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Prevalence of gastrointestinal parasites in vipers (Serpentes: Viperidae) reared in Padang City, West Sumatra, Indonesia

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Abstract. *Mairawita, Herwina H, Hidayat F, Janra MN, Diniyati F.. 2024. Prevalence of gastrointestinal parasites in vipers (Serpentes: Viperidae) reared in Padang City, West Sumatra, Indonesia. Biodiversitas 25: 1352-1358.* Vipers are widely distributed worldwide, including in the Asian region, and are currently decreasing in their natural population due to various factors. The most prominent characteristic is the exploitation of vipers for being human pets. Among other cities in West Sumatra, Padang is considerably dense with reptile hobbyists and owners who keep reptiles for their fancy, including the vipers, as this snake taxon has a colorful morphological appearance. This study aims to investigate gastrointestinal parasites in reared vipers in Padang City in terms of parasitic species inventory and their prevalence. Parasites were collected from the feces of vipers in Padang City from November to December 2021. Parasite extraction was conducted at the Animal Taxonomy Laboratory, Department of Biology, Universitas Andalas, Padang, Indonesia. Fecal samples of reared viper species were obtained from 38 individuals (five genera and 10 species). Fecal samples were then processed with a centrifugation-float method to observe the parasites and four types of endoparasites were revealed, namely *Kalicephalus* spp. (38.8%), *Ophidascaris* spp. (33.3%), *Oxyuris* spp. (44.4%), and *Rhabdias* spp. (38.8%), in their egg stage. Gastrointestinal parasites in reared vipers in Padang City are more common as single infestation cases at 63% than mixed infestation cases at 32% and not infested only at 5%.

Keywords: Endoparasite, parasites, snakes, viper, West Sumatra

INTRODUCTION

Indonesian Archipelago occupies only 1.3% of the global terrain, yet Indonesia has a very high and unique natural biodiversity. Herpetofauna is part of Indonesian natural wealth, comprising 16% of all reptile and amphibian species worldwide (Arifan 2021; Rohman 2022). Reptiles, a half element of herpetofaunistic diversity, are parts of the ecosystem and biodiversity found in aquatic, terrestrial, and arboreal habitats (Gillespie 2012). Reptiles play an important ecological role within the ecosystem despite reptiles being unpopular among many people. Global conservation agencies, such as the International Union for Conservation of Nature (IUCN) and the Convention on International Trade in Endangered Species (CITES), have been long in discussion regarding the need for obtaining more robust information on less popular organisms such as reptiles. The scarcity of comprehensive information on Indonesian reptiles remains a critical knowledge gap, with most available data limited to domestically reared reptiles. This deficiency underscores the need for in-depth research and a broader exploration of reptilian species inhabiting the diverse ecosystems of Indonesia. The nation's rich biodiversity, comprising a myriad of reptile species, necessitates concerted efforts to unveil their ecological roles, behaviors, and conservation status (Mardiastuti 2021).

Many reptile species face global, regional, or local extinction. Most organisms, including reptiles, significantly suffer from habitat loss, environmental degradation, introduction of invasive species, environmental pollution, disease, overexploitation, and global climate change (Az-Zahra 2021).

Like many other animals, reptiles can serve as hosts for various viral, bacterial, and parasitic pathogens, some of which can be of zoonotic concern, as pointed out by Mitchell (2011). As part of reptiles, Snakes are hosts for twelve groups of at least five endoparasite phyla in the Slovenia region and two species of ectoparasites (Rataj et al. 2011). Snakes such as Salmonella are also vulnerable to bacterial infection (Corrente 2017). However, numerous studies have focused on the ecological aspects of reptile hosts and their conservation, focusing on the environmental perspective. Zoonotic parasites have received relatively less attention. This gap in research has resulted in limited knowledge about the biology, ecology, and zoonotic potential of most of these parasites. Unfortunately, even in endemic regions, these aspects have been historically neglected (Bower 2019).

Moreover, in transmitting parasitic zoonoses associated with reptiles, the primary mode typically involves organisms that the reptiles act as intermediate or paratenic hosts. In many cases, humans are typically infected through the consumption of reptiles, while in the latter, the parasite stages are released into the environment, thereby exposing humans to potential risks (Mitchell 2011)

Parasites are organisms that live in the host-body organisms and potentially harm and the parasites can negatively affect the infected host's health. Based on the host body position, parasites can be grouped into ectoparasites and endoparasites (Silvestre 2021). Parasitic infestation can severely impact the definitive host, such as hindering the host organism's growth due to nutrition absorption by the parasite from the system of the definitive host (Karbagam and Ganesh 2020*). Knemidokoptiasis*, caused by *Knemidocoptid* mites that infest the skin of birds, was found in Sumatra (Garcia-Rejon et al. 2023). Endoparasites are commonly found in the host digestive tract organisms; in snakes, it is usually caused by roundworm infestation. Roundworms (phylum Nematelminthes, class Nematoda) infect snakes using two modes of transmission: through infective eggs and larvae (Garcia-Rejon et al. 2023) and the parasitic disease is quite rare and studied for snakes in the wild, even those in rearing. Despite their urgency in formulating an effective control strategy (Irsya et al. 2017; Janra and Herwina 2021), various aspects of snake parasitisms need a comprehensive investigation. This study aims to explore the inventory and prevalence of gastrointestinal parasitism in reared vipers in Padang City, West Sumatra, to contribute to the knowledge of parasitisms on viper snakes.

MATERIALS AND METHODS

Study area and sampling methods

The study was conducted from November to December 2022, surveying viper owners and reptile hobbyists residing in Padang City, West Sumatra, Indonesia. Before inquiring about the fecal samples from their reared vipers, the owners and hobbyists were engaged through social media or other online platforms to ask about their willingness to participate in this study. Upon agreeing, the fresh fecal sample of vipers was directly scooped from the rearing cage or terrarium using a sterilized spoon. The Fecal was then properly labeled in a plastic tube containing 10% formaldehyde. During fecal collection, the reared vipers were documented using a 24 MP camera instilled in the Vivo v15 smartphone for identification. All fecal samples were transported to and processed at the Laboratory of Animal Taxonomy, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Andalas.

Ethical conduct during fecal sampling

This study required no ethical conduct or permit since the work was mainly conducted on the fecal matters of the vipers. At the same time, viper documentation was made remotely without direct contact between the surveyor and vipers. Any scientific work subjecting certain organisms without impacting them requires no permit (Vanhooren 2013). Authors retain the position of no favor toward reptile ownership by humans, yet the reptile hobbyists and owners surveyed in this study remain anonymous.

Fecal sample processing and parasite identification

The standard centrifugation floating method was used to extract parasites and/or their eggs from fecal samples (Pyziel-Serafin 2022). As much as 2 g fecal sample from each viper individual (n = 38) was placed into 15 ml reaction tubes and diluted with distilled water until three fourth tubes were filled. Tubes were spun using a Hettich Universal 1200 centrifuge at 2,000 rpm for 5 minutes. The supernatant layer formed atop the fecal solution was disposed of before refilling with saturated NaCl solution until three-fourths of the tubes were filled. The tubes were spun again for another 5 minutes, with saturated NaCl solution added afterward to top the tubes bulgingly. The test tubes were then slid onto the opening of the tubes, left for around 5 minutes, and lifted. Next, cover glasses were placed on the wetted side of each object glass before being examined with Corona Binocular Microscope XSZ-107 BN on optimum magnification (100x400) to detect the presence of parasites, oocysts, or parasite eggs. Upon spotting parasites, oocysts or eggs were snapped with a 24 MP camera Vivo v15 smartphone. The measurements of parasites, oocysts, or eggs used the online GIMP software (available for free at https://gimp.org) and expressed in micrometer (µm) units until two decimal precisions. The identification process was conducted by observing parametric measurements, morphological characters, and pictures of the objects, all guided with proper references, either for identifying parasites (Garcia 2016) or vipers (Das 2015, reptile-database.org, inaturalist.org).

Data analysis

The identified parasite, oocyst or egg, was then accordingly grouped according to its taxonomical family, genus, and species sequence. The individual count per species, parasitism prevalence, its hosts, and the nature of parasite infestation (single or mixed parasite species) were also noticed and recorded. The result was then descriptively outlined using tables and pictures.

RESULTS AND DISCUSSION

The diversity

The online inquiry was returned by nine viper keepers from Padang City, coded with Owner #1 to #9, then subsequently surveyed, resulting in five genera and 10 species of vipers recorded (Table 1; Figure 1). The fecal samples were collected from viper species *Crasdocephalus brongersmai* (2 individuals), *Ovophis convictus* (2 individuals), *Parias hageni* (2 individuals), *Parias* sp. (4 individuals), *Parias sumatranus* (4 individuals), *Trimeresurus gunaleni* (3 individuals), *Trimeresurus* cf *puniceus* (5 individuals), *Trimeresurus (Popeia) barati* (3 individuals), *Tropidolaemus subanulatus* (4 individuals), and *Tropidolaemus wagleri* (9 individuals). Of 38 vipers, 36 individuals showed either single or mixed parasitism. Two individuals of *Trimeresurus* cf *puniceus* (Owner #7) were observed not to have any parasite detected from their fecal samples.

Table 1. Details of parasitism on reared vipers (Serpentes, Viperidae) in Padang City, West Sumatra, Indonesia

Owner ID#	Viper species	Parasite and type of infestation	
		Single	Mixed
I	*Ovophis convictus* #1	*Oxyuris* sp.	-
	Ovophis convictus #2	*Kalicephalus* sp.	-
	Parias hageni #1	-	*Kalicephalus* sp., *Oxyuris* sp., *Rhabdias* sp.
	Parias sp #1	*Oxyuris* sp.	-
	Tropidolaemus subanulatus #1	*Rhabdias* sp.	-
	Tropidolaemus wagleri #1	-	*Kalicephalus* sp., *Ophidascaris* sp., *Oxyuris* sp., *Rhabdias* sp.
II	*Parias hageni* #2	*Oxyuris* sp.	-
	Tropidolaemus wagleri #2	*Rhabdias* sp.	-
	Tropidolaemus wagleri #3	*Oxyuris* sp.	-
III	*Parias sumatranus* #1	-	*Kalicephalus* sp., *Ophidascaris* sp., *Rhabdias* sp.
	Tropidolaemus wagleri #4	-	*Ophidascaris* sp., *Rhabdias* sp.
IV	*Parias* sp #2	*Kalicephalus* sp.	-
	Tropidolaemus subanulatus #2	*Oxyuris* sp.	-
	Tropidolaemus wagleri #5	-	*Ophidascaris* sp., *Rhabdias* sp.
	Tropidolaemus wagleri #6	-	*Ophidascaris* sp., *Oxyuris* sp.
	Tropidolaemus wagleri #7	*Oxyuris* sp.	-
V	*Trimeresurus gunaleni* #1	*Kalicephalus* sp.	-
	Parias sumatranus #2	*Ophidascaris* sp.	-
VI	*Crasdocephalus brongersmai* #1	*Ophidascaris* sp.	-
	Trimeresurus cf. puniceus #1	*Oxyuris* sp.	-
	Tropidolaemus subanulatus #3	-	*Kalicephalus* sp., *Ophidascaris* sp., *Rhabdias* sp.
	Tropidolaemus subanulatus #4	*Kalicephalus* sp.	-
VII	*Parias* sp #3	-	*Kalicephalus* sp., *Ophidascaris* sp., *Rhabdias* sp.
	Parias sp #4	-	*Ophidascaris* sp., *Oxyuris* sp.
	Trimeresurus (Popeia) barati #1	*Kalicephalus* sp.	-
	Trimeresurus (Popeia) barati #2	*Oxyuris* sp.	-
	Trimeresurus (Popeia) barati #3	*Rhabdias* sp.	-
	Trimeresurus cf. puniceus #2	-	-
	Trimeresurus cf. puniceus #3	-	-
	Tropidolaemus wagleri #8	*Rhabdias* sp.	-
VIII	*Trimeresurus gunaleni* #2	*Oxyuris* sp.	-
	Trimeresurus gunaleni #3	-	*Oxyuris* sp., *Rhabdias* sp
	Parias sumatranus #3	*Kalicephalus* sp.	-
	Tropidolaemus wagleri #9	-	*Kalicephalus* sp., *Ophidascaris* sp., *Oxyuris* sp., *Rhabdias* sp.
IX	*Parias sumatranus* #4	-	*Kalicephalus* sp., *Ophidascaris* sp., *Rhabdias* sp.
	Crasdocephalus brongersmai #2	*Ophidascaris* sp.	-
	Trimeresurus wagleri #1	*Oxyuris* sp.	-
	Trimeresurus wagleri #2	*Kalicephalus* sp.	-
	Total Infected Hosts	24	12
	Total non-infected host		2
	Total inspected hosts		38
	Percentage (%)	63.1%	31.6%

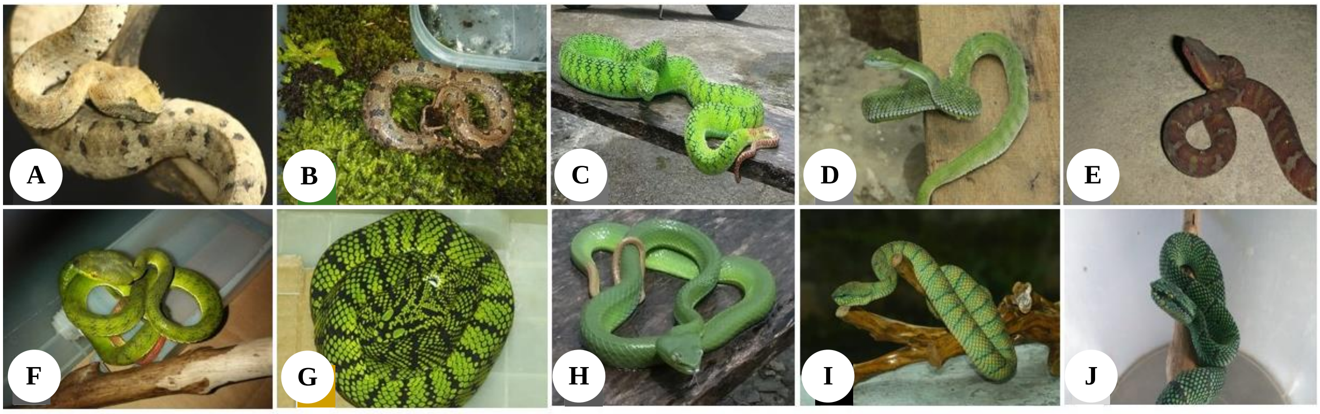

Figure 1. A. *Crasdocephalus brongersmai*, B. *Ovophis convictus*, C. *Trimeresurus gunaleni*, D. *Parias hageni*, E. *Trimeresurus CF puniceus* F. *Parias* sp., G. *Parias sumatranus*, H. *Trimeresurus (Popeia) barati*, I. *Tropidolaemus subanulatus*, J. *Tropidolaemus wagleri*

Moreover, four endoparasite genera were recorded from the fecal samples of reared vipers in Padang City, as mentioned in Table 2. All endoparasites found in this study were classified into two classes of Nematoda. The first Secementea was represented by *Kalicephalus* sp., *Ophidascaris* sp., and *Oxyuris* sp., while Secemata had only *Rhabdias* sp. as representative in Figure 2. The single parasite infestation was observed to happen twice compared to the mixed parasite infestation. The latter type of infestation occurs when more than one endoparasite species is found in a single host. Two individuals of *Tropidolaemus wagleri* (owned respectively by Owner #1 and #VIII) had the most severe mixed infestation, where all four parasite genera were found in their fecal samples. Mixed parasite infestation with two or three parasite taxa was observed to happen equally in five vipers each.

Nematodes from families of Rhabditidae, Strongylidae, Capillariidae, Heterakidae, Oxyuridae, Spiruridae, Filariidae, Cosmocercidae, and Kathlaniidae are commonly found in reptiles (Telford 2016; Sastry 2018) Albeit non-pathogenic or mildly pathogenic, infestation of these nematodes in reptiles should be treated carefully. Strongylids and Rhabditids can cause diarrhea and respiratory distress. At the same time, Oxyurid worms can excessively infest within the reptile colon, which may impact a certain degree of risk to the host animal (Telford 2016). Ants are the common vector for endoparasites to infest terrestrial reptiles such as snakes; eggs or oocysts from these nematodes can survive for a couple of days while waiting for host or vector organisms to be infested (Sastry 2018).

Observation and measurements on nematode eggs identified from the fecal samples of rear vipers in Padang City can be described below:

Kalicephalus sp.

Eggs of *Kalicephalus* sp. is oval, thick, transparent protein walls with green blastocysts formed in the center portion (Figure 2A). The eggs were measured to have 72.3 µm length and 52.3 µm width. The eggs of *Kalicephalus* sp., previously described as 74-76 µm in length and 49-51 µm in width, are oval, have a thin shell, and contain a segmented yolk (Levine 2015). The eggshell measured 40-42 µm, and its outer layer formed a halo with 67-72 µm length. The embryo is spherical and has a well-developed external protein coat. After being removed from the uterus, eggs mix with the intestinal contents of host organisms (Telford 2016). Furthermore, eggs of *Kalicephalus* sp. are strongylus in its characteristic form blastomere, which is covered by a thick hyaline layer as soon as expelled with host feces, such as snakes (Prichard and Geary 2019; Smales et al. 2022) *Kalicephalus* sp. is common endoparasite in the digestive tract of snakes and lizards. *Kalicephalus* and *Diaphanocepahlus* are the only genera under Diaphanocephalidae and they have around 33 known species (Veira 2016). Snakes can be infected orally with third-stage larvae in an experimental setting, yet the infection mechanism in the wild remains a mystery. It is suspected that snakes frequently wag their tongues to sense the environment, making it possible for nematodes to enter the snake's body (Scheifler et al. 2022). The members of Diaphanocephalidae can inflict thinning and wrinkles on the skin of host snakes (Sastry 2018).

Table 2. Prevalence of endoparasites observed from fecal of reared vipers in Padang City, West Sumatra, Indonesia (n = 38)

Phylum	Class	Order	Family	Species	Infected host (prevalence)
Nematoda	Secernentea	Strongylida	Diaphanocephaloidae	*Kalicephalus* sp.	14 (36.8%)
		Ascaridida	Ascarididae	*Ophidascaris* sp.	12 (31.6%)
		Oxyurida	Oxyuridae	*Oxyuris* sp.	16 (42.1%)
	Secernata	Rhabditida	Rhabditidae	*Rhabdias* sp.	14 (36.8%)

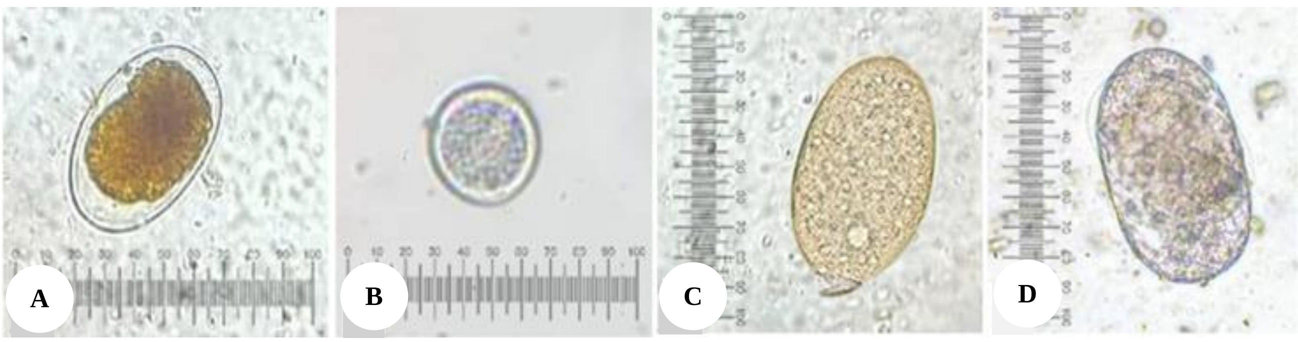

Figure 2. Eggs of parasitic Nematodes found from fecal of vipers reared in Padang City, West Sumatra, Indonesia (under 40x magnification): A. *Kalicephalus* sp., B. *Ophidascaris* sp., C. Infertile egg of *Oxyuris* sp., D. *Rhabdias* sp.

Ophidascaris sp.

The egg of *Ophidascaris* sp. is oval with a white protein wall and is found in the morula phase. This egg was measured at 46.7 µm in length and 37.1 µm in width (Figure 2B). These characteristics align with previous observations for eggs of this genus: round, oval, or eclipse with thick yellow-brownish near transparent shells (Pavlović 2021; Smales et al. 2022). The primary membrane is slightly separated from the outer wall.

The cell division of the egg looks solid, brownish and tends not to fill the eggshell. Eggs generally undergo at least eight stages of cell division, most probably due to the prolonged retention of feces in the snake's rectum; therefore, eggs are highly resistant in dry environments, and eggs retained in dry feces in irregularly cleaned cages are often infective. Infertile eggs are thin-shelled with wrinkled surfaces and no visible cavities, generally larger than fertile eggs (Elder et al. 2018). The members of Ascaridida usually become the leading cause of the host's digestive problems as well as infection of organs, resulting in nose bleeding.

Oxyuris sp.

The study revealed that the eggs were infertile, ovoid-shaped, and asymmetrical. The egg has a valve on one end, with translucent aspects and thick albumin walls (Figure 2B). A measurement of an egg resulted in 89.2 µm in length and 53.0 µm in width. This description follows the descriptions for eggs of *Oxyuris*: asymmetrical shape, oval on one side and flat on the other, a clear and thick egg wall consisting of the outermost albuminous layer, a membrane, and an inner layer of eggs containing larvae (Ezenwa and Jolles 2011) *Oxyuris* infects orally through infective fertilized eggs which can stick to cage and stay infective for up to two months. An infestation case was previously reported on *Platyceps karelini* from California, USA (Forrer et al. 2017). Oxyurid members have characterized behavior that migrates to the host's intestines from the point of infection. At the same time, consuming nutrients from the host body until it matures and reaches the anus to lay eggs. The egg-laying process usually causes itching at the anus area and stimulates scratching on high-level organisms (especially mammals), which eventually triggers self-infection on the host body, not only in the anus but also extend to vagina, bladder, peritoneum, kidneys, liver, and eyes (Kotepui 2023).

Oxyuris sp.

Eggs were found infertile, ovoid-shaped, and asymmetrical; the egg has a valve on one end with translucent aspects and thick albumin walls (Figure 2C). The measurement of an egg resulted in 89.2 µm in length and 53.0 µm in width. This description follows the description for eggs of *Oxyuris*: asymmetrical shape, oval on one side and flat on the other, a clear and thick egg wall consisting of the outermost albuminous layer, a membrane, and an inner layer of eggs containing larvae (Ezenwa and Jolles 2011), and *Oxyuris* infects orally through infective fertilized eggs which can stick to cage and stay infective for up to two months. An infestation case was previously reported on *Platyceps karelini* from California, USA (Forrer et al. 2017). Oxyurid members have characterized behavior that migrates to the host's intestines from the point of infection. At the same time, consuming nutrients from the host body until it matures and reaches the anus to recur the eggs-laying. The egg-laying process usually causes itching at the anus area and stimulates scratching on high-level organisms (especially mammals), which eventually triggers self-infection on the host body, not only in anus but also extend to vagina, bladder, peritoneum, kidneys, liver, and eyes (Kotepui 2023)

Rhabdias sp.

Eggs were found in the late gastrulae phase and oval (Figure 2D), and the egg was measured to have 71.2 µm in length and 47.5 µm in width. The eggs' characters are in line with the morphological feature of *Rhabdias*, which is commonly found in herpetofauna: oval-shaped, thin-walled, -strongyle-type (Ezenwa and Jolles 2011; Forrer 2017; Jasmi et al. 2014; Kavitha 2014). Infestation of this worm genus is usually related to diseases in host organisms' skin, lungs, digestion tract, and sensory system, with eventual lethal consequences. Symptoms of gastrointestinal tract infection include heartburn, cramping at lower abdominal pain, irregular bowel movements, and weight loss, and the later stage of infection could cause the death of cells in organs of the digestive tract and constriction of the blood vessels (Navaree 2008; Badri 2022; Miranda et al. 2022).

Single and multiple infestation

A single infestation of endoparasite can cause a mild to severe impact on the body and digestive system of the host organism, while a mixed infestation would multiply the negative impact and severity on the hosts (Telford 2016; Forrer et al. 2017; Elder et al. 2018; Sastry 2018; Badri 2022; Miranda et al. 2022). As mentioned in Table 3, the study revealed that 36 (95%) out of 38 reared viper individuals were found to be internally parasitized, which should be considered an alarming indication to viper owners and start to intensify the care of their pets. The single infestation prevailed more frequently (63.1%) than the mixed infestation (31.6%) in the vipers reared in Padang City (Table 3). Within the single infestation cases, *Oxyuris* sp. was recorded as the highest (41.7%) compared to *Kalicepahlus* sp. (29.1%), *Rhabdias* sp. (16.7%) or *Ophidascaris* sp. (12.5%). The infestation of *Oxyuris* sp. was also the highest in overall observation (26.3%). Meanwhile, within the mixed infestation cases observed in this study, the combination of *Kalichepalus* sp., *Ophidascaris* sp., and *Rhabdias* sp. became the most common case (33.3%). The case where all parasite species infested the same host was observed on two *Trimeresurus wagleri* owned by Owner #I and #VIII (see Table 1). The infestation with two or three parasites at the same host was equally recorded five times each. A mixed infestation has been previously observed in wild snakes, as the free-living populations have ample opportunity to be exposed to various natural parasites (Rataj et al. 2011; Pedersen and Antonovics 2013).

Table 3. Detail on the Nematodes prevalence in reared vipers from Padang City, West Sumatra, Indonesia

Nematode taxa	Number of infected vipers (n = 38)	Prevalence	
		Per infestation type	Overall
Kalichepalus sp.	7	29.1%	18.4%
Ophidascaris sp.	3	12.5%	7.9%
Oxyuris sp.	10	41.7%	26.3%
Rhabdias sp.	4	16.7%	10.5%
Subtotal single infestation	24	100%	63.1%
Ophidascaris sp., *Oxyuris* sp.	2	16.7%	5.3%
Ophidascaris sp., *Rhabdias* sp.	2	16.7%	5.3%
Oxyurus sp., *Rhabdias* sp.	1	8.3%	2.6%
Kalichepalus sp., *Oxyuris* sp., *Rhabdias* sp.	1	8.3%	2.6%
Kalichepalus sp., *Ophidascaris* sp., *Rhabdias* sp.	4	33.3%	10.5%
Kalichepalus sp., *Ophidascaris* sp., *Oxyuris* sp., *Rhabdias* sp.	2	16.7%	5.3%
Subtotal mixed infestation	12	100%	31.6%
Total infestation	36		94.7%
Non-infested host and percentage	2		5.3%

Parasites involved in co-infection interact, which is critical in understanding the dynamics of host and parasite communities in the wild. Co-infecting parasites have been shown to alter the risk of infection, the intensity of infection, and the health consequences of infection (Telfer 2010; Taylor 2015; Suwanti 2018). Competition between co-infecting parasite species may reduce the severity of infection in one scenario (Telfer 2010), while in another scenario, suppression of the host's immune response by one infesting parasite may increase the likelihood or severity of possible infection by other parasites (Lettoof 2020). These studies highlight the existence of parasite interactions in the form of mixed infestation in host organisms; despite the mechanism of co-infection in reared snakes, limited and supporting factors are still less known.

The high prevalence of parasite infestation may indicate that the reared vipers originated from a wild population instead of captive breeding, as the environmental conditions in wild nature can be more severe than in the rearing setup. On the other hand, conditions within the environment of captivity can increase parasitism incidents. Viper owners presumably contribute to parasite infection; some admitted feeding their pets with prey caught from their surrounding residentials. In addition, the hygiene of rearing cages was unknown at this point; no cleaning standard or protocol was available to be followed. The existence of an intermediate host bridging the parasites into their permanent host was also unknown and needs further investigation. All these conditions increase the possibility of parasite infection and infestation in reared vipers (Hallinger 2020). Despite this study obtaining information regarding the high prevalence of endoparasitism in vipers in Padang City, extending the survey to encompass other reared reptile taxa and expanding the sampling area to include more localities in West Sumatra is necessary. Contributing factors determining the intensity of parasitism in reared reptiles were also worth scrutinizing to ensure the welfare and health of these exotic pets.

In conclusion, the parasitological study on pet vipers (Serpentes, Viperidae) reared in Padang City recorded four taxa of gastrointestinal Nematodes by inspecting fecal samples from 38 viper individuals of five genera and ten species (prevalence = 94.7%). The identified nematodes were from genera *Kalicephalus*, *Ophidascaris*, *Oxyuris*, and *Rhabdias* that infested vipers in either single or mixed infestation. Single parasite infestation occurred more than the mixed parasite infestation (63.1% vs. 31.6%), with *Oxyuris* singularly infested vipers the most (26.3%). In comparison, the combination of *Kalicephalus*, *Ophidascaris*, and *Rhabdias* was the most mixed infestation case (10.5%). The infestation of all nematodes in one host viper was observed in two *Tropidolaemus wagleri* individuals. This finding calls for more careful and hygienic rearing standards for pet vipers to lower the prevalence of parasitism the rearing setup.

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