

A Questionnaire Survey of Living Environments of House Dogs and Measures Taken by Dog Owners to Prevent Zoonotic Parasite, *Dirofilaria Immitis* Infection in Nagasaki City, Japan

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Abstract To examine the role of living environments of domestic dogs and the measures taken by dogs owners to protect their dogs in the prevention of *Dirofilaria immitis* infection, we carried out a questionnaire survey in Tomachi (from the southern part of Nagasaki City) and Sakamoto, Takao and Yamazato (from the northern part of the same city) in 1989 (for 320 dog owners) and 1993 (for 397 owners). The percentage of dog owners who answered to the questionnaire was 65.9% in 1989 and 55.9% in 1993. In the northern 3 districts where positive rates the percentage of larvae-carrying dogs were low, dogs were often kept indoors. In the southern district (Tomachi) where the positive rate was high, dogs were often kept outdoors (in the yard). The high percentage of dogs kept outdoors in Tomachi seems to have increased the exposure of dogs to main vector mosquito, *Cx. p. pallens*. In all districts, mosquito-repellent coils were most frequently used as a means to control mosquitoes. The percentage of dog owners who used preventive drugs tended to be low.

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Key words: *Dirofilaria immitis*, House dog, Zoonotic parasite

Introduction

We (Oda *et al.*, 1993, 1994) reported that the positive rate of dogs (the percentage of house dogs having the larvae of *Dirofilaria immitis*) increased from the 1968 survey to the 1983 survey in the eastern, western and southern parts of Nagasaki City, and that this percentage decreased during the same period in the northern part of the same city. We assumed that the decrease in this infection rate in the northern part of Nagasaki City is attributable to: (1) a decrease in the number of *Culex pipiens pallens* (*Cx. p. pallens*; mosquitoes which are a main vector of *Dirofilaria immitis*) in this area following the development of public sewage systems, and the reform in the use of roads and open roadside ditches which reduced the sites of

origin of this species of mosquito; and (2) a decrease in the population density of house dogs. Two other possible factors which may be associated with this decrease in the positive rate (infection rate) in house dogs are assumed to be improvement in the dogs' living environments and measures taken to prevent *Dirofilaria immitis* infection. To get a clue for relationship among these two factors and *Dirofilaria immitis* infection, we recently carried out a questionnaire survey on households containing dogs in the southern and northern parts of Nagasaki City.

Subjects and Methods

Two questionnaires were sent to the owners of dogs which were checked for *Dirofilaria immitis*

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Table 1. Number and percentage of dog owners responded to questionnaires in 1989 or 1993 in Nagasaki City

Year	1989			1993		
	No. dog-owners	No. responded	Response rate(%)	No. dog-owners	No. responded	Response rate(%)
Tomachi	114	71	62.3	137	74	54.0
Sakamoto	32	24	75.0	55	32	58.2
Takao	122	82	67.2	149	85	57.0
Yamazato	52	34	65.4	59	31	52.5
Total	320	211	65.9	397	222	55.9

Table 2. Questionnaire

Please answer the following questions by circling the number of the correct response.

I. Do you know what *Dirofilaria immitis* is?
1. Yes 2. No

II. Are there many mosquitoes in your neighborhood?
1. Very many mosquitoes 2. Many mosquitoes
3. Some mosquitoes 4. None

III. Which of the following measures are you taking to protect your dogs from mosquitoes?
1. Our dogs are kept indoors at night.
2. We burn mosquito-repellent coils.
3. We use mosquito control devices.
4. The kennels are covered with insect control nets.
5. Other methods (specify: _____).
6. Nothing in particular.

IV. Where do you keep your dogs?
1. Indoors 2. In the yard (Outdoors) 3. In kennels

V. Are you taking any particular measures to prevent *Dirofilaria immitis* infections?
1. Yes 2. No

VI. If you said "Yes" for No. 5, answer Questions A and B.
(A) When did you begin to take these measures?
In 1989
1. Before 1986 2. In 1987 3. In 1988 4. In 1989
In 1993
1. Before 1986 2. In 1987 3. In 1988 4. In 1990
5. In 1992

(B) Have you used such measures every year or intermittently?
1. Every year 2. Intermittently

VII. How have you used preventive medicine to protect your dogs from *Dirofilaria immitis* infection?
1. Orally administered every day or every other day.
2. Orally administered once a month.

Thank you very much for your cooperation.

infection in 1989 and/or 1993 in four districts of Nagasaki City: Tomachi in the southern part, and Sakamoto, Takao and Yamazato in the northern part of Nagasaki City. A pre-paid postcard, on which the questionnaire had been printed, was sent to 320 dog owners at the time of the first survey (July-August, 1989) and to 397 dog owners at the time of the second survey (August-September, 1993). The questionnaires were returned by mail. Table 1 shows

the number and percentage of dogs owners in each district who responded to each survey. The response rate was lower in the second survey (55.9%) than in the first survey (65.9%), probably because the length of time since the check for *Dirofilaria immitis* infection to the survey was longer for the second survey than for the first survey.

Items of Questionnaire

As shown in Table 2, the questionnaire included 7 questions: (1) presence or absence of knowledge about infection with *Dirofilaria immitis* (a pathogen for dog filariasis), (2) density of mosquitoes, (3) measures taken to control mosquitoes, (4) dogs' living environments, (5) use of preventive drugs, (6) the time when preventive drugs began to be used, and (7) frequency of the use of preventive drugs. The respondent was instructed to select one answer (or several answers for some questions) from the list of answers given.

Results

1. Knowledge about *Dirofilaria immitis*

In the first survey, the percentage of respondents who had knowledge about *Dirofilaria immitis* was 80% or more in each district. This percentage was slightly higher in the second survey, indicating an increased awareness of dog owners about this parasite (Table 3-I).

Table 3-I. Results on answer for questionnaire Do you know what *Dirofilaria immitis* is?

Year	District	No. responses	Yes	(%)
		(A)	(B)	(B/A × 100)
1989	Tomachi	71	61	(85.9)
	Sakamoto	24	20	(83.3)
	Takao	82	71	(86.6)
	Yamazato	34	32	(94.1)
	Total	211	184	(87.2)
1993	Tomachi	74	66	(89.2)
	Sakamoto	32	28	(87.5)
	Takao	85	80	(94.1)
	Yamazato	31	30	(96.8)
	Total	222	204	(91.9)

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Table 3-II. Results on answer for questionnaire
Are there many mosquitoes in your neighborhood?

Year	District	No. responses(%)		Very many mosq. (%)		Many mosq. (%)		Some mosq. (%)		None (%)	
		(A)		(B)	(B/A×100)	(C)	(C/A×100)	(D)	(D/A×100)	(E)	(E/A×100)
1989	Tomachi	70	(100.0)	13	(18.6)	35	(50.0)	21	(30.0)	1	(1.4)
	Sakamoto	24	(100.0)	2	(8.3)	14	(58.3)	7	(29.2)	1	(4.2)
	Takao	83	(100.0)	11	(13.3)	40	(48.2)	32	(38.6)	0	(0.0)
	Yamazato	34	(100.0)	1	(2.9)	12	(35.3)	20	(58.8)	1	(2.9)
	Total	211	(100.0)	27	(12.8)	101	(47.9)	80	(37.9)	3	(1.4)
1993	Tomachi	73	(100.0)	11	(15.1)	41	(56.2)	19	(26.0)	2	(2.7)
	Sakamoto	32	(100.0)	5	(15.6)	14	(43.7)	13	(40.6)	0	(0.0)
	Takao	84	(100.0)	17	(20.2)	40	(47.6)	26	(31.0)	1	(1.2)
	Yamazato	29	(100.0)	6	(20.7)	15	(51.7)	8	(27.6)	0	(0.0)
	Total	218	(100.0)	39	(17.9)	110	(50.5)	66	(30.3)	3	(1.4)

Table 3-III. Results on answer for questionnaire
Which of the following measures are you taking to protect your dogs from mosquitoes?

Year	District	No. responses(%)		Indoors at night (%)		Mosq. coil (%)		Mosq. devices (%)		Control nets (%)		Other methods (%)		Nothing (%)	
		(A)		(B)	(B/A×100)	(C)	(C/A×100)	(D)	(D/A×100)	(E)	(E/A×100)	(F)	(F/A×100)	(G)	(G/A×100)
1989	Tomachi	71	(100.0)	15	(21.1)	24	(33.8)	6	(8.5)	0	(0.0)	9	(12.7)	28	(39.4)
	Sakamoto	24	(100.0)	4	(16.7)	9	(37.5)	5	(20.8)	0	(0.0)	2	(8.3)	10	(41.7)
	Takao	83	(100.0)	15	(18.1)	29	(34.9)	6	(7.2)	3	(3.6)	10	(12.0)	37	(44.6)
	Yamazato	35	(100.0)	3	(8.6)	11	(31.4)	3	(8.6)	0	(0.0)	5	(14.3)	15	(42.9)
	Total	213	(100.0)	37	(17.4)	73	(34.3)	20	(9.4)	3	(1.4)	26	(12.2)	90	(42.3)
1993	Tomachi	74	(100.0)	15	(20.3)	29	(39.2)	4	(5.4)	3	(4.1)	7	(9.5)	28	(37.8)
	Sakamoto	32	(100.0)	7	(21.9)	11	(34.4)	3	(9.4)	0	(0.0)	3	(9.4)	15	(46.9)
	Takao	85	(100.0)	13	(15.3)	33	(38.8)	3	(3.5)	1	(1.2)	3	(3.5)	44	(51.8)
	Yamazato	31	(100.0)	4	(12.9)	16	(51.6)	0	(0.0)	2	(6.5)	1	(3.2)	12	(38.7)
	Total	222	(100.0)	39	(17.6)	89	(40.1)	10	(4.5)	6	(2.7)	14	(6.3)	99	(44.6)

2. Density of mosquitoes

Table 3-II shows the answers given regarding the density of mosquitoes and the infection rate in each district. In the 1989 survey, dog owners in Tomachi (from the southern part of Nagasaki City) and Sakamoto (from the northern part), where the percentage of larvae-carrying dogs was high, often reported that there were many or very many mosquitoes, while a lower density or an absence of mosquitoes was often reported by dog owners in Takao and Yamazato (from the northern part) where the positive rate was low. Four years later, i.e., in the 1993 survey, high densities of mosquitoes were often reported by dog owners in each district, although the infection rate of dogs was low in each district. This probably reflects an increased

recognition by dog owners about the fact that *Dirofilaria immitis* is transmitted by mosquitoes.

3. Measures taken to control mosquitoes

It is shown in Table 3-III the answers to the question about the measures taken to control mosquitoes. In 1989, only about 20% of all dog owners kept their dogs indoors at night, and this percentage was particularly low in Yamazato. The percentage of dog owners who burned mosquito-repellent coils to protect their dogs from mosquitoes was about 40%, and did not differ among different districts. The percentage of dog owners who used other mosquito-control devices or insect-control nets was low in all districts except for Sakamoto. In 1993, the percentage of dog

Table 3-IV. Results on answer for questionnaire
Where do you keep your dogs?

Year	District	No. responses (%)		Indoors (%)		In the yard (%)		In kennels (%)	
		(A)		(B)	(B/A×100)	(C)	(C/A×100)	(D)	(D/A ×100)
1989	Tomachi	71	(100.0)	21	(29.6)	39	(54.9)	15	(21.1)
	Sakamoto	24	(100.0)	5	(20.8)	14	(58.3)	8	(33.3)
	Takao	83	(100.0)	28	(33.7)	33	(39.8)	32	(38.6)
	Yamazato	35	(100.0)	13	(37.1)	8	(22.9)	13	(37.1)
	Total	213	(100.0)	67	(31.5)	94	(44.1)	68	(31.9)
1993	Tomachi	74	(100.0)	21	(28.4)	34	(45.9)	25	(33.8)
	Sakamoto	32	(100.0)	13	(40.6)	12	(37.5)	12	(37.5)
	Takao	85	(100.0)	32	(37.6)	40	(47.1)	26	(30.6)
	Yamazato	31	(100.0)	15	(48.4)	12	(38.7)	7	(22.6)
	Total	222	(100.0)	81	(36.5)	98	(44.1)	70	(31.5)

Table 3-V. Results on answer for questionnaire
Are you taking any particular measures
to prevent *Dirofilaria immitis* infection?

Year	District	No. responses		Yes (%)	
		(A)		(B)	(B/A×100)
1989	Tomachi	70		26	(37.1)
	Sakamoto	24		6	(25.0)
	Takao	81		29	(35.8)
	Yamazato	31		10	(32.3)
	Total	206		71	(34.5)
1993	Tomachi	71		30	(42.3)
	Sakamoto	30		9	(30.0)
	Takao	82		37	(45.1)
	Yamazato	31		18	(58.1)
	Total	214		94	(43.9)

owners who kept their dogs indoors was similar to that for the 1989 survey in each district. However, the percentage of dogs owners who used mosquito-repellent coils increased slightly. This increase was particularly marked in Yamazato.

4. Dogs' living environments

Table 3-IV shows the living environments of dogs

in dogs. In 1989, about 30% or less of all households in each district kept dogs indoor. In 1993, this percentage increased markedly in 3 districts, excluding Tomachi where the percentages remained low, at about 30%. In 1989, the percentage of dog owners who kept dogs outdoors (in their yards) was much higher in Tomachi and Sakamoto as compared to the other districts. In 1993, this percentage increased in all districts as compared to the 1989 survey, and the degree of this increase was similar among all districts. In 1989, the percentage of dog owners who had kennels was similar to the percentage of dog owners who kept their dogs indoors. In 1993, the percentage of dog owners with kennels increased in Tomachi and Sakamoto, while it decreased in Takao and Yamazato. This probably reflects the increase in the number of dog owners who kept their dogs indoors in the latter two districts.

5. Use of preventive drugs

Table 3-V shows the responses to the question concerning the use of preventive drugs against *Dirofilaria immitis* infection. In 1989, 30-40% of all dog owners in each district used this kind of drugs. In 1993, this percentage increased in Yamazato, while it remained unchanged in the other districts.

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Table 3-VI-A. Results on answer for questionnaire

If you said "Yes" for No. V, answer Questions A and B.
When did you begin to take these measures?

Year	District	No. responses (A)	Before 1986	In 1987	In 1988	In 1989	
			Yes(B) (%) (B/A×100)	Yes(B) (%) (B/A×100)	Yes(B) (%) (B/A×100)	Yes(B) (%) (B/A×100)	
1989	Tomachi	71	10 (14.1)	4 (5.6)	6 (8.5)	4 (5.6)	
	Sakamoto	24	2 (8.8)	2 (8.3)	2 (8.8)	0 (0.0)	
	Takao	83	15 (18.1)	7 (8.4)	9 (10.8)	1 (1.2)	
	Yamazato	35	5 (14.3)	4 (11.4)	1 (2.9)	1 (2.9)	
	Total	213	32 (15.0)	17 (8.0)	18 (8.5)	6 (2.8)	
Year	District	No. responses (A) (%)	Before 1986	In 1987	In 1988	In 1990	In 1992
			Yes(B) (%) (B/A×100)	Yes(B) (%) (B/A×100)	Yes(B) (%) (B/A×100)	Yes(B) (%) (B/A×100)	Yes(B) (%) (B/A×100)
1993	Tomachi	74 (100.0)	4 (5.4)	4 (5.4)	4 (5.4)	5 (6.8)	7 (9.5)
	Sakamoto	32 (100.0)	1 (3.1)	0 (0.0)	3 (9.4)	3 (9.4)	2 (6.2)
	Takao	85 (100.0)	9 (10.6)	1 (1.2)	2 (2.4)	7 (8.2)	11 (12.9)
	Yamazato	31 (100.0)	4 (12.9)	0 (0.0)	0 (0.0)	6 (19.4)	6 (19.4)
	Total	222 (100.0)	18 (8.1)	5 (2.3)	9 (4.1)	21 (9.4)	26 (11.7)

Table 3-VI-B. Results on answer for questionnaire
Have you used such measures every year or intermittently?

Year	District	No. responses (A)	Every year		Intermittently	
			Yes (B)	(%) (B/A×100)	Yes (B)	(%) (B/A×100)
1989	Tomachi	71	8	(11.3)	9	(12.7)
	Sakamoto	24	3	(12.5)	0	(0.0)
	Takao	83	18	(21.7)	5	(6.0)
	Yamazato	35	8	(22.9)	1	(2.9)
	Total	213	37	(17.4)	15	(7.0)
1993	Tomachi	74	21	(28.4)	5	(6.8)
	Sakamoto	32	7	(21.9)	1	(3.1)
	Takao	85	20	(23.5)	5	(5.9)
	Yamazato	31	9	(29.0)	2	(6.5)
	Total	222	57	(25.7)	13	(5.9)

users, because ivermectin (a specific remedy for *Dirofilaria immitis* infection) was launched on the market in 1988. This comparison however revealed no marked increase in the number of dog owners who used preventive drugs (Table 3-VI-A). Table 3-VI-B shows the responses to the question concerning the time when preventive drugs had begun to be used. No particular tendency was noted by the analysis of these responses. In 1989, however, the percentage of dog owners who answered that they had been using this kind of drugs every year was slightly higher in Takao and Yamazato (about 20%) than in Tomachi and Sakamoto (about 12%). In 1993, this percentage slightly increased in Tomachi and Sakamoto (about 20%). The percentage of dog owners who answered that they had been using this kind of drugs intermittently was about 10% in each district.

6. Time when preventive drugs began to be used

We then compared the frequency of the use of preventive drugs before 1988 with the frequency after 1988 to estimate the number of ivermectin

7. Methods to use preventive drugs

Table 3-VII shows the intervals at which owners used preventive drugs. In 1989, the percentage of

Table 3-VII. Results on answer for questionnaire
How have you used preventive medicine
to protect your dogs from *Dirofilaria immitis* infection?

Year	District	Total		Answer	
		No. responses (%) (A)	Every day (%) (B) (B/A×100)	Once a month (%) (C) (C/A×100)	
1989	Tomachi	13 (100.0)	4 (30.8)	9 (69.2)	
	Sakamoto	3 (100.0)	1 (33.3)	2 (66.7)	
	Takao	21 (100.0)	8 (38.1)	13 (61.9)	
	Yamazato	6 (100.0)	5 (83.3)	1 (16.7)	
	Total	43 (100.0)	18 (41.9)	25 (58.1)	
1993	Tomachi	25 (100.0)	2 (8.0)	23 (92.0)	
	Sakamoto	8 (100.0)	0 (0.0)	8 (100.0)	
	Takao	22 (100.0)	1 (4.5)	21 (95.5)	
	Yamazato	12 (100.0)	1 (8.3)	11 (91.7)	
	Total	67 (100.0)	4 (6.0)	63 (94.0)	

dog owners who reported that they had been using preventive drugs every day or every other day was about 80% in Yamazato, while about 60% of dog owners used the drugs once a month in the other districts. In 1993, about 90% or more of dog owners in each district used drugs once a year, probably reflecting the use of newly available drugs.

Discussion

When asked about the density of mosquitoes seen in the environment in 1989, many dog owners in Tomachi and Sakamoto answered that the density was high, while many dog owners in Takao and Yamazato answered that the density was low. The survey carried out using light traps in 1989 (Oda *et al.*, 1994) revealed that the number of *Cx. p. pallens* caught in these districts was much lower than the numbers in previous surveys. It is therefore likely that the dog owners in Tomachi and Sakamoto who answered "lot of mosquitoes" in the 1989 survey really meant "some of *Cx. p. pallens*", some other species of mosquitoes and even some other species of insects". In 1993, most dog owners in each district answered that the density of mosquitoes was high. This finding in the 1993 survey can be interpreted as reflecting an elevated awareness by dog owners about mosquitoes, if we take into account the results of the light trap survey mentioned above. When asked about any measures taken to protect dogs from mosquitoes, the percentage of dog owners who answered that they

burn mosquito-repellent coils, increased in 1993 in Yamazato district. This also indicates an increased awareness by dog owners of the fact that *Dirofilaria immitis* is transmitted by mosquitoes.

When asked about the living environments of their dogs, about 30% of dog owners in each district answered in 1989 that they had been keeping their dogs indoors. In 1993, this percentage remained unchanged at about 30% in Tomachi, while the percentage increased to about 40% in the other 3 districts. In 1989, the percentage of dog owners who kept their dogs in their yards was about 50% in Tomachi and Sakamoto and was lower (about 30%) in the other two districts. In 1993, this percentage became slightly low in Tomachi and Sakamoto, and in Takao and Yamazato, this percentage was a little high. This means that in Tomachi dogs were often kept outdoors (in the yards), while in the other three districts the percentage of dogs kept indoors increased. It is likely that the increase in the percentage of people who kept dogs indoors in 1993 over the percentage for 1989, represents the fact that dog owners who had allowed dogs to go out of house into the yard or on the veranda during the daytime. Dogs kept out in the yard are more prone to being bitten by mosquitoes as compared to dogs kept indoors.

Methods available for individual dogs owners to protect their dogs from *Dirofilaria immitis* include the use of preventive drugs and the use of anti-mosquito devices. When all 4 districts were analyzed together, the percentage of dog owners who used drugs was not high (about 30%). The most frequent device used for mosquito control was mosquito-repellent coils. In 1993, the percentage of dog owners who used this device increased markedly in each district.

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長崎市の飼い犬の飼育環境と人畜共通寄生虫、 犬糸状虫の予防の実態に関するアンケート調査

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要 旨 犬糸状虫の感染と犬の飼育環境や飼い主の予防の実施の有無との関連性の手がかりをつかむため、1989年と1993年に長崎市の南部の戸町地区と北部の坂本、高尾、山里の3地区の320名または397名の飼い主を対象に犬の飼育環境と予防の実態についてアンケート調査を実施した。1989年と1993年の回収率はそれぞれ65.9%または55.9%であった。感染率の低い北部3地区では家の中で犬を飼うと答えた人が多かった。感染率の高い南部の1地区では庭で犬を飼う人が多かった。このことから南部の犬は北部の犬に比べて主要伝搬蚊であるアカイエカに刺される機会が多くなることが推測される。予防措置としてはどの地区でも蚊取り線香が高頻度に使われていることがわかった。予防薬を投与している飼い主は一般に少なかった。

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