Mini Review
Volume 13:1, 2025

Journal of Health Education Research & Development

ISSN: 2380-5439 Open Access

The Use of Limnological Education to Eradicate Cyclops (The Vector of Guinea Worm *Dracunculus medinensis*)

Moshood Keke Mustapha*

Department of Zoology, University of Ilorin, Ilorin, Nigeria

Abstract

The presence of Cyclops, the intermediate host of Dracunculiasis or Guinea worm disease, in lentic waterbodies poses a challenge to eradication efforts. Despite progress, the disease persists due to new transmission routes *via* animals. To address this, limnological education is proposed, involving formal and informal teaching on Cyclops identification, biology, prevention and control. The education strategy includes awareness campaigns, public lectures, workshops and training using various tools such as pictorial charts, audio-visuals and handouts. Capacity building through monitoring, water quality management and the enhancement of treatment facilities is emphasized. Evaluation methods encompass interviews, surveys, quizzes and practical fieldwork to identify areas for improvement. Additionally, the integration of mobile applications for data collection and transmission is suggested, facilitating collaboration between limnologists, public health officials and government and non-governmental organizations. This socially and environmentally friendly limnological education approach aligns with the WHO's goal to eradicate Guinea worm disease by 2030.

Keywords: Limnology • Education • Cyclops • Dracunculiasis • Eradication • Water

Introduction

Lentic waterbodies such as lakes, reservoirs etc. provide many important functions which include provision of drinking water and also contain diverse species of planktonic organisms such as cyclops which are intermediate host of *Dracunculus medinensis* the organism causing Dracunculiasis or Guinea worm disease [1].

Dracunculiasis is a debilitating neglected tropical disease which affects many people in rural areas of Africa and Asia where it has been associated with reduced economic status and low levels of education [2]. The disease is transmitted by people drinking contaminated, untreated open stagnant surface water from reservoirs, lakes and ponds that are infested with Cyclops.

The transmission and life cycle of the parasite has been described by Pellegrino et al. Although the disease is on the verge of being eradicated, it has not been completely eradicated, but reduced from 3 million to 27 cases at the end of 2020 in Africa [3]. The deadline target date for the eradication of the disease was set at 2020 by WHO, but has now been postponed to 2030 due to new routes of transmission which was previously unknown coming from animals such as dogs, while baboons and cats have also implicated as reservoir host for the disease [4].

Infection in humans is through ingestion of Cyclops through drinking of contaminated water, while in animals is through eating aquatic animals such as frogs or fish that have ingested infected Cyclops which are in turn eaten raw or undercooked from which the parasite is released into gut. In both human and animal transmission of Dracunculiasis, the Cyclops is implicated in the transmission.

In order to eradicate the disease, limnological education of the people on sampling, identification, life cycle, behavior, transmission routes, prevention and control of Cyclops is needed. According to Moustafa, et al., Guinea worm eradication will be unachievable in the presence of high transmission potentials such as the intermediate host.

Limnological education is the use formal and informal teaching, learning and enlightening experience of limnology to solve challenges and problems, for sustainable use, to maintain the health status and for management of the inland waters and its vast resources.

Limnology is an integrative, interdisciplinary and multidisci plinary ecology/environmental study of the physical, chemical and biological characteristics of inland waters such as lakes, reservoirs, ponds and other stagnant waters. Limnological education which involves teaching the

***Address for Correspondence:** Moshood Keke Mustapha, Department of Zoology, University of Ilorin, Ilorin, Nigeria; E-mail: kmoshood@unilorin.edu.ng*

Received: 13 March, 2024, Manuscript No. JBHE-24-129441; **Editor assigned:** 18 March, 2024, PreQC No. JBHE-24-129441 (PQ); **Reviewed:** 02 April, 2024, QC No. JBHE-24-129441; **Revised:** 07 January, 2025, Manuscript No. JBHE-24-129441 (R); **Published:** 14 January, 2025, DOI: 10.37421/2380-5439.2025.13.173

people means by which physical, chemical and biological characteristics of water can be manipulated to control Cyclops and hence Guinea worm eradication thereby making WHO deadline target date of 20230 achievable.

Literature Review

This paper focuses on various ways through which limnological education can help in the control of Cyclops the intermediate host of Dracunculiasis or Guinea worm disease in water bodies and hence Dracunculiasis or Guinea worm disease could be eradicated by the people especially in rural communities in Africa and Asia where the disease has not been totally eradicated and new routes of transmission is emerging.

Using Limnological education to eradicate Dracunculiasis through control of Cyclops especially through the new routes of transmission from animals

The following limnological education and activities should be applied in rural communities where the people lack access to clean water, but drink contaminated, untreated open stagnant surface water from reservoirs, lakes and ponds.

Some of these activities highlighted below have been used to eradicate Guinea worm disease in the past, but with the surge in infection due to new routes of transmission, control of Cyclops which is the intermediate host of the disease and through which the disease is now becoming zoonotic by eating aquatic animals such as frogs or fish that have ingested infected Cyclops which are in turn eaten raw or undercooked by the people from which the parasite is released into gut is highly necessary in order to totally eradicate the disease.

Awareness and sensitization of the community that Guinea worm has not been totally eradicated and new routes of transmission is emerging through eating of Cyclops-infected animals. This could be done by advertisement, flyers, posters and banners where people in the community will be able to listen and see them. This is more pertinent to people in rural Africa and Asia where there are no health facilities to show such things.

Public lectures, workshops and training programmes which involve teaching and demonstrating to the participants on how to sample waterbodies for Cyclops with aid of plankton net/water sampler, their identification using powerful magnifying hand lens/microscope and field guides.

Educating the participants on the life cycle, behaviour, transmission routes of Cyclops which lead to Guinea worm infection and various ways of breaking their life cycle and transmission routes. These could be done using flip pictorial charts, audio-visuals, handouts, manuals, protocols, field guides and other interactive modules.

Boat trips on the waterbody to sample for Cyclops and monitoring of water quality in terms of the physico-chemical and biological parameters that favor the development, composition, diversity, distribution and abundance of Cyclops should be regularly organized.

Prevention and control of Cyclops should be taught to participants by demonstrating how to use pipe and filter cloths to sieve the water which contains the Cyclops before drinking, how to apply temephos (a WHO approved larvicide) in right concentration to kill the Cyclops and ways of introducing of natural predators such as fish species and the types of fish species into the reservoir to prey on the Cyclops.

Capacity building in the community to eradicate Cyclops could be done through monitoring and surveillance of the waterbodies to track Cyclops assemblages, management of the waterbodies to improve the water quality and prevent conditions that favour the assemblages of the Cyclops.

Community engagement and advocacy for rational, healthy and sustainable management of waterbodies involving partnerships of the community with industries, local businesses and stakeholders to ensure economically viable, socially acceptable and practical solutions to the eradication of Cyclops in the waterbodies. Capacity building could also be through the community building or improving water treatment facilities which will bring clean and safe water as well as providing equipment and resources for monitoring, prevention and control of Cyclops to the people.

Limnological data generated from the sampling and monitoring of Cyclops and water quality in the waterbodies should be made available to limnologists, public health officials, Government and Non-Governmental Organizations which can then be used to develop policies, regulations and control methods for Cyclops and Guinea worm in eradication in the community.

Evaluation of the success of Cyclops eradication in waterbodies should be done using interviews, questionnaire-based survey, quizzes, practical field work on

- Water sampling and Cyclops identification and biology.
- Ways of using cloth and pipe filters to sieve water.
- Application of temephos and introduction of fish species as natural predator of Cyclops

The evaluation will allow for assessment and feedback on using limnological education to eradicate Cyclops in waterbodies in order to identify areas of weakness, adjustment, improvement and further involvement for successful prevention and control of Cyclops in waterbodies and ultimately eradication of Guinea worm in the community [5].

Through the use of limnological education to control Cyclops in waterbodies, mobile applications could be developed and made available to the community to collect and transmit sampling and monitoring data of Cyclops and water quality in waterbodies.

All these limnological education and activities were suggested to be adopted by the rural communities in Africa and Asia where resurgence in the transmission of Guinea worm disease is occurring due to new routes of transmission [6].

My lessons from the field in Apodu community, a rural community in Malete, Kwara State, Nigeria, where the people lack access to clean water and drink contaminated, untreated open stagnant surface water from Apodu reservoir that is highly infested with Cyclops necessitated my suggestion for the use of limnological education which is a cheap and effective method to control Cyclops and eradication of Guinea worm disease.

The people in the community knew of the ravaging Guinea worm disease, but did not know that Cyclops is the intermediate host of the disease and the ways of controlling the vector. With the limnological education and activities suggested to the community, there is now a reduction in the transmission of the disease in the community, thanks to Cyclops control [7].

For this effort of mine, the Association for the Science of Limnology and Oceanography (ASLO) Education and Engagement Committee awarded me the ASLO Global Outreach Initiative Award and fund to use limnological education to eradicate Dracunculiasis through Cyclops control especially through the new routes of transmission from animals in Apodu community, Malete, Kwara State, Nigeria.

Anticipated outcomes in using limnological education to eradicate Cyclops and eradication of Guinea worm disease.

By the use of limnological education to eradicate Cyclops in rural communities of Africa and Asia, the people in these areas will be able to know that

Cyclops is the intermediate host of Guinea worm infection and that Guinea worm has not been totally eradicated, with new routes of transmission emerging through animals. This will enable the community to have more knowledge, information and behavioral changes about drinking water from open surface waterbodies contaminated with Cyclops in particular and the Guinea worm disease in general [8].

The community will be able to sample and monitor waterbodies themselves regularly for Cyclops, identify them, break their life cycle and transmission routes, understand the factors (physical, chemical and biological) that contribute to their composition, diversity, distribution and abundance and the various methods (physical, chemical and biological) that can be used in controlling them.

They will be able to prevent and control Cyclops in waterbodies using cloth and pipe filters appropriately, know how to apply temephos (ABATE) in the right concentration to kill the Cyclops and types of fish species that can be introduced as natural predators of Cyclops in waterbodies [9].

Whole community involvement and capacity building in the sampling, monitoring, surveillance, prevention and control of Cyclops, improvement of the water quality and prevention of conditions that favor the assemblages of the Cyclops. Capacity building would enable the community to build or improve water treatment facilities which will bring clean and safe water as well as providing equipment and resources for monitoring, prevention and control of Cyclops to the people and ultimately to the eradication of Guinea worm in the community.

Community engagement and advocacy for rational, healthy and sustainable management of waterbodies involving partnerships with industries and local businesses and stakeholders to ensure economically viable, socially acceptable and practical solutions to the eradication of Cyclops in the waterbodies

Mobile application would be developed to transmit data from sampling and monitoring of Cyclops and water quality in the waterbodies which could then be made available to limnologists, public health officials, government and non-governmental organizations etc. to develop policies, regulations, control and eradication of Cyclops assemblages in waterbodies and eradication of Guinea worm in the community.

The post-evaluation of using limnological education to eradicate Cyclops will show the effectiveness of limnological education to control, prevent and eradicate Cyclops in waterbodies and Guinea worm disease entirely. The post-evaluation would be followed up periodically to test the knowledge acquired by the participants from using limnological education to eradicate Cyclops from waterbodies. The results of the evaluation will be transmitted to public health officials, government and non-governmental organizations to justify or adjust the developed policies, regulations and limnologically education inclined prevention and control methods of eradication of Cyclops in waterbodies towards the successful eradication of Guinea worm in the community.

The anticipated outcomes are already manifesting in Apodu community, Malete, Nigeria.

Conclusion

With the postponement of the deadline target date for the eradication of Guinea worm by WHO to 20230 and the new routes of transmission which was previously unknown coming from animals such as dogs, baboons and cats, in order to eradicate the disease by this target date, it is highly imperative to control Cyclops which are the intermediate host of the disease. The best way of achieving the eradication of the disease and meeting up with WHO new target date is to use simple limnological education which is cheap, socially and environmentally friendly and which people can key into. This is more pertinent since the disease is found in rural communities of Africa and Asia with reduced economic status and low levels of education and the people drink from contaminated, untreated open stagnant surface waterbodies such as reservoirs, lakes and ponds that are infested with Cyclops.

Acknowledgements

The author acknowledges Apodu community in Malate, Kwara State Nigeria for allowing the author give limnological education and activities to the people.

Declarations

MKM designed and implemented the study, analyzed and interpreted the data, wrote, read and approved the final version of the manuscript.

Authors' Contributions

MKM designed and implemented the study, analyzed and interpreted the data, wrote, read and approved the final version of the manuscript.

Funding

None.

Conflicts of Interest

None declared.

Ethical Approval

Not required.

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How to cite this article: Mustapha, Moshood Keke. "The Use of Limnological Education to Eradicate Cyclops (The Vector of Guinea Worm D*racunculus Medinensis*)." *J Health Edu Res Dev* 13 (2025): 173.