Seroprevalence of Bovine Schistosomosis in Yola Metropolis, Adamawa State, Nigeria

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ABSTRACT

A cross sectional study was conducted in cattle herds in Yola metropolis from January to March 2018; aimed at detecting *Schistosoma* antibodies using IgG *Schistosoma* ELISA kits (Diagnostic Automation/ Cortez Diagnostic INC Woodland Hills California, USA). Four wards; Bole Yolde Pate, Karewa, Namtari and Ngurore were randomly selected and animal identification based on location, management system, age, breed and sex were recorded. A total of 200 sera samples were tested for *Schistosoma* antibodies. An overall seroprevalence of 6.5% (13/200) was obtained in this study. Highest *Schistosoma* antibodies was detected in Ngurore ward 18.5% (5/27); while least antibody detection of 3.7% (3/81) was recorded in Karewa ward. Based on management system, an extensive management system had the highest seroprevalence (9.8%) whereas least seroprevalence (3.7%) was recorded for both intensive and semi intensive management system. Detection of *Schistosoma* antibodies from both location and management system varies insignificantly (p>0.05). Young animals had higher prevalence (7.9%) than the adult animals (6.2%). Based on breed, no *Schistosoma* antibody was detected in Cross Breeds, while *Schistosoma* antibodies were detected from Red Bororo 7.6% (1/13), White Fulani 6.9% (10/145) and Sokoto Gudali breeds 6.3% (2/32). Sex specific prevalence showed higher prevalence in males (10.4%) than in females (4.5%). No statistical significant association was found between schistosomosis and age, sex and breed (p>0.05). The present study provides a baseline data on the prevalence and distribution of *Schistosoma* infection in cattle in the study area. A further expanded study that may cover the entire state as well as control measures designed to target the parasite and its intermediate host to prevent higher prevalence rates in future was recommended.

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Article History

Received 19 Sep 2018
Revised 30 Oct 2018
Accepted 30 Dec 2018

1. INTRODUCTION

Trematode parasitism is one of the major problems constraining both animal and human productivity around the world (Jejaw et al., 2015). They are found in vast water lodged and marshy grazing fields, a condition anticipated for being ideal for the propagation and maintenance of the intermediate host (snails) and hence high prevalence of the infection (Fromsa et al., 2011; Islam et al., 2012; Zangana and Aziz, 2012). Schistosomosis is a worldwide infectious parasitic disease prevalent in the tropics and sub tropics and seriously endangers human health (Weifeng et al., 2018). According to the map of global distribution of schistosomosis, nearly 200 million people are infected in 74 countries and regions worldwide especially in Asia, Africa and Latin America (Gryseels, 2012; WHO, 2013; WHO, 2014).
The blood flukes are grouped under the genus *Schistosoma* and family Schistosomatidae. Schistomes under this group are elongated, unisexual and dimorphic trematodes, which inhabit the blood vessels of their host (Weifeng et al., 2018). Members of Schistosomatidae show morphological and physiological peculiarities which set them apart from all other trematodes (Aylate et al., 2017). Firstly, they are dioecious, the male bearing the female in a ventral canal, gynaecophoric canal and secondly, they live in the blood streams of warm-blooded hosts, being the only trematode to do so (Aylate et al., 2017). They can be differentiated through their morphological features, life cycle, host specificity and behavioural characteristics (Tewodros and Alemseged, 2015).

The major *Schistosoma* species that cause animal schistosomosis include; *Schistosoma bovis, Schistosoma japonicum, Schistosoma matthei, Schistosoma intercalatum, Schistosoma nasale and Schistosoma rodhoni* (Jejaw et al., 2015). *Schistosoma bovis* and *Schistosoma matthei* are the most important species that can cause schistosomosis in ruminants (Kassahum et al., 2017). The adult worms inhabit the mesenteric vessels of the definitive host and the intermediate forms develop in snails from the genus *Biomphalaria, Bulinus*, and *Monocephala* (Kassahum et al., 2017). There are three main species of Schistosome infecting humans, *Schistosoma mansoni, Schistosoma japonicum*, which inhabit the mesenteries around the intestine and *Schistosoma haematobium* which are found in the venules surrounding the bladder (Aylate et al., 2017).

Schistosomosis is one of the major endemic disease and a limiting factor to livestock productivity in Africa that deserve serious attention, even though there has been little recognition of its veterinary significance (Huyse et al., 2009; Tewodros and Alemseged, 2015). Cattle infected with *Schistosoma bovis* develop a syndrome characterized by liver damage, roughness of hair coat, pale mucous membrane, severe emaciation and a very poor reproductive performance that result in a significant economic down turn and a threat to public health (Hambali et al., 2016). Of significance is the threat to public health due to natural interactions and hybridization between *Schistosoma* species (Hambali et al., 2016). Hybridization between *Schistosoma bovis* and *Schistosoma haematobium* had been reported from a patient in Senegal (Huyse et al., 2009) and from an outbreak in France (Boisser et al., 2016).

Economic impacts of schistosomosis in Nigeria include reduced income generation, productivity of workers (Hambali et al., 2016) as well as impact leading to enormous animal economic losses and inhibition of socio-economic development (King, 2010; Saleh and Hassan, 2012). Therefore the diagnosis of schistosomosis in animal and human being is a key step to propose and establish a control strategy (Niaz et al., 2010). Schistosomosis has been the focus of various studies because of its medical, veterinary and social importance (Niaz et al., 2010). To the best of our knowledge, there was no attempt of serological studies on the organism in Yola metropolis. This study was conducted to detect *Schistosoma* species antibodies in cattle in Yola metropolis which will serve as baseline information about the distribution of the disease in the study area and suggests appropriate measures towards the control of the disease.

2. MATERIAL and METHODS

2.1. Study Area

The study was conducted in Yola metropolis of Adamawa state, Nigeria. Adamawa is bordered by the states of Borno to the northwest, Gombe to the west and Taraba to the southwest. Topographically, it is a mountainous land crossed by the large river valley-Benue, Gongola and Yedsarem. The valleys of the Cameroon, Mandara and Adamawa mountains form part of the landscape. Yola lies between Coordinates: 9°20′N 12°30′E / 9.333°N 12.500°E , covering a total area of 1,213.30 square kilometers and has population of 3,178,950 based on 1991 National Population Census (Adebayo and Tukur, 1999). Most inhabitants are civil servants, traders, fishermen, farmers and cattle rearers (Adebayo and Tukur, 1999). The state has an estimated cattle population of 3.1 million (MLP, 2012), made up of White Fulani, Red Bororo, Sokoto Gudali breeds and cross breeds, which constitute 88% of cattle breeds in Nigeria (Ngere, 1983).
2.2. Sample Size
The sample size was determined through conventional statistical method as described by (Thrusfield, 2007).

\[ n = \frac{z^2pq}{d^2} \]

- \( n \) = sample size
- \( p \) = Prevalence
- \( d \) = desired absolute precision (0.05)
- \( z \) = standard normal deviation for 95% confidence level (1.96)
- \( q = 1 - p \).

Using 10\% prevalence for the sample size of cattle (Hambali et al., 2016) 138.2 were approximated to 200 samples to increase precision. Therefore 200 sera samples were collected.

2.3. Study Design
A cross sectional study was conducted to estimate the prevalence of bovine Schistosomosis in the study area. Samples were collected between the months of January to March 2018. Four wards; Bole Yolde Pate, Karewa, Namtari, and Ngurore from Yola metropolis were randomly selected and animal identification based on age, sex, breed, location and management system of the study animals were recorded. The study animals were sampled using simple random sampling techniques.

2.4. Ethical Approval
All animal owners were informed about the purpose and procedures of the study before being asked for their consent to participate. Permits for the described field studies were obtained from the Ministry of Livestock Production Yola, Adamawa state, Nigeria.

2.5. Sample Collection
A total of 200 blood samples were collected in the study area. Blood sample was collected from the cattle after proper restrain. The sex and breed of the animal were determined by physical examination and aging was done by dentition and recorded at the time of sample collection. Ten millilitres (10ml) of blood was aseptically collected from the jugular vein using 10ml syringe, 18G hypodermic needle. The blood sample was dispensed into universal bottles free from anticoagulant for serum to be separated and collected in the laboratory. The blood sample was further centrifuged at 3000g for 15 minutes. Thereafter clarified sera was decanted into a clean labelled serum vials and stored at -20\(^\circ\)C until analysed.

2.6. Serological Test
Serological test was conducted using IgG Enzyme Linked Immunosorbent Assay (ELISA) at the Viral Research Division of National Veterinary Research Institute Vom, Plateau State. The IgG Schistosoma ELISA kits were supplied by Diagnostic Automation/Cortez Diagnostic INC Woodland Hills California, USA.

2.7. Procedure
Test samples: 1:40 dilution of the sera was made using the dilution buffer.
Wash buffer: the cap was removed and contents were added to 475ml of DI water and the diluted wash; buffer was placed into a squeeze bottle 96-well polystyrene plate was used. 100ul of negative control was added to well number one (1) 100ul of positive control was added to well number two (2). 100ul of the diluted (1:40) test samples to the remaining wells.
Negative and positive controls were supplied as prediluted. It was incubated at room temperature (15°C to 25°C) for 10 minutes (Wang et al., 2015). The content in the well were shook out and washed for three times with the diluted wash buffer. Then two drops of enzyme conjugate was added to each well and incubated for 10 minutes at room temperature. The contents were then shook out and washed 3 times with the wash buffer. Two drops of chromogen was dropped into every well and incubated for 5 minutes at room temperature. Then two drops of stop solution was added to stop the reaction. ELISA reader was used to read wells at 450nm with a reference filter at 620-650nm (Wang et al., 2015).

2.8. Data Analysis
The data was analysed using Statistical Package for Social Sciences (SPSS) version 20.0 and Chi Square (X²) test to evaluate the association between different parameters (age, sex, management system and breed) and the value of p<0.05 was considered significant.

3. RESULTS and DISCUSSION
Out of the 200 sera screened, 13 tested positive to Schistosoma antibodies giving an overall prevalence of 6.5% (13/200). Prevalence of bovine schistosomosis based on the location and management system is shown in Table 1. The finding is lower than the 10.0% reported in Maiduguri, Borno state (Hambali et al., 2016). We attributed the low prevalence obtained to the fact that the present study was conducted during hot dry season (January-March) where the infection rate of the parasite is low because of harsh dry conditions and less likelihood of infection due to unavailability of snail intermediate host as water sources are scarce. It has been reported that schistosoma infection rate in cattle increases during rainy season due to abundance of snails and favourable conditions on the land which is suitable for the survival of the intermediate host as compared to dry season (Khan, 2011; Negero and Deresa, 2017). The low prevalence obtained in this study can also be attributed to climatic variations such as difference in humidity and temperature leading to drying of the natural habitat thereby decreasing the population of snails and infective cercaria resulting to decrease prevalence of the disease. The prevalence of the disease might be higher in Maiduguri and its environs because of migration and movement of cattle from neighboring countries that share borders with the state.

Based on location, Ngurore ward had the highest number of Schistosoma antibody detection 18.5% (5/27) followed by Namtari ward 5.4% (3/55) and Bole Yolde Pate ward 5.4% (2/37) and least antibody was detected in Karewa ward 3.7% (3/81); the difference in the prevalence among the wards were not statistically significant (p>0.05). We attributed the highest prevalence recorded in Ngurore ward to the fact that the ward has more pockets of stagnant water bodies, marshy areas and ponds with higher drainage system for irrigation as compared to the remaining wards. With the increased in dry season farming activities in the area, this favours multiplication of the intermediate host. Urquhart et al. (1997) documented similar findings and concluded that marshy, water logged and poorly drained areas with low soil pH are often endemic to schistosomosis. Karewa ward had the least prevalence rate and this could be because of the less water bodies present in the ward, as well the ward is more of residential area thus having more houses than farms.

Based on management system, ninety-two samples were examined from extensively managed cattle, 9.8% (9/92) were positive by ELISA. Out of the eighty one samples collected from animals under semi-intensive management, 3.7% (3/81) tested positive. Twenty seven animals were examined in the intensive management system and 3.7% (1/27) tested positive. There was insignificant association between the prevalence rates in the different management systems p> 0.05. The highest prevalence obtained among extensively reared cattle can be attributed to frequent exposure of the animals to different water bodies and marshy areas as they move from site to site in search for good grazing area and drinking water and hence may be exposed to water bodies infested with the intermediate host (snail) and this will aid in the transmission of the disease. The following authors reported similar findings (Urquhart et al., 1997; Lulie and Guadu., 2014). Although the result of this study disagrees with the report of Aylate et al., (2017) who reported animals under semi-intensive management system had higher prevalence rate than those that were extensively managed.

The prevalence of bovine schistosomosis based on age, breed and sex is shown on Table 2. Age specific prevalence of bovine schistosomosis was categorized into Young (<2 years) and Adult (>2 years). Out of the Two hundred samples
screened, higher seroprevalence was recorded in young animals 7.9% (3/39) than adults 6.2% (10/161). There was no statistical significant association between the prevalence of bovine schistosomosis among the age groups (p > 0.05). The higher prevalence in young animals than in adults indicates that the prevalence of the disease decreases as age increases. We attributed this to the fact that in northern Nigeria, calves are traditionally weaned between the ages of 1-2 year and then allowed to graze with the adult animals and having lower immunity as compared to the adult animals are predisposed to the infection. This result corroborates with the earlier findings (Habtamu and Mariam, 2011; Chanie et al., 2012; Aylate et al., 2017). However, the results disagrees with the earlier findings of Hambali et al. (2016) and Kassahum et al. (2017) who reported higher in adult than in young animals. We attributed this to differences in categorizing of age groups of the animals.

Four different breeds of cattle were examined; Red Bororo, Sokoto Gudali, Cross Breed and White Fulani. No Schistosoma antibody was detected in Cross Breeds 0.0% (0/10), while Schistosoma antibodies were detected from Red Bororo 7.6% (1/13), White Fulani 6.9% (10/145) and Sokoto Gudali 6.3% (2/32) breeds. However, there was no statistical significant association between the prevalence of bovine schistosomosis in the different breeds of the cattle (p> 0.05). The higher prevalence in Red Bororo and least in Cross Breed buttressed the earlier finding of Adane and Mulat (2015).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Number examined</th>
<th>Number positive (+)</th>
<th>Prevalence (%)</th>
<th>X^2</th>
<th>p-value</th>
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<tbody>
<tr>
<td>Location (ward)</td>
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<tr>
<td>Bole Yolde Pate</td>
<td>37</td>
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<tr>
<td>Karewa</td>
<td>81</td>
<td>3</td>
<td>3.7</td>
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<tr>
<td>Namtari</td>
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<tr>
<td>Ngurore</td>
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<td>5</td>
<td>18.5</td>
<td>7.602</td>
<td>0.3689</td>
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<tr>
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<td>9</td>
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<tr>
<td>Semi-intensive</td>
<td>27</td>
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<td>3.7</td>
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<tr>
<td>Total</td>
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<td>13</td>
<td>6.5</td>
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<table>
<thead>
<tr>
<th>Parameters</th>
<th>Number examined</th>
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<th>Prevalence (%)</th>
<th>X^2</th>
<th>p-value</th>
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</thead>
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<tr>
<td>Age</td>
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<tr>
<td>Adult</td>
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<td>6.2</td>
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<tr>
<td>Young</td>
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<td>3</td>
<td>7.9</td>
<td>0.937</td>
<td>0.9904</td>
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<tr>
<td>Cross Breed</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Bororo</td>
<td>13</td>
<td>1</td>
<td>7.6</td>
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<td></td>
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<tr>
<td>Sokoto Gudali</td>
<td>32</td>
<td>2</td>
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<tr>
<td>White Fulani</td>
<td>145</td>
<td>10</td>
<td>6.9</td>
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<tr>
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<tr>
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</table>
This might be due to fact that most cross breeds cattle were kept indoors especially during milking periods where there is sufficiently gathered feed resources but watering is usually outside especially during the dry season where it is difficult to obtain water from a distant area for animals to drink. The result disagrees with the report of Aylate et al., (2017) who hypotised higher prevalence in cross breeds than locals in Kemissie, Dawa Cheffa District of Ethiopia. The cross breeds from this present study were strictly intensively managed and hence were not exposed to infested water bodies or ponds that could favour the development and multiplication of the intermediate host (snail) which would bring about transmission of the disease.

Based on sex prevalence, out of the total 200 samples collected; 133 females and 67 males were screened. Out of which 4.5% female (6/133) and 10.4% males (7/67) were positive for schistosomosis. The higher prevalence recorded in male than female animals appears to be related to the practice of maintaining females under better management and feeding condition for milk production and breeding but males are allowed to graze freely in pasture and so are more stressed. Males are also fed relatively poor diet which increases their susceptibility to most infection (Houdijk and Athana, 2003; Negero and Deresa, 2017). There was no significant difference (p>0.05) between sexes and this might be because both sex groups are exposed to similar pasture lands and watering points and thereby developing the disease at almost the same rates. The following authors reported similar findings (Habtamu and Mariam, 2011; Mersha and Belay, 2012; Chanie et al., 2012; Hambali et al., 2016; Aylate et al., 2017). However this result is contrast the findings of Kassahum et al. (2017) that reported a higher prevalence in female than in male animals.

In conclusion, the serological investigations for the evidence of bovine schistosomosis demonstrate the presence of its antibodies in the study area. Young animals irrespective of location, breed and sexes are easily susceptible and at risk of the infection cause by schistosomosis.

We therefore recommend routine application of molluscicide to reduce the snail population at seasons where the number of the snail increases. The water bodies should be fenced to reduce water contamination with Schistosoma eggs. Young animals should be kept at home or the weaning time of calves should be extended until they become mature and their immunity develops. Government should make adequate provision of drugs for both prevention and control of the disease in the study area.

4. Acknowledgements
The authors wish to acknowledge Dr. Yiltawe Wungak of Foot and Mouth Disease, Viral Research Division, National Veterinary Research Institute Vom for help rendered in the course of procurement of the ELISA kits used in this study and also during running of the tests.

5. REFERENCES


