), releasing a dog allows interaction with others, which causes the quick spread of the rabies virus. In a fight between dogs, and one is infected with rabies, the healthy dog is likely to be infected (Gilang, 2015). Dogs kept outside the house are generally less familiar with their owners, making it difficult for officers to vaccinate (Utami and dan Sumiarto, 2012).

According to Kamil et al. (2004), dogs that are released throughout the day in their care have an 8.5 times greater chance of contracting rabies than those that are tied up. This is because the transmission of rabies in the field begins with the contact of rabid strayed dogs with those not properly cared for, thus allowing the bite of a rabies-positive animal. Furthermore, contact between pet dogs and others is a risk factor that significantly affects rabies transmission. In this case, the chance of contracting rabies is 12.55 times greater than in dogs with no history of contact with others (Dibia et al. 2015). According to Petersen et al. (2012), at a deer farm in Pennsylvania, USA, the rabies virus is transmitted through contact between deer and wildlife, namely raccoons and skunks. Similarly, the incidence of rabies in caged Bali cattle in the Badung Peninsula occurred due to dog bites (Faizah et al. 2012). Utami et al. (2017) reported that those kept indoors tend to have protective antibodies against rabies 3.8 times greater than dogs that roam. This may be because those who keep dogs at home generally love animals more and maintain their health by ensuring routine vaccination.

The questionnaire assesses public attitudes towards rabies using a rating system and a Likert scale. In attitude assessment, three and one points were awarded for a positive and negative answer, respectively. Attitudes were categorized into positive, neutral, and negative with scores of > 26, 13-26, and < 13, respectively, with a maximum score of 39. The analysis results based on the Likert scale showed that the attitude score of the people of Carangsari village towards rabies was 33. This indicates that they are very positive in dealing with rabies.

Table 2 shows that 137 at 89.5% dogs were vaccinated against rabies, while 17 at 11.1% dogs were not. This vaccination data is based on a survey that was last conducted in 2019. Since the Covid-19 outbreak, all regional funding to purchase anti-rabies vaccines has been directed (budget refocusing) to deal with the pandemic; hence vaccine procurement and vaccination activities were not carried out during the survey. According to Kakang et al. (2017), the number of dogs vaccinated in Denpasar City was 98.23%, which is higher than those in Carangsari village in 2019 at 89.5%. Similarly, those vaccinated in Gianyar Regency were 91.4% (Suwartama et al. 2018). Furthermore, dogs in Denpasar City and Gianyar Regency have strong herd immunity because over 70% have received the vaccination. The rabies vaccination coverage for dogs in Bali at the end of 2012 was around 76% (Putra 2012). According to Tang et al. (2014), vaccination coverage is lower or below 70%, which is a significant contributing cause of rabies outbreaks in the country. Vaccines are very necessary because they can prevent the occurrence of high morbidity and mortality from viral infections. The strategy for controlling and eradicating rabies in animals is generally carried out by vaccination activities (Putra, 2012). Rabies Transmitting Animals (HPR) that are not vaccinated are more likely to contract rabies than those that have been vaccinated (Kardiwinata et al. 2012). According to Dibia et al. (2015), dogs that are not vaccinated have a 19.13 times greater risk of being infected with rabies when compared to those that were vaccinated. In addition, unvaccinated dogs are very susceptible to rabies infection because they lack antibodies against the virus.

The 75 families in Carangsari village agreed to report dog bites in accordance with the appeal of the relevant agencies. In the case of a bite, dogs should be evaluated, and when proven that it has rabies, the bitten person must receive VAR/SAR according to the location of the bite. According to Dartini (2011), the public's indifference to the surrounding conditions, such as not reporting a suspected rabid dog or not coming to the counseling center, are obstacles to controlling rabies. The 75 families in the village agree and feel disturbed by the presence of stray dogs, and a total of 58 (77.3%) agreed to the removal of dogs, but 17 (22.7%) disagreed. The presence of stray and uninhabited dogs in the village disturbs the environment's safety, comfort, and cleanliness. These non-proprietary dogs will roam the streets, markets, cemeteries, and trash cans in search of food. The existence of public opinion that agrees with the elimination of dogs, as much as 77.3%, is a wrong attitude from the community. Due to their territorial nature, they will maintain their territory, making it difficult for dogs from other groups to enter the area. Therefore, eliminating this group will not solve the problem because the vacancy of the territory will encourage an influx of stray dogs from other places to live in the area. All residents of Carangsari, comprising 75 families, agree that dogs should be sterilized to control the population. People do not want their dogs to continue reproducing because carrying out maintenance and feeding will burden the community. For this reason, they strongly agree that dogs should not continue to give birth allowing sterilization. In contrast to

the results of Suwartama et al. (2018) in Gianyar Regency, 8.6% of dogs were neutered. Furthermore, it is feared that when the mother dog has a female puppy, it will be abandoned or disposed of by most Balinese people. The disposal can lead to the spread of rabies (Nasution 2011) because the population of stray dogs is increasing, and it is difficult to conduct vaccination.

According to the 75 families in Carangsari village, dogs are the most common animal that transmits rabies. The transmission mode is mainly through dog bites, as reported by 74 families at 98.7%, and only 1 at 1.3% did not know. Based on the response of the Carangsari Village community regarding the symptoms of rabies, 31 families (41.3%) stated changes in behavior, 10 (13.3%) said dogs became aggressive, 15 (20%) said they bit objects/people, 14 (18.7%) said they are afraid of water and 5 (6.7%) said they salivate a lot. Suartha et al. (2012) reported that some still do not know the clinical symptoms of rabies (39%). Public knowledge about rabies is highly dependent on the level of education and the sources of information. The appearance of clinical signs varies from species to species and is closely related to the disease's incubation period, which varies from 4 days to 8 weeks in dogs (Tepsumethanon et al. 2008). A total of 74 families representing 98.7%, stated that rabies could be prevented, and only 1 at 2.8% cannot be prevented. The entire community agreed that people who are bitten should be given the anti-rabies vaccine or serum, and the dogs that bite people should be killed. The questionnaire was adopted to assess public knowledge using a scoring system and the Likert scale. For the knowledge assessment, a score of three was given for the correct answer, while the wrong and doubtful answers were given zero. Respondents' knowledge was categorized as high, medium, and low, with a score of >40, 20-40, and <20, respectively, with a maximum score of 60. The knowledge of the villagers was 45, accounting for 89.78% and based on a Likert scale, indicating a high level of knowledge. According to Wicaksono et al. (2018), 51.1% of the Sukabumi community's knowledge of rabies is in the medium category; only 26.2% of the people have a good level of knowledge. However, the entire community believes that dogs that bite humans should be killed. Similarly, Wicaksono et al. (2018) found that 61.1% of the Sukabumi community immediately caught and killed the dog, but it was still smaller than the Carangsari village. Dogs attack people for various reasons, including being provoked or accidentally stepping on them, which causes the dog to get startled and bite. However, in the case of dogs with rabies, one of the clinical symptoms is biting objects/people. The community needs to report any bite case, allowing for the evaluation of such dogs for clinical signs of rabies. Those that are positive can be killed, and their brains should be examined at the Denpasar Veterinary Center, which is authorized to act as a diagnostic laboratory. Furthermore, public knowledge about rabies can be obtained from counseling conducted by government agencies or information from the mass media. Suwartama et al. (2018) stated that 89.3 and 77.1% of the residents of Gianyar Regency know the dangers of rabies and the characteristics of rabid dogs, respectively. However, this is still lower than the average knowledge about rabies in Carangsari Village, which is 89.78%. This knowledge level is low compared to Denpasar City (Kakang et al. 2017). For people who have never attended rabies education, knowledge about the dangers and characteristics of rabid dogs is obtained through information provided by neighbors and television broadcasts. This is consistent with the report of Suartha et al. (2012) that the public knows about rabies from print and electronic media. On the other hand, Utami et al. (2017) stated that the lack of intensive government socialization about rabies knowledge education may cause dog owners' ignorance of the risk posed by the disease.

Table 4 shows that there are 64 healthy dog families in Carangsari Village, and 11 do not understand, with percentages of 85.3% and 14.7%, respectively. The entire community provided food and drink for their pet dogs. In addition, 64 families at 85.3% provided a clean environment for their dogs, and the remaining 11 at 14.7% did not. A total of 70 families representing 93.3%, provided comfortable conditions, and 5 at 6.7% did not. Only 1 family representing 1.3%, provides their dog with quality food, and 74 at 98.7% only feed the rest of the household. Allowing dogs to roam freely is done by 63 families, and only 12 tie/cage their dogs, accounting for 84 and 16%, respectively. Meanwhile, it is the duty of the dog owner to implement proper animal welfare practices, such as freedom from pain, injury, disease, stress, and the freedom to exhibit natural behaviors (WSPA, 2021). The villagers' welfare practices are good at 83.33%, while the remaining 16.3% are not. Furthermore, the condition of dogs in Gianyar Regency who were fed household leftovers was 96.4%, lower than in Carangsari (Suwartama et al. 2018). About 31.76% of the dogs in Denpasar City were fed with household leftovers (Kakang et al. 2017). In addition to the assumption that dogs can find their food, the availability of poor-quality feed is closely related to the economic ability of the people to buy nutritious food. According to Murphy et al. (2009), food quality significantly affects the health status of animals. A well-maintained dog with adequate nutrition stimulates the components of the immune system to develop perfectly and function optimally. Animals with protein deficiency or deficiency of certain amino acids are more susceptible to viral infections.

According to Brown et al. (2016), one of the important components in the prevention and control of rabies is to carry out routine dog health checks. Dogs that were not evaluated for their health status have a 2.4 times greater risk of contracting rabies than those whose health is checked (Dibia et al. 2015). Dog owners in Bali still pay little attention to their pet's well-being, as seen by the time they spend feeding, bathing, and visiting the vet (Suartha et al. 2014). According to Dibia et al. (2015), dogs that are not treated have a 3.02 times greater risk of being infected with rabies than those with excellent body conditions. Generally, the condition of a well-maintained dog can stimulate the components of the immune system to develop perfectly and function optimally. The body is immune to infection when the immune system is working properly.

Over the past ten years, much effort, money, and time have been spent to control rabies in Bali; yet, the disease is still endemic in most districts, and the cases tend to increase annually. The main objective of a rabies control program in dogs is generally to get at least 70% vaccination coverage to ensure the level of immunity above the threshold protection for repeated infection (WHO 2013). The global

initiative to control and eradicate rabies in Asia by 2030 includes this target as one of its goals (Rupprecht et al. 2020).

It was somewhat difficult to get a constant 70% coverage vaccination due to geographical factors and uncertain dog population (Townsend et al. 2013; Minoungou et al. 2021; Yale et al. 2022). In contrast to previous investigations published elsewhere, the intensive community empowerment implemented in this study achieved more than 70% covered vaccination (Taylor et al. 2017; Utami et al. 2019). These results suggested that the success and important implementation of animal welfare education for dog owners in handling rabies cases in low-income countries have shown to be promising. The results are also consistent with the previous studies (Taylor et al. 2017; Utami et al. 2019; Philpotts et al. 2019; Baatz et al. 2020). In this study, the role of well-trained local officers was considered valuable to guide dog owners in implementing the necessary rabies management procedures, as reported by others (Utami et al. 2019).

The data reported here was considered more convincing since most dog owners had a favorable positive attitude toward managing rabies, 98.5% supported immunizing, and 85.3% understood that sterilization was the best way to control the dog population to increase coverage vaccination. Due to the advancement in this study and the recent availability of tools for rabies eradication under One Health capacity, dogs and other susceptible animals could potentially impact the elimination of human rabies in Bali (Acharya et al. 2020; Rupprecht et al. 2020). This approach was recommended to overcome rabies in other places in Bali province, where the highest cases have recently been reported.

Conclusion

Although there was a good correlation between the involvement of community empowerment and the reduction of rabies cases in the study area, certain attitudes need to be improved. The implementation of this method may be relevant in other places in Bali, especially at district levels where high cases are currently reported, to help eradicate rabies simultaneously.

Acknowledgment

The authors are grateful to the Chancellor, Chair of the Institute for Research and Community Service, for funding this study with contract No. B/43/UN.14.2.9/PT.01.05/ 2021. The authors are also grateful to the Head of Carangsari Village and all of its community.

Author's Contribution

All authors were actively involved in the early planning of the study, experimentation, data analysis, preparation and completion of the manuscript.

REFERENCES

Acharya KP, Acharya N, Phuyal S, Upadhyaya M and Lasee S, 2020. One-health approach: A best possible way to control rabies. One Health 10: 100161. https://doi.org/10.1016/j.onehlt.2020.100161

Baatz A, Anderson KL, Casey R, Kyle M, McMillan KM, Upjohn M and Sevenoaks H, 2020. Education as a tool for improving canine welfare: Evaluating the effect of an education workshop on attitudes to responsible dog ownership and canine welfare in a sample of key stage 2 children in the United Kingdom. Plos One 15(4): e0230832. https://doi.org/10.1371/journal.pone.0230832

Balogh KD, 2018. Strenghthening rabies eradication in Bali. Indonesia. FAO project report. FAO.ID@fao.org.

Batan IW, Yunita L, Sri M, Calvin I, Abdul AN, Nurul F, Rasdiyanah, Imam S, Herbert, Palgunadi NWL, Kardena IM, Sri KW and Suatha IK, 2014. The spatial distribution of rabid animal in Bali during 2008-2011. Jurnal Veteriner. 15(2): 205-211.

Broom DM, 1991. Animal welfare: concepts and measurement. Journal of Animal Science 69(10): 4167–4175. https://doi.org/10.2527/1991.69104167x

Brown CM, Conti L, Ettestad P, Leslie MJ, Sorhage FE and Sun B, 2016. Compendium of animal rabies prevention and control, 2016. Journal of the American Veterinary Medical Association. 239(5): 609-617. https://doi.org/10.2460/javma.248.5.505

Dartini NL, 2011. Profil imun respon terhadap rabies dan analisis genetika gen penyandi glikoprotein virus rabies isolat Bali. Thesis. Program Pascasarjana Bioteknologi Universitas Udayana, Denpasar.

Dibia IN, Sumiarto B, Susetya H, Putra AAG and Scott-Orr H, 2015. Risk factors analysis for rabies indogs in Bali. Jurnal Veteriner 16(3): 389-398.

Faizah N, Batan IW and Suatha IKS, 2012. Gambaran klinik sapi bali tertular rabies di Ungasan, Kutuh, dan Peminge. Indonesia Medicus Veterinus, 1(3): 370–384.

Fischer M, Wernike K, Freuling CM, Muller T, Aylan O, Brochier B, Cliquet F, Vazquez- Moron S, Hostnik P, Huovilainen A, Isakson M, Kooi EA, Mooney J, Turcitu M, Rasmussen TB, Revilla-Fernandez S, Sunreczak M, Fooks AR, Maston DA, Beer M and Hoffman B, 2013. A step forward in molecular diagnostic of lyssaviruses-results of a ring trial among European laboratories. Plos One 8(3): E5. https://doi.org/10.1371/journal.pone.0058372

Garde E, Marín-Vial P, Pérez GE and Sandvig EM, 2022. A review and analysis of the national dog population management program in Chile. Animals 12(3): 228. https://doi.org/10.3390/ani12030228

Gilang GIKR, 2015. Analisis dan faktor risiko yang berhubungan dengan gigitan anjing rabies di Provinsi Bali Tahun 2013. Thesis. Udayana University. Denpasar.

Hewson CJ, 2003. What is animal welfare? Common definitions and their practicalconsequences. The Canadian Veterinary Journal 44(6): 496–499. https://pubmed.ncbi.nlm.nih.gov/12839246

Hiby E, Agustina KK, Nattras Atema K, Bagus GN, Girardi J, Harfoot M, Haryono Y, Hiby L, Irawan H, Kalalo L, Purnama SG, Subrata IM, Swacita IBN, Utami NWA, Januraga PP and Wirawan DN, 2018. Dog ecology and rabies knowledge of owners and non-owners in Sanur, a Sub-District of the Indonesian island Province of Bali. Animals 8(7): 112. https://doi.org/10.3390/ani8070112

Kakang DM, Batan IW and Nindhia TS, 2017. Pemeliharaan anjing oleh masyarakat Kota Denpasar yang berkaitan dengan faktor risiko rabies. Indonesia Medicus Veterinus, 6(2): 138-152. https://doi.org/10.19087/imv.2017.6.2.138

Kamil M, Sumiarto B and Budhiarta S, 2004. Kajian kasus kontrol rabies pada anjing di Kabupaten Agam, Sumatera barat. Agrosains, 17(3): 313-320.

Kardiwinata P, Sutarga M, Subrata M and Suariyani P, 2012. Sistem pemeliharaan anjing sebagai salah satu hewan penular rabies pada penderita rabies di Provinsi Bali tahun 2011. Archive Community Health. 1(1): 50-54.

Knobel DL, Cleaveland S, Coleman PG, Fèvre EM, Meltzer MI, Miranda MEG, Shaw A, Zinsstag J and Meslin FX, 2005. Re-evaluating the burden of rabies in Africa and Asia.

Bulletin of the One Health Organization 83(5): 360-368. http://www.ncbi.nlm.nih.gov/pmc/articles/pmc2626230/

Lugelo A, Hampson K, Ferguson EA, Czupryna A, Bigambo M, Duamor CT, Kazwala R, Johnson PCD and Lankester F, 2022. Development of dog vaccination strategies to maintain herd immunity against rabies. Viruses 14: 830. https://doi.org/10.3390/v14040830

Minoungou G, Dahourou LD, Savadogo M, Tialla D, Comabari AHB, Kanyala E, Ouattara L, Kabore SA, Ouedraogo V, Taboure Y and Kere I, 2021. Surveillance of animal rabies in Burkina Faso: a retrospective laboratory data from 2008 to 2012. International Journal of Veterinary Science 10: 172-176. https://doi.org/10.47278/journal.ijvs/2021.051

Murphy FA, Gibbs EPJ, Horzinek MC and Studdert MJ, 2009. Rhabdoviridae. In: Veterinary Virology, 3rd Ed. Elsevier, pp: 429-439.

Nasution AA, 2011. Alur penyebaran rabies di Provinsi Bali secara kewilayahan (spasial). Skripsi. Denpasar: Fakultas Kedokteran Hewan Universitas Udayana, Denpasar.

Petersen BW, Tack DM, Longenberger A, Simeone A, Moll ME, Deasy MP, Blanton JD and Rupprecht CE, 2012. Rabies in captive deer, Pennsylvania, USA, 2007–2010. Emerging Infectious Diseases 18(1): 138–141. https://doi.org/10.3201%2Feid1801.111189

Philpotts I, Dillon J and Rooney N, 2019. Improving the welfare of companion dogs-is owner education the solution? Animals 9(9): 662. https://doi.org/10.3390/ani9090662

Putra AAG, 2012. Epidemiologi rabies di Bali: analisis kasus rabies pada "semi free-ranging dog" dan signifikasinya dalam siklus penularan rabies dengan pendekatan ekosistem. Buletin Veteriner, 23(78): 45-55.

Rupprecht CE, AbelaRidder B, Abila R, Amparo AC, Banyard A, Blanton J, Chanachai K, Dallmeier K, Balogh KD, Vilas VDR, Ertl H, Freuling C, Hill R, Houillon G, JakavaViljanen M, Kasemsuwan S, Léchenet J, Nel L, Panichabhongse P, Rahman SA, Tantawichien T, Vandeputte J, Viriyabancha W, Vos A, Wallace R, Yale G, Yurachai O and Mueller T, 2020. Towards rabies elimination in the Asia-Pacific region: From theory to practice. Biologicals 64: 83-95. https://doi.org/10.1016/j.biologicals.2020.01.008

Santhia K and Sudiasa W, 2019. Human rabies epidemiology in Bali, Indonesia. International Journal of Health and Medical Sciences 2(1): 7-16. https://doi.org/10.31295/ijhms.v2n1.77

Sindawati KA, Puja IK and Dharmawan INS, 2021. The role of dog population management in eradication of rabies: case study in Pejeng village, Tampaksiring district, Gianyar regency, Bali province. Buletin Veteriner Udayana 13(2): 125-136. https://doi.org/10.24843/bulvet.2021.v13.i02.p03

Suartha IN, Anthara MS, Putra IGNN, Dewi NMRK and Mahardika IGN, 2012. Public knowledge about rabies in an effort to Bali rabies free. Buletin Veteriner Udayana 4(1): 41-46.

Suartha IN, Anthara MS, Dewi NMRK, Wirata IW, Mahardika IGN, Dharmayudha AAGO and dan Sudimartini LM, 2014. Perhatian Pemilik Anjing dalam Mendukung Bali Bebas Rabies. Buletin Veteriner Udayana. 6(1): 87-91.

Supartika IKE, 2020. Repot on rabies surveilan in Bali. Disease Investigation Center Denpasar 2020.

Supartika IKE, Setiaji G, Wirata K, Hartawan DHW, Putra AGG, Dharma DMN, Soegiarto and Djusa ER, 2009. The first rabies case in Bali Province (Kasus rabies pertama kali di Provinsi Bali). Buletin Veteriner BBVet Denpasar 21: 7-12.

Suwartama B, Batan IW and Agustina KK, 2018. Sistem pemeliharaan anjing dan tingkat pemahaman rabies masyarakat desa yang belum tertular rabies di Kabupaten Gianyar. Indonesia Medicus Veterinus 7(3): 219-233. https://doi.org/10.19087/imv.2018.7.3.219

Tang HB, Pan Y, Wei XK, Lu ZL, Lu W, Yang J, He XX, Xie LJ, Zeng L, Zheng LF, Xiong Y, Minamoto N and Luo TR, 2014. Re-emergence of Rabies in the Guangxi Province of Southern China. PLOS Neglected Tropical Diseases 8(10): e3114. https://doi.org/10.1371/journal.pntd.0003114

Taylor LH, Wallace RM, Balaram D, Lindenmayer JM, Eckery DC, Mutonono-Watkiss B, Parravani E and Nel LH, 2017. The role of dog population management in rabies elimination-a review of current approaches and future opportunities. Frontiers in Veterinary Science 4: 109. https://doi.org/10.3389/fvets.2017.00109

Tepsumethanon V, Wilde H and Sitprija V, 2008. Ten-day observation of live rabies suspected dogs. Developments in Biologicals. 131: 543-546. PMID: 18634517

Townsend SE, Sumantra IP, Pudjiatmoko, Bagus GN, Brum E, Cleaveland S, Crafter S, Dewi APM, Dharma DMN, Dushoff J, Girardi J, Gunata IK, Hiby EF, Kalalo C, Knobel DL, Mardiana IW, Putra AAG, Schoonman L, Scott–Orr H, Shand M, Sukanadi IW, Suseno PP, Haydon DT and Hampson K, 2013. Designing programs for eliminating canine rabies from islands: Bali, Indonesia as a case study. Plos Neglected Tropical Diseases 7(8): e2372. https://doi.org/10.1371%2Fjournal.pntd.0002372

Utami NWA, Subrata IM, Purnama SG, Swacita IBN, Agustina KK and Wirawan DN, 2017. Model penanggulangan rabies berbasis desa dan dampaknya pada populasi anjing liar di Sanur. Proceedings Senastek, Kuta, 15-16 December 2017. Pp. 180-188.

Utami NWA, Agustina KK, Atema KN, Bagus GN, Girardi J, Harfoot M, Haryono Y, Hiby L, Irawan H, Januraga PP, Kalalo L, Purnama SG, Subrata IM, Swacita IBN, Swarayana IMI, Wirawan DN and Hiby E, 2019. Evaluation of community-based dog welfare and rabies project in Sanur, a Sub-district of the Indonesian Island Province of Bali. Frontiers in Veterinary Science 6: 193. https://doi.org/10.3389/fvets.2019.00193

Utami S and Sumiarto B, 2012. Tingkat dan faktor risiko kekebalan protektif terhadap rabies pada anjing di Kota Makassar. Jurnal Veteriner 13(1): 77-85.

WHO, 2013. Expert consultation on rabies, second report. WHO Technical Report Series 982. http://apps.who.int/iris/bitstream/10665/85346/1/9789240690943_eng.pdf (Accessed date 5 November 2021)

Wicaksono A, Ilyas AZ, Sudarnika E, Lukman DW and Ridwan Y, 2018. Pengetahuan, sikap, dan praktik pemilik anjing terkait rabies di Kabupaten Sukabumi, Jawa Barat. Jurnal Veteriner 19(2): 230-241. https://doi.org/10.19087/jveteriner.2018.19.2.230

WSPA, 2021. Five freedoms of animal welfare. World Society for Protection of Animals. (https://www.worldanimalprotection.us/blogs/five-domains-vs-five-freedoms-animal-welfare (Accessed date 5 November 2021)

Yale G, Lopes M, Isloor S, Head JR, Mazeri S, Gamble L, Dukpa K, Gongal G and Gibson AD, 2022. Review of oral rabies vaccination of dogs and its application in India. Viruses14(1): 155. https://doi.org/10.3390/v14010155