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**Research Article****Relationship between Sanitation of *Warung Makan Tegal* and Intestinal Nematodes Infestations in Cockroaches in Tembalang District, Semarang City***Punguan Sitanggang<sup>a</sup>, Retno Hestningsih<sup>b</sup>, Martini<sup>b</sup>, Praba Ginanjar<sup>b</sup>*<sup>a</sup> Port Health Office of Medan. Correspondence : [punguan.sitanggang@gmail.com](mailto:punguan.sitanggang@gmail.com)<sup>b</sup> Department of Epidemiology and Tropical Disease, Faculty of Public Health, Diponegoro University, Semarang, Indonesia**Abstract**

**Background:** Cockroaches are insects that are considered disgusting and act as mechanical vectors. The existence of cockroaches in a place becomes a benchmark of low sanitation in the place. The properties possessed by cockroaches by eating anything, so that in looking for food can spread nematodes by walking and removing dirt on top of food, dishes or other eating utensils that pass. The purpose of this study was to determine the intestinal nematode infestation in cockroaches.

**Methods:** This study was an observational study with a cross sectional approach. The stall samples were taken using a total sampling of 43 stalls and cockroach samples were determined by 2 cockroaches from each warteg.

**Results:** Observations under a microscope showed that intestinal nematodes were found in cockroaches including hookworm (14.0%), and *Oxyuris vermicularis* (30.2%).

**Conclusion:** Intestinal nematodes (hookworm and *Oxyuris vermicularis*) are found in cockroach bodies

**Keywords:** Cockroaches, intestinal nematodes, sanitation, Tegal food stalls

**Background**

Cockroaches are one of the mechanical vectors that can carry disease agents.<sup>1</sup> These insects are very close to human life. They like buildings that are warm, moist and have plenty of food. They also live in groups, can fly, are active at night like in the kitchen, storage food, garbage, dirty water channels, generally avoiding light, hiding in dark

places during the day and often hiding in the sidelines of buildings.<sup>2,3</sup>

Sanitation is a component of environmental health, namely intentional behavior to cultivate clean life and prevent humans from coming into direct contact with feces.<sup>4</sup> WHO said that poor access to sanitation facilities is closely related to the transmission of worm disease.<sup>1,5</sup>

Based on Nababan's research entitled *Identification of Parasites* (helminth and protozoa intestine) on the outer surface of cockroach bodies in several food stalls in Tembalang Semarang there are helminth parasites namely *Ascaris lumbricoides* eggs (10%), *Ascaris lumbricoides* larvae (30%), *Oxyuris vermicularis* eggs (23.3%), *Oxyuris vermicularis* larvae (3.3%), *Trichuris trichiura* eggs (3.3%), hookworm eggs (6.7%) and hookworm larvae (6.7%).<sup>6</sup>

*Warung makan Tegal* (warteg) is one of the public places which sell affordable and relatively cheap food and drinks among the public. Warteg has parts that can become a breeding ground for cockroaches and are closely related to the spread of worm disease.

The purpose of this study is to determine the presence of intestinal nematode infestations in cockroaches in *Warteg* of Tembalang, Semarang City.

**Methods**

The type of this research is a descriptive survey research by observing and examining the laboratory of the object under study without intervening. This study uses a cross sectional study design because observations are carried out only once at the same time.<sup>7,8</sup>

The population used in this study are all cockroaches in 43 wartegs in Tembalang, Semarang City. This study uses purposive sampling technique that is to take or choose cockroach samples intentionally which are

caught or taken to the laboratory for further investigation.<sup>9</sup> The samples taken are the first cockroach on each trap in each food stall. If there is no cockroach in the trap, the intestinal nematode infestation is negative. Cockroach samples in this study are about 43 cockroaches.

Laboratory tests using flotation concentration method. The independent variable in this study is the type of cockroach species, and the dependent variable is intestinal nematode infestation in cockroaches. The results of the research data are analyzed univariately.

**Results**

The distribution of the presence of nematodes in cockroaches in warteg is calculated from the whole wartegs. If cockroaches are not found in the warteg, then the presence of nematodes in the warteg is considered negative. Cockroach traps are installed in the kitchen and toilet. The traps resulting in getting cockroaches are 20 traps in the kitchen and 23 traps in the toilet. One cockroach of each trap is taken to be examined in the laboratory. Thus, there are 43 cockroach samples.

Based on Table 1, it can be seen that the number of cockroaches caught from 43 wartegs as many as 138 cockroaches. The types of cockroaches are 128 *Periplaneta americana* (92.75%), 8 *Blatella germanica* (5.80%), and 2 *Blatta orientalis* (1.45%).

Cockroach Type	Kitchen		Toilet		Total	
	f	%	f	%	f	%
<i>Periplaneta americana</i>	52	37,68	76	55,07	128	92,75
<i>Blatella germanica</i>	3	2,17	5	3,62	8	5,80
<i>Blatta orientalis</i>	1	0,72	1	0,72	2	1,45

Table 1. Distribution of Frequency of Number of Cockroaches in *Warteg* of Tembalang Semarang

Based on Table 2. it can be seen that from 43 cockroaches in Tembalang sub-district, there are 14 cockroaches (32.6%) which have intestinal nematodes on the

surface of the body. This is higher than the cockroaches having intestinal nematodes in the cockroach intestine, which are 5 cockroaches (11, 6%).

The presence of intestinal nematodes based on cockroach discovery sites	Cockroach Body Surface		Cockroach Intestine	
	f	%	f	%
Positive	14	32,6	5	11,6
Negative	29	67,4	38	88,4
<b>TOTAL</b>	<b>43</b>	<b>100</b>	<b>43</b>	<b>100</b>

Table 2. Distribution of Existence of Intestinal Nematodes Based on Discovery Places on Cockroaches in Warteg of Tembalang Semarang

Based on Table 3, it can be seen that from 43 stalls in Tembalang, there are 2 types of intestinal nematodes that infect

humans, which are *Hookworm* type of 14.0% and the type of *Oxyuris sp.* of 30.2%.

No.	Nematode Type	Positive		Negative		Total	
		F	%	f	%	f	%
1.	<i>Cacing Tambang</i>	6	14,0	37	86,0	43	100
2.	<i>Oxyuris sp.</i>	13	30,2	30	69,8	43	100

Table 3. Frequency Distribution of Intestinal Nematodes Types in Cockroaches in Warteg of Tembalang Semarang

Based on Table 4. it can be seen that from 43 stalls in Tembalang, the highest temperature is in the kitchen with

an average of 30.1°C, while the highest humidity is in toilets with an average of 70.83%.

The place	Temperature (°C)		Average	Humidity (%)		Average
	Min	Maks		Min	Maks	
Kitchen	28,6	32	30,1	69	73	70,81
Toilet	28,6	31,5	30,0	69	73	70,83

Table 4. Frequency Distribution of Temperature and Humidity Conditions in Warteg of Tembalang Semarang

## Discussion

Cockroaches are one of the mechanical vectors in some diseases, and can also act as biological vectors. Cockroaches can be a place of life and an intestinal nematode transmitter because they eat anything, including leftover food that is disposed of in the sewerage and in the trash. Mechanically cockroaches can spread intestinal nematodes by walking and removing dirt on top of food, dishes, or other eating utensils.<sup>10</sup>

Temperature and humidity affect the presence of cockroaches in warteg. In Table 4.10, the lowest temperature conditions are 28.6°C and the highest is 32°C with an average of 30°C. This temperature is the temperature favored by cockroaches. As stated by Salbiah (2007), nymph and adult cockroaches are active at temperature of 15.5 - 31.7°C.<sup>11</sup> Humidity at the lowest level is 69% and the highest is 73% with an average of 70.8%. Cockroaches need relative humidity above 50% to survive.

Based on Figure 4 the density of cockroaches in 43 stalls in Tembalang is >2 for 31 stalls (72%) and <2 for 12 stalls (28%). This is not in accordance with the Regulation of the Minister of Health of the Republic of Indonesia Number 50 Year 2017 that industry or food stall business must be free from cockroach density of <2. The number of cockroaches <2 is said to be low and if the number of cockroaches is > 2 then the population density of cockroaches in that location is high. If the population density of cockroach in a building is high, cockroach control must be carried out.<sup>12</sup>

The total number of cockroaches caught are 138 cockroaches, which are 128 *Periplaneta americana* (92.75%), 8 *Blattella germanica* (5.8%) and 2 *Blatta orientalis* (1.45%).

Laboratory results of intestinal nematode infestation in cockroaches in wartegs found 2 types of intestinal nematode eggs that infect humans. Nematodes that are often found in humans are *Ascaris lumbricoides*, *Trihuris trichiura*, hookworm, and *Oxyuris vermicularis*.<sup>13</sup> Hookworms are found in 6 stalls (14.0%), lower than *Oxyuris vermicularis* nematodes that are found in 13 stalls (30.2%). Meanwhile, the presence of *Ascaris lumbricoides* and *Trihuris trichiura* worms is not found in cockroach bodies.

Type of hookworm and *Oxyuris vermicularis* are found on the surface of the body and in the intestines of cockroaches. The presence of intestinal nematodes on the body surface of cockroaches is appropriate with Nababan research, along with the presence of eggs *Oxyuris vermicularis* (23.3%) and hookworm eggs (6.7%) on the surface of cockroach bodies. With the discovery of hookworm and *Oxyuris vermicularis* in the intestines, the results are not in accordance with the research conducted by Jayabalan. The type of intestinal nematode found in the intestines of cockroaches is *Strongyloides stercoralis* (37.7%).

Hookworm or adult hookworm lives in the small intestine. Adult female worms lay eggs, and eggs will come out with feces. Hookworm eggs are oval. It is 60 microns length and 40 microns width. There is only one layer of thin and transparent wall.<sup>14</sup>

Adults of *oxyuris vermicularis* nematodes live inside the cecum cavity, ascending colon and appendix. Male worms are about 2-5 mm length and 0.1-0.2 mm width. Female worms are 8-13 mm length and 0.3-0.5 mm width. This worm egg is asymmetrical oval, and one side is flat. The length is 50-60 microns and the width is 20-32 microns. It has 2 layers of thin and

transparent walls. Eggs always contain larvae.<sup>14</sup>

## Conclusions

Intestinal nematode infestation in cockroaches caught in 43 wartegs in Tembalang which are positive for intestinal *hookworm* nematodes are 14.0% and *Oxyuris sp.* are 30.2%. The number of cockroaches caught in Tembalang's warteg are 138. They are *Periplaneta americana* (92.75%), *Blatella germanica* (5.80%) and *Blatta orientalis* (1.45%).

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## Competing interest

The author reports no conflicts of interest in this work.

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