Original Research Article

Understanding the Association between Selected Agama agama Characteristics and Intestinal Parasitic Infection in Otuoke, Nigeria

Abstract

Lizards (*Agama agama*) are the most widely distributed reptiles and has shown to be a means of transport and reservoir host to a number of protozoan and helminth parasites. The aim of this study is to determine the association between parasitic infection of *Agama agama* and selected characteristics (age and sex). The observational study was carried out at Otuoke community where 50 *Agama agama* comprising both male and females were randomly obtained. The lizards were sacrificed and their feaces were collected from their intestines and studied in the laboratory for parasite presence using light microscope. The results showed the identification of four parasites in the lizards namely; nematode (*Strongyluris brevicaudata* and *Parapharyngodon colonensis*), cestode (*Oochoristica truncate*), trematode (*Mesocoelium monas*) and Conoidasida (*Toxoplasma gondii*). There was no association between age (described as length of the animal) and prevalence of parasitic infection. Also, there was no association between sex and prevalence of the parasitic infection and finally, there was no association between weight and prevalence of the parasitic infection. This study has shown that although parasites are present in *Agama agama*, there was no gender, age and weight variations or dependence of the rate of their infection.

Keywords: *infection, lizard, intestinal parasites*

Introduction

Agama, derived from Sranan Tongo meaning "lizard," represents a genus of small-to-moderate-sized, insectivorous Old-World lizards. With at least 37 species distributed across Africa, primarily in sub-Saharan regions, these reptiles vary in size, typically reaching 12 to 30 centimeters when fully grown (Maurice and Robert, 2002). Lizards, one of the most widely distributed reptiles globally, demonstrate remarkable adaptability across various habitats (Robert et al., 2020). However, this study revolves around the Agama agama lizard, a species known to be a means of transport and reservoir host forhelminth and protozoan parasites, thereby raising significant concerns (Wekhe and Olayinka, 2009). In Nigeria, comprehensive investigations by Robert et al., 2020, Akinboade and Johnson (2011), and Wekhe and Olayinka (2009) have identified the prevalence of protozoan parasites such as Eimeria oocysts, Plasmodium, and Haemogregarina species, with Eimeria oocysts being the most prevalent (68.7%).

Lizards, owing to their poikilothermic nature, thrive across tropical climates globally, featuring diverse sizes, shapes, and colors. While most lizard species pose no harm to humans, their intriguing characteristics and the threat they pose when cornered have fueled interest in keeping them as pets, including species like bearded dragons, iguanas, anoles, and geckos. In Africa, commonly found lizard species include Geckos, Agama lizards, Chameleons, Monitor lizards, and Alligator lizards.

In addition to being fascinating animals, lizards including Agama agama play a crucial role in maintaining the balance of ecosystems by serving as biological controls for insects and arthropod pests (Vasconcelos et al., 2022). However, because of their diet of insects, they are susceptible to gastrointestinal tract infections, some of which can be zoonotic and pose a risk to human health. Among this group of lizards, the *Agamidae* family, and specifically the *Agama agama* species, have become the most well-known.

These lizards are typically native to West African countries, particularly the sub-Saharan region. Because they live in social groups, they are known to be gregarious animals, with a male leader, approximately six females, and subordinate males (Wagner et al., 2009a).

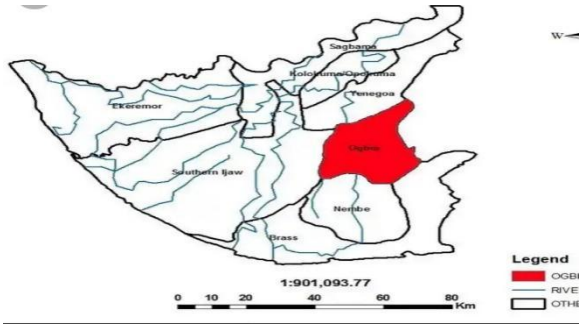
Regrettably, despite playing important ecological roles, Agama agama lizards have been linked to the transportation and reservoir hosting of a number of helminth and protozoan parasites, some of which have the potential to infect humans (zoonotic significance). Contact with objects contaminated by infected saliva or feces increases the risk of human infection, as does unintentional ingestion of parasite eggs. Ascaris species, Capillaria species, and Raillietiella species are among the gastrointestinal parasites in Agama agama lizards that have been linked to human transmission, according to several research done in Nigeria (Adeoye and Ogunbanwo, 2007). However, there is still a lack of knowledge about the frequency of gastrointestinal parasites in Agama agama from Bayelsa State, Nigeria, and the risks associated with their transmission to people and commercial poultry flocks.

As an overview, this study focuses on exploring the significance of Agama agama lizards, providing vital insights into their health and potential implications for ecosystems, human health, and the poultry industry. By examining their role as carriers of zoonotic parasites and expanding our understanding of the relationship between these reptiles and various parasites, this study aims to address critical gaps in scientific knowledge, ultimately contributing to the health and well-being of both natural and human environments.

Materials and Methods

Study Area

Otuoke is a suburb in Bayelsa state in Ogbia local government area, which is located in the Niger Delta region of Nigeria. Its population is made up primarily of farmers and fishermen. There are fewer than 10,000 people living in Otuoke overall (Jibueze, 2015). In Ogbia, the year-round weather is oppressive, with the wet season being warm and cloudy and the dry season being hot and mostly clear. The average annual temperature fluctuates between 71°F and 87°F; it is rarely lower or higher than 64°F or 90°F. The entire Ogbia community agreed that Otuoke should become the center because it is the only community in the kingdom with access to both roads and water.



Map 1:showing Ogbia local government area.

Study design

The observational study was conducted on 50 *Agama agama*. These lizards were randomly hand-picked between January to August, 2022 at different locations within the study area. The *Agama agama* was kept in a ventilated container and was transferred to Biology laboratory in Federal University Otuoke, Bayelsa state for dissection and examination of parasites.

Laboratory Examination for Parasitic Infection

A preparation of chloroform was used to euthanize fifty (50) lizards. The organs were removed and placed in separate petri dishes filled with reptile saline. In order to prevent the parasites from being killed, the dissecting board, knife, scissors, and picker were cleaned with disinfectant (spirit) and then rinsed under running water.The weight of the lizard was taken using digital weighing scale and the length was measured using transparent meter rule, then the lizard was placed on the dissecting board, the lizard was dissected open longitudinally and the intestine was harvested and was excised into different petri dish containing saline solution. The feces were pressed out from the intestine and was introduced into a specimen container, it was emulsified with a saline water, sieved into a container, then introduced into a centrifuge tube, and was centrifuged under 3500rpm for 10minutes. After centrifugation, the precipitate was filtered out from the sediment, the sediment was dropped on a slide with a drop of iodine and was covered with a cover slip, it was then view with microscope under the magnification of X40 for parasitological examination (Hayat et al., 2016; Adedokun et al., 2022; Wokem and Onosakpkonome, 2014; Onosakponome et al., 2021).

Statistical analysis

The proportion was determined for descriptive assessment of the prevalence of the infection based on studied characteristics (length and sex). For inferential statistics, the correlation between each of the investigated characteristics and the prevalence of parasitic infections was ascertained using chi-square analysis. The test was considered significant at p-value < 0.05.

Results

Parasites identified

Table 1 below shows thatfive different helminth species were found in the lizard's intestine. Among the helminth parasites discovered were two nematode species: There were found to be *Strongyluris brevicaudata, Parapharyngodon colonensis, Oochoristica truncate, Mesocoelium monas, and Toxoplasma gondii*, among other cestode species. The intensity of intestinal parasites was extremely high.

Table 1: Parasites identified

Parasites	**Scientific nomenclature**
Nematode	*Strongyluris brevicaudata* *Parapharyngodon colonensis*
Cestode	*Oochoristica truncate*
Trematode	*Mesocoelium monas*
Conoidasida	*Toxoplasma gondii*

Table 2 below showed that the number of male infected was 18 and prevalence of 90%, while in female 23 was infected with the prevalence of 76.7%.There was no significant association (p-value = 0.229) between sex and prevalence.

Table 2: Overall prevalence of infection based on sex

Sex	No. examined	No. Infected (%)	χ^2	p-value
Male	20	18 (90)		
Female	30	23 (76.7)		
Total	50	41(82)	1.445	0.229

Table 3 below showsif infection is dependent on age (described in size), here 13 small *Agama agama* were infected with the prevalence of 46.4% while 15 adult were infected with the prevalence of 53.6%. There was no significant association (p-value = 0.083) between size and prevalence

Table 3: Prevalence of infection based on size

Size	No. examined	No. Infected %	χ^2	p-value
Small	18	13 (46.4)		
Adult	32	15 (53.6)		
Total	50	28(100)	3.004	0.083

Table 4 below shows if infection is dependent on weight, here 11 *Agama agama weighing* ≥25g were infected with the prevalence of 50%; 8 *Agama agama weighing between* 25-35g were infected with the prevalence of 75%; and 11 *Agama agama weighing* ≥36g were infected with the prevalence of 55%. There was no significant association (p-value = 0.472) between weight and prevalence.

Table 4: prevalence of infection based on weight

Weight (g)	no. examined	No. infected(%)	χ^2	p-value
≥25	22	11(50)		
26-35	8	6(75)		
≥36	20	11(55)	1.502	0.472

Discussion

My study's findings indicated a prevalence of 28% in Agama agama from the Otuoke community in the Ogbia local government area of Bayelsa state, Nigeria. *Toxoplasma gondii, Strongyluris brevicaudata, Mesocoelium monas, Oochoristica truncate, and Parapharyngodon colonensis* were the parasites that were isolated from Agama agama. Nematodes, particularly *S. brevicaudata and P. colonensis*, were the most common of the five parasite species found. Acanthocephalan was not found during the investigation. Of the five parasites discovered in a study of reptile species by Borkovcova and Kopriva (2005), nematodes were the most frequently found, followed

by trematodes and cestodes;no acanthocephalans were found. It has been demonstrated that exposure to helminthes with direct life cycles, their large size, and their diverse plant diet all contribute to the high diversity found in helminth infra-communities (Martin et al., 2005). Thus, it seems that saurian reptiles' diet and helminth acquisition are related (Sanchis et al., 2000).

My research indicates that because they are the more active sex, male lizards had a higher prevalence of infection than female lizards. Males are more vulnerable to parasite infection than females, presumably because testosterone suppresses the immune system, at least while the organism is reproducing (Uller and Olsson 2003; Roberts et al., 2004). Males maintain high testosterone hormone levels early in the mating period (Tokarz, 2008), which increases their aggression and increases their capacity to seize and hold onto territory. A significant amount of energy and metabolites are needed for the development of eggs in pregnant females, which cannot be used for parasite defense. As a result, it appears that both sexes devote more energy to procreation than to parasite defense (Amo et al., 2005). Due to their tendency to obstruct the lizards' already narrow intestine, cestodes have a low worm burden because their length reduces the intestine's carrying capacity.
The lizard's size was utilized to calculate its age. The most parasitized lizards, according to my research, were adults. This is consistent with research by Ribas et al. (1995) and Amo et al. (2005), which found a positive correlation between the adult size of the lizards they studied and the prevalence of helminthes infection. Because they interact more with other adults, expose themselves to vectors, and occupy more favorable places like basking spots or refuges, adults were expected to be more infected than young lizards. Additionally, older lizards were thought to have more time and probability to come into contact with the parasites On the other hand, dominant older male lizards frequently confine younger ones to less than ideal areas. Additionally, Ribas et al. (1995) demonstrated that lizard body size was positively correlated with the total mass of nematodes. The findings also suggest that as people age, they lose their immunity to infection. However, in a study involving a partenogenetic whiptail lizard (Cnemidophorus nativo), the host body size had no discernible effect on the infection rate (Menezeset al., 2004).
Lizards typically have a lifespan of five to twenty years. Their mean intensities did not differ significantly. This implies that the presence and quantity of parasite transmission stages, or encysted forms (in the case of parasites with a direct life cycle) or its vector (in the case of parasites with an indirect life cycle), within the host's habitat are dependent on the amount of rainfall. In Nigeria, May, June, and July are included in the wet season. In the rainforest belt, A. agama breeds year-round; however, in drier savanna regions, the breeding season falls during the rainy season (Enge et al., 2004). In May and June during this study, the highest and lowest amounts of rain were recorded, respectively. Both sexes *of Strongyluris brevicaudata* were found to exhibit high intensity in May, which decreased by June and then increased once more in July to reach its highest peak in the case of the males, but further decreased in the case of the females. Observing the structure of the egg, which is covered by two distinct transparent and inelastic membranes, 115 X 88 microns, making them weather-tolerant, could help explain these variations in intensity (Hallmann and Griebeler, 2015). Conversely, *P. colonensis* showed a consistent decline in prevalence over the course of the three months. Throughout the three months, *S. brevicaudata* exhibited a generally high prevalence, with July recording the highest mean discussion. These parasites don't seem to be affected by the season and appear to have better seasonal adaptations.

Thick-shelled eggs of S. brevicaudata contain embryos at the time of deposition (Seguel et al., 2022). Amo et al.'s (1995) analysis of the prevalence of infection in adults revealed no monthly variations. They proposed that infections happened at the beginning of the breeding season, when lizards were busier.

Conclusion

In conclusion, this study revealed that nematodes specifically, *Strongyluris brevicaudata* and *Parapharyngodon colonensis* were the most common parasitic infections in *Agama agama* lizards, with a 28% prevalence. The higher infection rate in male lizards was explained by the immune-suppressive effects of testosterone during the reproductive stage. Larger and more active adult lizards displayed higher levels of parasitization. The aging process of lizards was observed to cause a loss of immunity, and although precipitation seemed to affect the spread of parasites, there were differences in the degree of infection between months, suggesting that *S. brevicaudata* is a parasite that is consistently prevalent due to its weather-adaptability. The study's overall findings emphasized the intricate interactions between various elements that affect the dynamics of parasitic infections in *Agama agama* lizards.

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