PREVALENCE AND RISK FACTORS OF HOOKWORMS INFECTION ON DOGS IN SUKABUMI REGENCY, WEST JAVA PROVINCE, INDONESIA

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ABSTRACT

A cross sectional study to estimate the prevalence and to identify risk factors of hookworms infection on dogs was conducted in rural area with different topography, Sukabumi Regency, Indonesia. A total of 204 dog stool specimens were examined for hookworm eggs using simple flotation methods. The data of related risk factors namely type of topography area (high and low land), purpose of having dog, dog demography, dog reared management and deworming were collected through dog owners interview’s with completed a questionnaire. Those data were analyzed using the chi-square test (χ²) and logistic regression. The prevalence of hookworm on dogs in Sukabumi was 24.5 % (95% confidence interval [CI]= 19.1-30.8). This prevalence was associated with topography of the area, the age of dog, and type of dog keeping methods. The prevalence of hookworms was higher in the high land area than low land area (OR= 5.935, 95% CI= 2.764-12.744). Logistic regression identified puppies as a high risk group to hookworms infection (OR= 2.041, 95% CI= 1.035-4.055). The dog which kept in the cage/heid had higher risk than free roaming dog (OR= 3.66, 95% CI= 1.479-9.091).

Key words: dog, hookworms, prevalence, risk factors, Sukabumi

INTRODUCTION

Hookworms are parasitic intestinal nematodes of most mammals including dogs, cats, and man. They are equipped with the hooks in buccal capsule, which have function in attaching to intestine mucosal surface and sucking the blood of definitive host as their nutrition. Infection of hookworm can cause anemia as result of loss of iron and protein of gut (Selian et al., 2013). Clinical sign and the severe infection is affected by the intensity of the infection. The hookworms infection can cause bloody diary, mucosa pale, and lost of body weight (Brunet et al., 2015; Indriyati and Sembiring, 2018). Hookworm disease in cats and dogs can result in anemia, and can be fatal leading to dead in high infection (Traversa, 2012).

Beside the effect on the health of dog and cat, hookworms is known also as zoonotic parasite. Dog and cat hookworm such as Ancylostoma caninum or Ancylostoma brasiliense can cause the disease called cutaneous larval migrans on human due to frequent contact between human and pets (Takely et al., 2013). Animal hookworm larvae can penetrate the human epidermis and migrate extensively within the skin resulting in a highly pruritic but self-limited disease called cutaneous larva migrans. However, the larvae of most species of hookworms could not migrate to dermis, and remain trapped in the skin. Besides causing cutaneous larva migrans, another species of canids and felids hookworm namely Ankylostoma ceylanicum has been found as a common patent enteric infection of human in Southeast Asia (Mahdy et al., 2012; Traub, 2013; Brunet et al., 2015). Migrated A. caninum to the intestine can result a painful intestinal disorder, bloody diarrhea, and weight loss (Brunet et al., 2015).

Considering the effect of hookworms infection on dog and cat and also on human, therefore the control measurement is very suggested to minimize the lost. Hookworms control in dog expected to reduce risk factor of hookworms infection on animals and human. Control program development required the information of risk factor acquiring the infection. Currently, the information about the prevalence and risk factor of hookworms infections in regional and rural areas in Indonesia is very limited. The purpose of this study was to determine the prevalence and related factors to

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hookworms infection in dogs in two subdistrict in Sukabumi Regency, West Java Province, Indonesia.

**MATERIALS AND METHODS**

**Study site**

A crossectional study was conducted at Sukabumi Regency, West Java Indonesia. Sukabumi is located at 70-25’ LS and 60-57’ LU. Topography of Sukabumi Regency is divided into two region namely mountainous and coastal. The study was conducted in two sub districts namely Jampang Tengah representing mountainous region and Cisolok representing coastal region. Jampang Tengah is located east of Sukabumi Regency while Cisolok is located northwest of Sukabumi Regency.

**Sample size**

Sample size was determined based on Dohoo et al. (2003) with the assumption of 95% confident interval, 50% expected prevalence regarding the absence of published data on the prevalence of hookworms infections in dogs in Indonesia, and 5% error. From the formula, a total of 204 dogs were sampled.

**Selection of dog and sampling**

Dogs were selected with multi stage random sampling based on sub district, village, sub village. Community whose dogs’ owners were available at the time of sampling and let their dogs sampled. The dogs were classified according to the purpose for which they were kept, namely companionship, security, hunting dogs and selling. A hunting dog was one that was actively involved in hunting at the time of the study. The dog’s health status was classified as apparently healthy if it did not exhibit any clinical signs of illness at the time of sampling. Demographic characteristics of the dogs including age and sex were assessed. Dogs aged one year and below were considered as puppies and above one year as adults.

**Parasitological examination**

Stoll samples were obtained directly from the rectum of each dog, with a cotton swab, once they were restrained. The number of 204 stool samples were collected and transported in a cool box to the laboratory. Coprological examination were performed using the simple flotation methods described in the MAFF manual (1986). Microscopic examination was conducted for presence of hookworm eggs. Identification of hookworm eggs was done according to the morphological characteristics and keys as outlined by MAFF (1986).

**Management practices survey**

The data of dog rearing management, including as purpose of dog rearing, dog demography, type of housing and deworming was obtained through the administration of a questionnaire to 192 dog owners who consented to be interviewed. The questionnaire was focused on management practices such as feeding, housing, helminths control and awareness of parasitic zoonosis from dogs to man. The dog owners’ demographics and level of education were also assessed.

**Data analysis**

The data of laboratory examination results, dog rearing management, dog demography, and deworming were managed and entered using excel program. The data was analyzed to obtain descriptive and analytical statistics. Categorical variables, such as purpose of dog rearing, dog demography, type of housing and deworming were compared the hookworms prevalent using chi-square test while logistic regression was used to estimate odds ratio to determine risk factor of hookworms infection.

**Ethical issue**

Permission was obtained from the Veterinary Services of Sukabumi Regency and West Java Province. Stoll samples were collected under supervision of veterinarian. Individual consent was obtained from the dog owners prior to sample taking on their dogs and administration of the questionnaires.

**RESULTS AND DISCUSSION**

Majority of respondent (68.75%) in Sukabumi had dog for hunting and some of respondents (28.12%) had dogs as home guard (Table 1). Only small proportion of respondents kept dog as a pet (1.5%) and as commodity of trading (1.04) while rest of respondent kept dog for other reasons. In general dogs in Sukabumi are free

| Characteristic                  | Number (n) | Total number (N) | Percentage (%) |
|-------------------------------|------------|-----------------|----------------|
| Purpose having the dog        |            |                 |                |
| Pet                           | 3          | 192             | 1.50           |
| House guard                   | 54         | 192             | 28.12          |
| Hunting                       | 132        | 192             | 68.75          |
| Trade                         | 2          | 192             | 1.04           |
| Other                         | 1          | 192             | 0.59           |
| Rearing model                 |            |                 |                |
| Free roaming                  | 170        | 192             | 88.50          |
| Cage/tied                     | 22         | 192             | 11.50          |
| Deworming                     |            |                 |                |
| No                            | 160        | 192             | 83.33          |
| Yes                           | 32         | 192             | 16.67          |
roaming dogs (88.5%) and only small number of respondents (11.5%) kept their dogs in the cage or tied around the house. Most of the people (80.33%) in Sukabumi did not deworm the dogs, only small number respondent (16.67) dewormed their dogs.

A total of 204 dogs stool samples were analyzed by microscopy for the presence of hookworms parasites. Of these samples, 50 samples were positive to hookworms with an overall prevalence of 24.5 % (95%, CI: 19.1-30.8). With regard to topography area, the infection was more frequent in mountainous area (Jampang Tengah) than coastal area (Cisolok) (Table 2). Based on sex, there was no significant difference (P>0.05) in prevalence between male and female dogs. In relation to age, the frequency of hookworm in puppies (29.9%) was significantly higher (P<0.05) than in adult dogs (17.24%). The prevalence of hookworms based on the purpose of raising the dog showed that the highest prevalence was in dogs kept as pet followed by dog kept for selling, dog for hunting, and dog for house guard (Table 3), however these prevalence were not significantly difference (P>0.05). The prevalence of hookworms infection was higher in dogs kept in the cage or tied (50%, 11/22) than in free roaming dogs (21.4%, 39/182) (P<0.05).

The prevalence of dog hookworms parasite (24.5%) obtained in this study is lower from that previously reported in other part of Indonesia. The prevalence of helminth infection depends on geography, host, rearing management, and behaviour (Selian et al., 2013). Akhira et al. (2013) reported higher hookworms infection (47.14%) in hunting dogs in the Subdistrict of Lareh Sag Halaban, West Sumatera. The other research reported higher prevalence of dog hookworms in Bali was 34% (Dharma et al., 2017), 92.31% in Yogyakarta, 88.64% Central Java and 92.5 in West Java (Erawan et al., 2016).

This prevalence of hookworms infection in Sukabumi Regency was associated with topography of the area, the age of dog, and type of dog keeping methods (Tabel 4). The prevalence of hookworms was higher in the mountainous region than coastal region (OR= 5.935, 95% CI= 2.764-12.744). Logistic regression analyses showed that puppies have highest risk to hookworm infection (OR= 2.041, 95% CI= 1.035-4.055). Keeping dog in cage or tied was risk to hookworm infection. The dog kept in the cage/tied had higher risk than free roaming dog (OR= 3.66, 95% CI= 1.479-9.091).

The study showed that the dogs of mountainous area have higher prevalence of hookworm infection compared to those of the coastal area. The dogs reared in mountainous area have risk 5.935 times to hookworms infection compared to the dogs in the coastal area. These results are in agreement with Raza et al. (2018) research that showed dogs raised in moderate temperature and high humidity have more frequently infected with hookworms as a result of optimum development of pre parasitic stages. Environmental condition such as temperature and humidity, sun light, rain fall, soil type and altitude have impact on the development of pre parasitic stage and transmission of hookworms (Ndokeji et al., 2016). Favorable environment support the development hookworms egg that passed along with the feces of the host to hatch and develop into rhabditiform larvae and reach infective stage ($L_3$). Mountainous region with covering of tree, warm, moist temperatures between 20 and 30 C provide favorable environment for development of hookworm eggs to infective stage (Hossain and Bhuiyan, 2016). Hookworms eggs may develop optimally, hach and reach $L_3$ on the moist soil shielded from direct sunlight and temperatures between 20 and 30 C such as in mountainous area. On the other hand, the hookworms eggs will fail to develop to infective stage at temperatures of less than 13 C. The hookworms larvae are also susceptible to freeze, dry, direct sunlight, and temperature above 45 C (Menelaos and Smaragda, 2006).

This research showed that the hookworms infection influenced by age of dogs. The younger dogs less than one year old were more susceptible compared to the older ones. The prevalence of hookworms infection was higher on the dogs less than one year old compared to the dogs above one year old. Similar result were reported in some countries such as Bangladesh (Shubhagata, 2012), Ethiopia (Endrias et al., 2010), and Brazil (Muradian et al., 2005) which supported this result research that ancylostomiasis was higher in dog with less one year old. The higher prevalence of hookworms infection in young dogs may be related to the transplacental and trans mammary infection routes in puppies (Bowman, 2013). The other factor contributes in hookworms infection are related to weak immunity of young dogs compared to older dogs. Furthermore, the older dogs have acquired immunity from previous infection especially in endemic areas.

This result also showed that keeping dog in cage or tied had more risk to hookworm infection compared to free roaming dog. The dog which kept in the cage/tied had 3.66 higher risk than free roaming dog to hookworm infection. This result was the opposite with other research, which showed that free roaming dog has higher risk to helminth infection (Mahdy et al., 2012). The difference in this research result is probably related to poor sanitation. The dog reared in the cage/tied in poor sanitation will be easier to be reinfected if their feces is not regularly removed. The hookworm eggs passed along with the feces of the dog contaminate the cage and develop in to infective stage in the feses. The infective larvae crawl out of the feces and reinfect the dogs.

The other factor which has potential influence to hookworms infection is deworming. The data showed that the prevalence hookworms infection was higher in untreated than treated dogs, however the difference was not significant. This condition was probably due to anthelmintic treatment not regularly, therefore reinfection still occurred. Based on the interview to dog owners showed that the owner deworm their dog in irregular treatment or if supported by government. In general it is suggested that the dogs live outdoors and have direct contact with parks, sandpits, playgrounds,
and other dogs should be regularly treated with anthelmintic at least four times a year to helminth control (ESCCAP, 2020). The present study showed that the prevalence of hookworms in dog in the urban area of Sukabumi district was relatively high. The presence of infected dogs with hookworms will put community health in that area at risk since hookworms are zoonotic. Hookworms infection in dogs can be controlled with regular anthelmintic treatment. Beside that as an important measure for the control of canine intestinal parasites is awareness of community particularly the owners. The dog owner should have responsibility to keep their animals in good condition and free from diseases. Therefore, it is needed that the government to have a program in improving knowledge, attitude and practice in keeping a animal. A consistent program of sanitary education must be included in public health government actions as a first step for the control of hookworm parasite in dogs. Regulation for limitation of free roaming dog as well as control of wild dog are also important in hookworms control.

Table 2. The prevalence of hookworms on dogs based on topography area and dog demography

| Risk factors          | N   | Hookworms infection | Chi-square |          |          |
|-----------------------|-----|---------------------|------------|----------|----------|
|                       |     | Infected            |            |          |          |
|                       |     | n (dog) | %     | not infected | n (dog) | %     | X² | P  |
| Topography            |     |          |        |            |          |        |    |    |
| Jampang Tengah        | 102 | 40       | 39.22 | 62         | 60.7    | 23.844| 0.000*|
| Cisolok               | 102 | 10       | 9.80  | 92         | 90.20   | 0.649 | 0.420|
| Sex                   |     |          |        |            |          |        |    |    |
| Male                  | 136 | 31       | 22.79 | 105        | 77.21   | 0.469 | 0.420|
| Female                | 68  | 19       | 27.94 | 49         | 72.06   | 0.469 | 0.420|
| Age                   |     |          |        |            |          |        |    |    |
| Puppies               | 117 | 35       | 29.91 | 82         | 70.09   | 4.331 | 0.037*|
| Adult                 | 87  | 15       | 17.24 | 72         | 82.76   | 4.331 | 0.037*|

* = Significant difference (P<0.05)

Table 3. The prevalence of hookworms on dogs based on the rearing management

| Risk factors                        | N   | Hookworms infection | Chi-square |          |          |
|-------------------------------------|-----|---------------------|------------|----------|----------|
|                                     |     | Infected            |            |          |          |
|                                     |     | n (dog) | %     | not infected | n (dog) | %     | X² | P  |
| Purpose of dog raising              |     |          |        |            |          |        |    |    |
| Pet animal                          | 3   | 2       | 66.67 | 1          | 33.33   | 6.95  | 0.138|
| Home guard                          | 60  | 13      | 21.67 | 47         | 78.33   | 0.649 | 0.420|
| Hunting                             | 138 | 33      | 23.91 | 105        | 76.09   | 0.469 | 0.420|
| Selling                             | 2   | 1       | 50.00 | 1          | 50.00   | 0.469 | 0.420|
| Other                               | 1   | 1       | 100.00| 0          | 0.00    | 0.469 | 0.420|
| The method of dog keeping           |     |          |        |            |          |        |    |    |
| Free roaming                        | 182 | 39      | 21.43 | 143        | 78.57   | 8.666 | 0.003*|
| Cage/tied                           | 22  | 11      | 50.00 | 11         | 50.00   | 8.666 | 0.003*|
| Presence of stray dog               |     |          |        |            |          |        |    |    |
| No                                  | 105 | 31      | 29.52 | 74         | 70.48   | 2.94  | 0.086|
| Yes                                 | 99  | 19      | 19.19 | 80         | 80.81   | 2.94  | 0.086|
| Contact with stray dog              |     |          |        |            |          |        |    |    |
| No                                  | 24  | 6       | 25.00 | 18         | 75.00   | 0.689 | 0.469|
| Yes                                 | 75  | 13      | 17.33 | 62         | 82.66   | 0.689 | 0.469|
| Cat raising                         |     |          |        |            |          |        |    |    |
| No                                  | 146 | 35      | 23.97 | 111        | 76.03   | 0.08  | 0.77 |
| Yes                                 | 58  | 15      | 25.86 | 43         | 74.14   | 0.08  | 0.77 |
| Anthelmintic treatment              |     |          |        |            |          |        |    |    |
| No                                  | 33  | 7       | 21.21 | 26         | 78.79   | 0.231 | 0.630|
| Yes                                 | 171 | 43      | 25.15 | 128        | 74.85   | 0.231 | 0.630|

* = Significant difference (P<0.05)

Table 4. Risk factor of hookworm infection on dogs in Sukabumi Regency

| Risk factors                        | N   | Positive hookworm | Chi-square | OR (95% CI) |
|-------------------------------------|-----|-------------------|------------|-------------|
|                                     |     | n (dog) | %     | X² | P  |          |
| Location                            |     |          |        |    |    |          |
| Jampang Tengah                      | 102 | 40      | 39.21 | 23.844| 0.000*| 5.935 (2.764-2.744) |
| Cisolok                             | 102 | 10      | 9.62  | 9.62  | 0.389 | 0.500 (0.244-0.921)  |
| Age                                 |     |          |        |    |    |          |
| Puppies                             | 117 | 35      | 29.91 | 4.331 | 0.037*| 2.041 (1.035-4.055) |
| Adult                               | 87  | 15      | 17.24 | 17.24 | 0.254 | 1.000 (0.591-1.777)  |
| The method of dog keeping           |     |          |        |    |    |          |
| Free roaming                        | 182 | 39      | 21.43 | 8.666 | 0.003*| 3.660 (1.4799-9.091) |
| Cage/tied                           | 22  | 11      | 50.00 | 50.00 | 0.000 | 1.000 (0.591-1.777)  |

* = Significant difference (P<0.05)
CONCLUSION

The prevalence of hookworms infection in Sukabumi Regency was 20.83%. This prevalence was associated with topography of the area, the age of dog, and type of dog keeping methods. Hookworms infection was higher in the mountainous area than coastal area. Logistic regression analyses showed that puppies have highest risk to hookworm infection. Keeping dog in cage or tied has higher risk to hookworm infection than free roaming dog. This study showed the importance of the owner care taking for their dog, including sanitation practices and anthelmintic administration to avoid dog hookworm infection.

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