

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

Yusuf Ridwan^{1*}, Ardilasunu Wicaksono², Siti Vanessa Fransiska³, and Princesse Theresa³

¹Division of Parasitology and Medical Entomology, Department of Animal Infectious Diseases and Veterinary Public Health, Faculty of Veterinary Medicine, IPB University, Bogor, Indonesia

²Division of Veterinary Public Health and Epidemiology, Department of Animal Infectious Diseases and Veterinary Public Health, Faculty of Veterinary Medicine, IPB University, Bogor, Indonesia

³Veterinary Study Program, Faculty of Veterinary Medicine, IPB University, Bogor, Indonesia

*Corresponding author: yusufridwan67@yahoo.com

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 (χ^2) 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/tied had higher risk than free roaming dog (OR= 3.66, 95% CI= 1.479-9.091).

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

ABSTRAK

Penelitian ini bertujuan mengetahui prevalensi dan mengidentifikasi faktor risiko infeksi hookworm pada anjing di daerah pedesaan dengan topografi yang berbeda di kabupaten Sukabumi. Sebanyak 204 spesimen feses anjing dikoleksi dan diperiksa terhadap adanya telur hookworm menggunakan metode pengapungan sederhana. Data faktor risiko berkaitan dengan perbedaan topografi (dataran tinggi dan rendah), tujuan memiliki anjing, demografi anjing, manajemen pemeliharaan anjing, dan pemberian obat anti cacing diperoleh melalui wawancara dengan pemilik anjing dengan mengisi kuesioner. Data yang diperoleh dianalisis dengan chi-square test (χ^2) dan logistic regression. Prevalensi hookworm pada anjing di Sukabumi adalah 24,5% (95% confidence interval [CI]= 19,1-30,8). Prevalensi hookworm dipengaruhi oleh topografi, umur anjing, dan manajemen pemeliharaan anjing. Prevalensi hookworm lebih tinggi di daerah dataran tinggi dibandingkan dataran rendah (OR= 5,935; 95% CI= 2,764-12,744). Hasil analisis menunjukkan anak anjing sebagai kelompok berisiko tinggi terinfeksi hookworm (OR= 2,041; 95% CI= 1,035-4,055). Anjing yang dipelihara di kandang atau diikat memiliki risiko lebih tinggi dari pada anjing yang dilelarkan (OR= 3,66; 95% CI= 1,479-9,091).

Kata kunci: anjing, faktor risiko, hookworm, prevalensi, 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 *Ancylostoma 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

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

MATERIALS AND METHODS

Study site

A cross-sectional 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 regions 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% confidence interval, 50% expected prevalence regarding the absence of published data on the prevalence of hookworm 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

Stool 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. Stool 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

Table 1. Characteristic of dog rearing in Sukabumi Regency

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 frequency 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 ones (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 Sago 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, hatch 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 feces. 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,

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

Risk factors	N	Hookworms infection				Chi-square	
		Infected		Not infected		χ^2	P
		n (dog)	%	n (dog)	%		
Topography							
Jampang Tengah	102	40	39.22	62	60.7	23.844	0.000*
Cisolok	102	10	9.80	92	90.20		
Sex							
Male	136	31	22.79	105	77.21	0.649	0.420
Female	68	19	27.94	49	72.06		
Age							
Puppies	117	35	29.91	82	70.09	4.331	0.037*
Adult	87	15	17.24	72	82.76		

* = 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		Not infected		χ^2	P
		n	%	n	%		
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		
Hunting	138	33	23.91	105	76.09		
Selling	2	1	50.00	1	50.00		
Other	1	1	100.00	0	0.00		
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		
Presence of stray dog							
No	105	31	29.52	74	70.48	2.94	0.086
Yes	99	19	19.19	80	80.81		
Contact with stray dog							
No	24	6	25.00	18	75.00	0.689	0.46
Yes	75	13	17.33	62	82.66		
Cat raising							
No	146	35	23.97	111	76.03	0.08	0.77
Yes	58	15	25.86	43	74.14		
Anthelmintic treatment							
No	33	7	21.21	26	78.79	0.231	0.630
Yes	171	43	25.15	128	74.85		

* = 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	%	χ^2	P	
Location						
Jampang Tengah	102	40	39.21	23.844	0.000*	5.935 (2.764-2.744)
Cisolok	102	10	9.62			
Age						
Puppies	117	35	29.91	4.331	0.037*	2.041 (1.035-4.055)
Adult	87	15	17.24			
The method of dog keeping						
Free roaming	182	39	21.43	8.666	0.003*	3.660 (1.479-9.091)
Cage/tied	22	11	50.00			

* = significant difference (P<0.05)

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 dog 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 an 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.

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.

ACKNOWLEDGEMENT

We gratefully thank to the General of Higher Education, Ministry of Research and Technology and Higher Education for Research grand. We are also thanks to Sukabumi Livestock Services and West Java Province Livestock Services for permission and technically supporting.

REFERENCES

- Akhira, D., Y. Fahrimal, and M. Hasan. 2013. Identifikasi parasit nematoda saluran pencernaan anjing pemburu (*Canis familiaris*) di Kecamatan Lareh Sago Halaban Provinsi Sumatera Barat. **J. Med. Vet.** 7(1):42-45.
- Bowman, D.D. 2013. **Georgis' Parasitology for Veterinarians**. 10th ed. WB Saunders Company, Philadelphia.
- Brunet, J., J.P. Lemoine, N. Levebvre, J. Denis, A.W. Pfaff, A. Abou-Bacar, R.J. Traub, B. Pesson, and E. Candolfi. 2015. Bloody diarrhea associated with hookworm infection in traveler returning to France from Myanmar. **Emerg. Infect. Dis.** 10(21):1878-1879.
- Dharma, I.P.P.N., I.B.M. Oka, and N.S. Dharmawan. 2017. Prevalensi infeksi cacing *Ancylostoma spp.* pada anjing di kawasan wisata di Bali. **Indonesia Medicus Veterinus**. 6(3):230-237.
- Dohoo, I., W. Martin, and H. Stryhn. 2003. **Veterinary Epidemiologic Research**. AVC Inc. Prince Edward Island, Canada.
- Endrias, Z., Y. Semahegn, and B. Mekibib. 2010. Prevalence of helminth parasites of dogs and owners awareness about zoonotic parasites in Ambo Town, central Ethiopia. **Ethiopian. Vet. J.** 14(2):17-30.
- Erawan, I.G.M.K., S.K. Widyastuti, and I.N. Suartha. 2016. Prevalence and intensity of infection of *Ancylostoma* spp. in dogs in Java. **Indonesia Medicus Veterinus**. 5(2):175-181.
- ESCCAP. European Scientific Counsel Companion Animal Parasites. 2017. **Worm Control in Dogs and Cats**. ESCCAP Guideline 01 Sixth Edition-February 2020. Worcestershire, WR14 3SZ, United Kingdom.
- Hossain, M. and J.U. Bhuiyan. 2016. Hookworm infection: A neglected tropical disease of mankind. **J. Adv. Vet. Anim. Res.** 3(4):297-320.
- Indriyati, L. and W.S.R.G. Sembiring. 2018. Pengaruh infeksi hookworm terhadap kadar hemoglobin penambang intan. **J. Health Epidemiol. Commun Dis.** 4(1):1-6.
- MAFF. Ministry of Agriculture Fisheries and Food. 1986. **Manual of Veterinari Parasitology Laboratory Techniques**. 3rd ed, Ministry of Agriculture Fisheries and Food-UK. HerMajesty's Stationary office, London, UK.
- Mahdy, M.A.K., Y.A.L. Lim, R. Ngui, M.R. Siti Fatimah, S.H. Choy, N.J. Yap, H.M. Al-Mekhlafi, J. Ibrahim, and J. Surin. 2012. Prevalence and zoonotic potential of canine hookworms in Malaysia. **Parasit. Vectors**. Doi: 10.1186/1756-3305-5-88.
- Menelaos, L.A. and K.E. Smaragda. 2006. Prevalence of hookworm parasites in dog from the area of Thessaloniki and their zoonotic importance. **Buletin USAMV-CN**. 63:297-230.
- Muradian, V., S.M. Gennari, L.T. Glickman, and S.R. Pinheiro. 2005. Epidemiological aspects of visceral larva migrans in children living at São Remo Community, São Paulo SP, Brazil. **Vet. Parasitol.** 134(1-2):93-97.
- Ndokeji, S., H.D. Mazigo, M. Temu, C. Kishamawe, W. Malenganisho, J. Todd, and J. Chagalucha. 2016. Prevalence and intensity of *Schistosoma mansoni* and hookworm infections among pre-school and school-aged children in Ilemela District, north-western Tanzania. **Tanzan. J. Health Res.** 18(2). Doi.org/10.4314/thrb.v18i2.
- Raza, A., J. Rand, A.G. Qamar, A. Jabbar, and S. Kopp. 2018. Gastrointestinal parasites in shelter dogs: occurrence, pathology, treatment and risk to shelterworkers. **Animals**. 8(7):1-23.
- Selian, R.M., M. Hanafiah, and R. Erdiansyah. 2013. Identifikasi parasit gastrointestinal pada feses orangutan sumatera (*Pongo abelii*) semi liar di kawasan Cagar Alam Pinus Jantho Kabupaten Aceh Besar. **J. Edukasi dan Sains Biologi**. 2(1):26-32.
- Shubhagata, D.A.S., M.A. Alim, S. Sikder, A.D. Gupta, and M. Masuduzzaman. 2012. Prevalence and worm load of enteric helminthiasis in stray dogs of Chittagong Metropolitan, Bangladesh. **Ankara Univ. Eczacilik Fak. Derg.** 23(3):141-145.
- Takely, E., B. Szostakiewicz, B. Wawrzycki, G. Kądziała-Wypyska, M. Juskiewicz-Borowiec, A. Pietrzak, and G. Chodorowska. 2013. Cutaneous larva migrans syndrome: a case report. **Postepy. Dermatol. Alergol.** 30(2):119-121.
- Traversa, D. 2012. Pet roundworms and hookworms: a continuing need for global worming. **Parasit. Vectors**. 5:1-19.
- Traub, R.J. 2013. *Ancylostoma ceylanicum*, a re-emerging but neglected parasitic zoonosis. **Int. J. Parasitol.** 43(12-13):1009-1015.