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Adedotun Ayodeji Bayegun is a Doctoral student of the Department of Pure and Applied Zoology Federal University of Abeokuta, Nigeria working on hybridization patterns among schistosome species in some endemic rural communities in Nigeria. He has a deep passion for Global Health, most especially areas involving mapping distribution of neglected tropical diseases (NTDs), identifying potential risk factors influencing NTDs occurrence and understudying disease control programs and the overall processes of strengthening community awareness and participation in such program. Currently, he has six publications in peer-reviewed journals and six conference proceedings showcasing evidence of his writing and articulation skills.

Project

Geographical Risk Distribution, Genetic Diversity and Transmission of Zoonotic Schistosomiasis in Ogun State, Nigeria

BACKGROUND OF THE STUDY

Schistosomiasis (or Bilharzia) is a serious Neglected Tropical Disease (NTD) of humans and animals, affecting poor rural and urban communities in many parts of the world, with the highest burden of over 29 million cases representing 14% of the world burden occurring in Nigeria (Hotez *et al*., 2012), in which 11.3 million are school-aged children (Ekpo *et al*., 2013). The symptoms of the disease include dysuria, blood in urine, blood in the stool, which can lead to cancer of the bladder or rectum, anaemia, liver dysfunction (WHO, 2021) and recently a gynaecological condition called female genital schistosomiasis (Ekpo *et al*., 2017). Schistosomiasis is a water-related disease, with three human species endemic in Nigeria; *Schistosoma haematobium*, *Schistosoma mansoni* and *Schistosoma intercalatum* (Midzi *et al*., 2014) and two livestock species; *Schistosoma bovis* and *Schistosoma currasoni* (Ndifon *et al*., 1988). The transmission of schistosomiasis takes place in surface water (rivers, streams, ponds) where people and livestock congregate daily for bathing, washing, swimming, drinking and agricultural practices. These water sources are inhabited by freshwater snails (*Bulinus* sp and *Biomphalaria* sp), which serve as intermediate host and transmits the infections to human and livestock, providing the opportunity for *Schistosoma haematobium* and *Schistosoma bovis* interaction. There are widespread surface waters in Nigeria, where humans and animals interact, becoming potential sources of hybrids as there is an opportunity for the mixing of animal and human *Schistosoma* species. Several studies have continued to report the high endemicity of the disease in Ogun state (Ekpo *et al*., 2013) despite the control of schistosomiasis through mass drug administration (MDA) with Praziquantel drug distributed annually.

In Nigeria, in a recent pilot study on schistosome hybrid in Ogun State, spindle-shaped eggs were recovered from human urine, typical of *Schistosoma bovis* (Bayegun *et al*., 2022), hence, we hypothesised that hybrid schistosome may have been established in Nigeria and may be

contributing to high transmission potential and reduced drug efficacy due to the use of surface water by both human and livestock in schistosome endemic communities, possibly providing an opportunity of *Schistosoma haematobium* and *Schistosoma bovis* interaction.

The new WHO guideline on control and elimination of human schistosomiasis recommendation number 6: States ***"In communities approaching the interruption of transmission, WHO suggests a verification framework that consists of testing for Schistosoma infection in non-human mammalian hosts***. However, the magnitude of the contribution of non-human mammalian hosts to the transmission of schistosomiasis remains understudied in Africa. Gower *et al*. (2017) suggested and argued for a comprehensive evaluation of the economic burden of livestock and zoonotic schistosomiasis in sub-Saharan Africa to determine if extending treatment to include animal hosts in a One Health approach will help endemic countries to reach elimination stages. However, limited data exist to support if there is a need for the implementation of treatment for animals.

The implications of hybrid schistosome pose a threat to the success of the Nigerian schistosomiasis control programme, as little is known about the extent of the transmission of hybrid schistosomes and its epidemiological implications for Nigeria and this is a potential threat to the elimination of schistosomiasis in Nigeria by 2030. Therefore, in line with recent WHO recommendations, to meet the SDG 3.3 and WHO 2030 NTD road map for the elimination of schistosomiasis as a public health problem, there is a need to establish surveillance of schistosome hybrid in Nigeria. This study, therefore, aims to map, identify, and characterize the genetic diversity and risk of zoonotic schistosomiasis in Ogun State, Nigeria.

METHODOLOGY

Study area, Ethical consideration and Community sensitization

This study will be conducted in four schistosomiasis endemic communities where humans and cattle/livestock share the same open source of water in Odeda and Abeokuta North Local Government areas of Ogun state as described by Bayegun *et al*. (2022). Ethical clearance will be got from the State Ministry of Health and visits will be made to the selected communities before the study commences to seek permission from the community heads, parents/guardians and cattle farmers. The location of each study site will be geo-referenced using the Global Positioning System (GPS) receiver (Garmin 12XL) for map production of prevalence distribution.

Study design, study population and sampling method

The study will employ a community-based approach where interested participants in the endemic communities will be selected for the study.

Data collection and analysis

Urine samples will be collected from school children and adults (those whose occupation predisposes them to water contact). The field study shall adopt a non-invasive collection of urine samples from school children and stool samples from livestock (cattle, sheep, and goats) for

schistosome eggs. The collected human urine and animal stool samples will be examined for the presence of *Schistosoma* eggs using the sedimentation and salt/sugar flotation methods respectively. Individual eggs will be picked using the micropipette and stored on Whatman indicator cards (GE Healthcare Life Sciences; Amersham, UK) for further molecular studies. Human and animal water-contact sites will be surveyed for infected aquatic snails (*Bulinus* species), and examination and collection of same for schistosome cercariae (the infective larval stage for the definitive host) and the individual cercariae will be pipetted in a volume of 3µl of water onto Whatman FTA indicator cards (GE Healthcare Life Sciences; Amersham, UK) for molecular analysis. The molecular characterisation, genetic diversity and phylogenetic analysis will be performed in the molecular laboratory of the Public Health and Epidemiology department, Nigerian Institute for Medical Research where new molecular techniques based on a multi-locus approach (Webster *et al*., 2019), analysing both mitochondrial and nuclear DNA simultaneously from individually preserved eggs, cercaria and snail specimens will be employed to identify whether the species infecting the host is a human, animal, or hybrid schistosome. All the data collected will be analysed using SPSS version 26.0 for Windows. Descriptive statistics and differences in proportions will be tested using the Chi-square test, either for the trend or for independence, as appropriate. Differences between means will be tested using independent samples t-test and One-way analysis of variance (ANOVA).

LIMITATIONS

Possible limitations of this study include the inaccessibility of the cattle-rearing communities due to the incessant herder/farmer conflict; this will however be resolved through community sensitization of herders and farmers. Also, another major setback is the rejection of praziquantel drug, and this will be curbed through health education methods and sensitization of the study participants.

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