TEACHING ABOUT GUINEA WORM PREVENTION: A MANUAL FOR SECONDARY SCHOOL TEACHERS

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Prepared for the Office of Health,
Bureau for Science and Technology,
U.S. Agency for International Development
under WASH Activity No. 375

by

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Chapter 1

INTRODUCTION

This is a teachers' guide on guinea worm prevention. It is intended for training of secondary school teachers teaching hygiene education/health programs. Secondary school students are highly respected in many village communities. They can influence community decisions and their parents' behavior. The guide was originally prepared as part of a program on Family Life Education in Nigeria, but it can be adapted by teachers in other countries. It consists of a set of lesson plans with supporting background materials for teachers to use. It includes content material as well as suggestions for classroom activities to show students how to inform their parents and siblings about the prevention of guinea worm. The message to be imparted through the students is for communities to take the initiative for building and maintaining a potable water source. Coupled with preventive health practices, this is the only practical way to stop the spread of the disease.

Included in Chapter 2 is an outline for a training workshop for teachers who will be using the guide.

Teachers play a very important role in rural communities in developing countries. Community members generally view them as role models, links to the "outside" world, and individuals of great knowledge. Secondary school teachers are particularly important, as their role is one of imparting an important body of knowledge.

Within their households and communities, young people attending secondary schools command special respect. They can influence the behaviors of siblings and frequently their advice is sought by household elders.

For all the above reasons, secondary school teachers are placed in the very important position of influencing behavior for guinea worm prevention in rural communities.

Chapter 3 consists of notes on different methodologies for the teacher's use, general guidelines for guinea worm educational activities, a vocabulary list to which trainees can add, and a list of persons and organizations who can be contacted to assist in carrying out the training session.

Chapter 4 contains an overview of the total unit, along with the objectives and expected outcomes. Lesson plans are provided for the teacher's use in the classroom. This section consists of four sessions which include life cycle and transmission, prevention, an exercise on water filtration, and identification and treatment. The lesson plans include discussion outlines and three stories with accompanying questions for discussion. Each of these parts can be pulled out of the text for duplication purposes for the students.

At the end of this manual are articles relevant to the content of this training unit. Some articles are recommended in the sessions for reading, while others have been included for general interest in the subject matter.

Chapter 2

TEACHERS' WORKSHOP

A. WORKSHOP SCHEDULE

1:30	Introduction
1:50	Lecture
2:20	Full group discussions on prevention and prioritizing options
3:15	Break
3:30	Filtering experiment and practice of process
4:00	Review materials. Asking everyone to quietly review and ask any questions on what was presented
4:30	Role of the teacher in the control of guinea worm in their communities
5:00	Wrap up

B. AGENDA FOR TEACHERS' WORKSHOP

1:30 - 1:50 p.m. INTRODUCTION TO THE TOPIC

- Solicit responses from large group regarding what they know about guinea worm, what traditional beliefs they may know about, whether or not they know anyone who has had guinea worm, and how they know when someone has it.
- Present session objectives

1:50 - 2:20 p.m. LECTURE BY EXPERT

Lecture should cover the history, prevalence, etiology (life cycle and transmission), clinical symptoms, complications/physical effects, and social/economic effects of guinea worm disease as well as how the disease is treated.

2:20 - 3:30 p.m. PREVENTION

- Large group generates list of ways to prevent the disease (record on flip chart).
- Resource person reviews list, elaborates on the alternatives generated by the group, and supplies additional information on water technologies not mentioned by the group.
- Participants divide into small groups to discuss the advantages and disadvantages of each prevention option (optionally, each small group is assigned two or three options to discuss). The resource person emphasizes the importance of community responsibility in prevention strategies.

3:30 - 3:45 p.m. BREAK

3:45 - 4:15 p.m. REPORTS FROM SMALL GROUPS

4:15 - 4:45 p.m. PRIORITIZE OPTIONS

- Plenary session. The methodologies are rated on the basis of cost, convenience, acceptability, level of difficulty, and long-term effectiveness.

4:45 - 5:10 p.m. WRAP UP

- The resource person recapitulates the main points, emphasizing the desirability of prevention over treatment and the importance of community responsibility. The resource person also reviews the role of educators in disease prevention and the guidelines for educational activities related to guinea worm disease. (See Chapter 2--Resource Materials)

Chapter 3

RESOURCE MATERIALS FOR TEACHERS

A. GUIDELINES FOR GUINEA WORM EDUCATIONAL ACTIVITIES

Community health education in concert with the provision of safe water sources is the key to the long-term success of guinea worm control. No technological "solutions" can be expected to succeed without concurrent educational interventions.

Two categories of educational activities are needed in any guinea worm program:

- Educational activities directed at helping the community to tackle the problem of guinea worm for the population as a whole, including the building of a viable and safe water source.

- Educational activities designed to help the individual cope more effectively with the problems of maintaining personal and family health and welfare in a community whose sources of drinking water are infected with guinea worm.

While the exact content, emphasis and target groups of guinea worm educational activities will vary according to the special circumstances and conditions of the affected community, the process of educational activities will need to have certain characteristics to be effective, regardless of content:

1) It should be active rather than passive. The target population should participate, take responsibility, guide, direct, evaluate, and contribute to the educational process, rather than merely serve as recipients of information.

2) It should be legitimate in the eyes of the community. It should be carried out by educators who are trusted and respected. It should be based on concepts, beliefs, and perceptions that the community finds believable and acceptable. The end result should be that the community decides to take specific actions that they can realize with the resources available to them.

3) It should bring about sustainable change. It should change behavior as a result of changes in attitude. A change in passive knowledge is not enough.

4) It should weave a net of messages into which nearly everyone is caught. Community leaders, both traditional and modern, government representatives and other people likely to lead community opinion must be convinced that the proposed strategies are legitimate and desirable. Specific messages, methods, and communication techniques should be directed at different groups in the community: men, women, children, elders, youth, etc.

5) It should emphasize problem-solving, be positive rather than negative. The emphasis should be on what people can do to improve the situation, on how to overcome obstacles, on how to solve problems--rather than on what should not be done, what old behaviors are negative, or what should be avoided. "DO" should be the focus of discussion rather than "DON'T."

6) It should be flexible, constantly evaluated and readapted to reflect the needs and interests of the community. It should respond to the priorities, interests, opportunities, and needs of the community as perceived by its members. These needs may change over time. If they do, the educational activities should change also. The process must assure regular opportunities for feedback and review, thus keeping a check on the "pulse" of the community. Also, the process must take into account the other, possibly conflicting, responsibilities, needs, and commitments of community members and adapt to them.

7) It should provide tangible, visible rewards for community efforts, both short- and long-term. Initial activities should consist of actions that produce quick results so that people see progress. At the same time momentum for a more long-term effort should be built. These activities will provide learning opportunities for management and organizational skills necessary to sustain a true control program. Initial activities should focus on projects that the target population perceives to be most important rather than those that the educators want.

B. HEALTH EDUCATION METHODS

Health education consists of learning activities which help people choose to behave in a manner that enhances their health. These learning activities provide information, promote understanding, mobilize community resources, teach living skills, and encourage social (family and group) support for healthy life styles. Several health education activities that can be used at the village level with minimum cost are described below. Normally a good health education program uses a mixture of these activities.

1. Group Discussion

Group discussions are useful for learning about community beliefs and needs, creating understanding about new ideas, and encouraging decisions for action. Discussions can be held with community leaders, people attending clinics, members of local organizations, and pupils at school.

During a discussion a health worker must be ready to learn from community members as well as to provide them with new knowledge. By listening to community members talk about their beliefs, the health worker can look for similarities between local and scientific ideas of guinea worm cause, prevention, and treatment. Discussion can begin with what is already known and then can move on to the scientific point of view.

Discussions are also an important part of community involvement. During a discussion community members can air their views about what actions against guinea worm are acceptable and affordable. Planning for guinea worm control can grow out of such discussion sessions.

2. Demonstrations

Demonstrations are valuable for teaching people new skills. Filtering water to prevent guinea worm is one such skill. A demonstration should be realistic, using local water pots and available material for filtering.

The health worker should explain carefully each step as he or she performs the demonstration. Community members should be given an opportunity to repeat the demonstration and to receive feedback and correction from those watching.

To make the demonstration more vivid, the water used in the demonstration should be the same pond water that people in the village actually use. After the water has been filtered, the filter can be turned over into a small glass jar and any cyclops caught in the filter can be washed into the jar with clear water. Everyone can then actually see the cyclops. A magnifying glass or hand lens is helpful but is not absolutely necessary.

3. Stories

A traditional way of imparting knowledge and values in many villages is telling stories. Health workers can also find story-telling useful in health education. By listening to a story, community members should be able to gain insight on which behaviors are healthy and which are harmful.

A story should be realistic and believable. At the same time it should not be about real people in the village, as this may embarrass them. Stories should always be followed by discussion. The story-teller should ask the listeners questions to determine whether or not they understood the main points of the story. Sample stories are included here in Part 3: Teaching Materials. One story shows how two boys got guinea worm and what was done for prevention. Sample questions are also included.

4. Posters

Posters can provide simple pieces of information and make health talks more interesting. Each poster should contain no more than one picture and one idea.

Posters on guinea worm may be available from the Ministry of Health, but homemade posters are just as effective. Even school children can be involved in a poster-making contest. Not only will the posters be useful in the community, but also the children will learn about guinea worm in the process.

Homemade posters can use the backs of old calendars or old posters or signs. Pictures can be cut from magazines or traced or hand drawn.

When using a poster during a talk, the student in his community should always involve his or her community fully. He will first ask people what they see in the poster. If a poster shows a person collecting water from the pond, the following discussion questions may be asked to encourage people to learn the message contained in the poster:

What is the women doing?
Why is she collecting water from the pond?
Is there any danger in this practice?
How could the woman make sure that the drinking water is clean?

5. Proverbs

In all cultures proverbs remind people of desirable behaviors and values. Talks and discussions should use proverbs to emphasize important points. In western Nigeria there is a proverb that says, "Before guinea worm becomes an ulcer, it is oluganbe leaf we call for." Literally, this proverb means that when a problem strikes that can get out of hand, we have to consult with elders to help us stop it, whether it is guinea worm or the oluganbe plant. The oluganbe leaf is part of a plant that often becomes unmanageable and takes over crop areas. This proverb is similar to the English saying, "A stitch in time saves nine." Both emphasize the need to take quick action before a problem becomes worse.

6. Songs

Songs provide simple information and are a good way to help people remember new ideas. The teacher can pick a tune that people already know and add new words about preventing guinea worm. Such a song can be sung several times at the beginning and end of health talks and meetings to help people think about action they can take to avoid the disease.

7. Drama

Drama is an exciting and entertaining way to teach new ideas and values. A story like the one on guinea worm described above can form the basis of a drama. School children can be involved in the drama, or a local drama group can be called in to help.

In order to ensure that the points of the drama are understood by the audience, the health worker must lead a discussion with the audience after the drama is over. The discussion questions can be similar to those used after a story, with both the actors and the audience involved in the discussion. The actors can ask the audience for advice on what they could do the next time to prevent guinea worm.

8. Health Talks

Health talks are really group health education presentations. These presentations should include posters, proverbs, songs, etc. The health worker should plan to visit major community organizations, schools, markets, and clinics to talk about guinea worm and rally support for community actions.

C. VOCABULARY LIST

Abate - See Temphos.

Dracunculiasis - parasitic, water-related disease caused by a long, string-like female worm--the nematode Dracunculus medinensis. Larval form infects intermediate crustacean host, cyclops, which infests drinking water sources. Disease is seldom fatal but often debilitating. Preventable by protecting water supplies and targeted for eradication by the World Health Organization. Usually called guinea worm disease.

Dracunculiasis Medinensis - nematode parasite which causes dracunculiasis.

Cyclops - water flea which acts as intermediate host for the parasite Dracunculus medinensis in the transmission of dracunculiasis (guinea worm disease).

Guinea Worm - commonly used name for dracunculiasis.

Incidence - The number of new cases of a disease in a defined population over a specific period of time.

Incubation - the period between the infection of an individual by a pathogen and the manifestation of the disease it causes.

Larva - The immature, often vermiform feeding form that hatches from the egg of many insects. This alters chiefly in size while passing through several stages and is finally transformed into a pupa or chrysalis from which the adult emerges.

Malaria - a water-related disease caused by sporozoan parasites of the genus Plasmodium in the red blood cells. Transmitted by the bite of female anopheline mosquitoes and characterized by attacks of chills and fever.

Onchocerciasis - parasitic, water-related disease, caused by infection by the nematode Onchocerca. This parasite invades the skin and subcutaneous and other tissues and produces fibrous modules. Blindness occurs after ocular invasion. Often called river blindness.

Prevalence - The percentage of a population that is affected with a particular disease at a given time.

River Blindness - commonly used name for onchocerciasis.

Schistosomiasis - parasitic, water-related disease, caused by infection by one of the genus of blood flukes, Schistosoma. Intermediate invertebrate hosts are certain snails. Specific acute stage symptoms vary with specific parasite, but complications are primarily related to fibrosis around eggs laid in sensitive tissues and vital organs.

Septicemia - invasion of the blood stream by virulent micro-organisms from a local seat of infection.

Sobia - Yoruba word for dracunculiasis.

- Igbo word for dracunculiasis.

- Hausa word for dracunculiasis.

Temphos - insecticide most commonly used for periodic chemical treatment of water to kill cyclops. It is sold under the brand name Abate. At concentrations of one part per million it is effective, odorless, tasteless, colorless and harmless to fish and vegetation. Also used to control blackfly vector of onchocerciasis.

Tetanus - an acute infectious disease, characterized by involuntary spasm of muscles, especially the jaw, and caused by the specific toxin of a bacillus (Clostridium tetani) which is usually introduced through a wound.

Chapter 4

SAMPLE LESSON PLANS FOR A GUINEA WORM UNIT

OVERVIEW OF THE UNIT

These materials outline a unit on dracunculiasis (guinea worm disease) for use for classroom teachers. The purpose of the unit is to improve the knowledge and skills of secondary school students with regard to the identification, treatment, and prevention of the disease. The exercises described are specifically designed to require few or no visual aids or printed materials and to be easily adjusted to variable conditions of room and class size.

Goals and Objectives

- To inform students about the nature of dracunculiasis (guinea worm), its mode of transmission, its clinical symptoms, and its consequences both for the individual and for the community.
- To make the students aware of methods available for the prevention and control of dracunculiasis, both at the individual/family and community level.
- To make the students aware of methods for treating persons infected with dracunculiasis.

At the end of the unit the students will be able to:

- Describe the life cycle of the guinea worm and the cycle of transmission to humans.
- Identify the "cyclops" that carries dracunculiasis and where it is to be found.
- Describe the clinical symptoms of dracunculiasis infection.
- List at least one adverse economic and one adverse social effect of dracunculiasis.
- List at least two individual/family-level methods for preventing dracunculiasis infection.
- Describe treatment procedures and concerns for an individual case of dracunculiasis infection.
- Describe the mechanics of filtering water through a cloth sieve and the rationale behind this procedure.

Organization of the Unit

The unit consists of a sample lesson plan and a number of background materials. The exercises in the lesson plan are keyed to background materials; therefore, it is recommended that teachers read and become familiar with the entire package before attempting to teach the unit.

The sample lesson plan is divided into four sessions each covering a specific topic and each meant to last an hour and a half. The time allotted for the sessions does not include breaks or lunch. Each session includes guidelines on how to conduct the session. These guidelines cover the purposes of the session, materials required, suggested advance reading for teachers, and procedures.

This segmented approach was adopted because the curricula and the time available for health education vary from state to state in Nigeria. It should provide maximum flexibility to the teacher in integrating guinea worm prevention and control concepts into his/her local situation.

SESSION #1: THE LIFE CYCLE AND TRANSMISSION OF GUINEA WORM

Purposes

1. To provide students with accurate information about the transmission of guinea worm through drinking water.

2. *To provide students with an opportunity to discuss traditional* local beliefs regarding guinea worm transmission.

3. To provide students with an opportunity to discuss methods of preventing guinea worm transmission including individual and community behavioral change.

Materials

1. Handout: Story #1 The Life Cycle and Transmission of Guinea Worm

2. Materials presented in part 1 of discussion outline

3. Blackboard and Chalk

4. Posters (if available)

Time: 70 Minutes

Advance Reading for Teachers

Background Reference #1, page 53:

> Guinea Worm Disease: Epidemiology, Control and Treatment by R. Muller.

Procedures

1. Introduction. Begin by introducing the topic and soliciting responses from the students regarding their current knowledge of guinea worm, e.g., what traditional beliefs are they familiar with? Do they know anyone who has had guinea worm? How can one tell when someone has guinea worm? etc.

2. Lecturette. Proceed with a lecturette on the cycle and transmission of guinea worm following the points given in Part One of the Discussion Outline. Posters showing the transmission cycle can be used to enhance the explanation if they are available.

3. Discussion. Introduce the discussion exercise. Then read Story #1 from the Handout to the group. Follow-up the story by conducting a discussion based on the discussion questions which accompany Story #1.

4. Wrap-up. Emphasize the following points:

   - Guinea worm can be transmitted only by drinking contaminated water.

   - A person's understanding of a problem can affect his/her behavior.

   - Prevention of guinea worm is preferable to treatment.

DISCUSSION OUTLINE

Part One: Life Cycle and Transmission

Historically one of the oldest-recorded diseases.

Parasite infection:

- The female worm (Dracunculus medinensia) lives in humans and emerges from an open sore.
- Larval form from the open sore infects intermediate crustacean cyclops, a water flea.
- Cyclops inhabit sources of drinking water.

Prevalence:

- Common in parts of Africa and Asia.
- In Africa, 19 countries, including Nigeria, are known to be infected in a belt extending across the northern part of the continent. Annual estimated incidence in Africa is 3.32 million cases and the population at risk is approximately 120 million.
- In Nigeria, about 2 to 5 million people are infected annually. Guinea worm disease is present in all Nigerian states, although some are more heavily infected than others.

Etiology and Life Cycle:

- When people drink water containing the cyclops that carry the infective third-stage larvae, gastric juices in the stomach kill the cyclops and free the larvae. These larvae then dig through the digestive tract and live in the abdomen. Male and female worms mate at three months and then the males die. The female continues to grow into an adult worm and moves toward the skin surface. The worms do not survive in people for more than one year--they either come out through the skin or die inside the body. Worms that die are absorbed and usually cause no symptoms.
- After an incubation or growing period of up to 12 months, the adult female worm moves to a position under the skin of the person suffering. A painful blister appears, usually on the lower leg or foot.

- When the person puts the affected part of the body in water, the blister breaks and hundreds of thousands of tiny first-stage larvae are released into the water. The adult female worm then emerges slowly through the sore made by the broken blister, usually taking about four weeks. This worm is very thin but may be as long as one meter. An individual might have up to 20 sores and worms emerging. In women, the worms can emerge from the breasts.

- Some of the larvae in the water are eaten by the "cyclops," or water fleas, where they live and develop into third-stage larvae. These third-stage larvae, living inside the water flea, pass on guinea worm infection to people. The moving water fleas are barely visible if water containing them is held up to a light.

Transmission:

- Necessary conditions for transmission:

    1. A body of water where the right type of cyclops (water flea) can act as an intermediate host.

    2. The water temperature must be between 25 and 30° Centigrade.

    3. An actively infected person to introduce the worm larvae into the body of water.

    4. The worm larvae must be ingested by the cyclops within 5 days or it will die.

    5. The larvae must remain in the cyclops for about 14 days to develop.

    6. A person must ingest the raw, infected cyclops by drinking contaminated water.

- Guinea worm disease can only be transmitted through drinking contaminated water; there is no alternative infective pathway.

- Thus, guinea worm disease is the only water-related disease that can be entirely prevented by protecting supplies of drinking water.

- The transmission season of the disease usually occurs during the dry season when water is scarce and sources highly contaminated. It is affected by seasonality, climatic conditions, local pattern of rainfall, and the prevalence of step wells and open cisterns.

- The disease has been targeted for elimination by the World Health Organization.

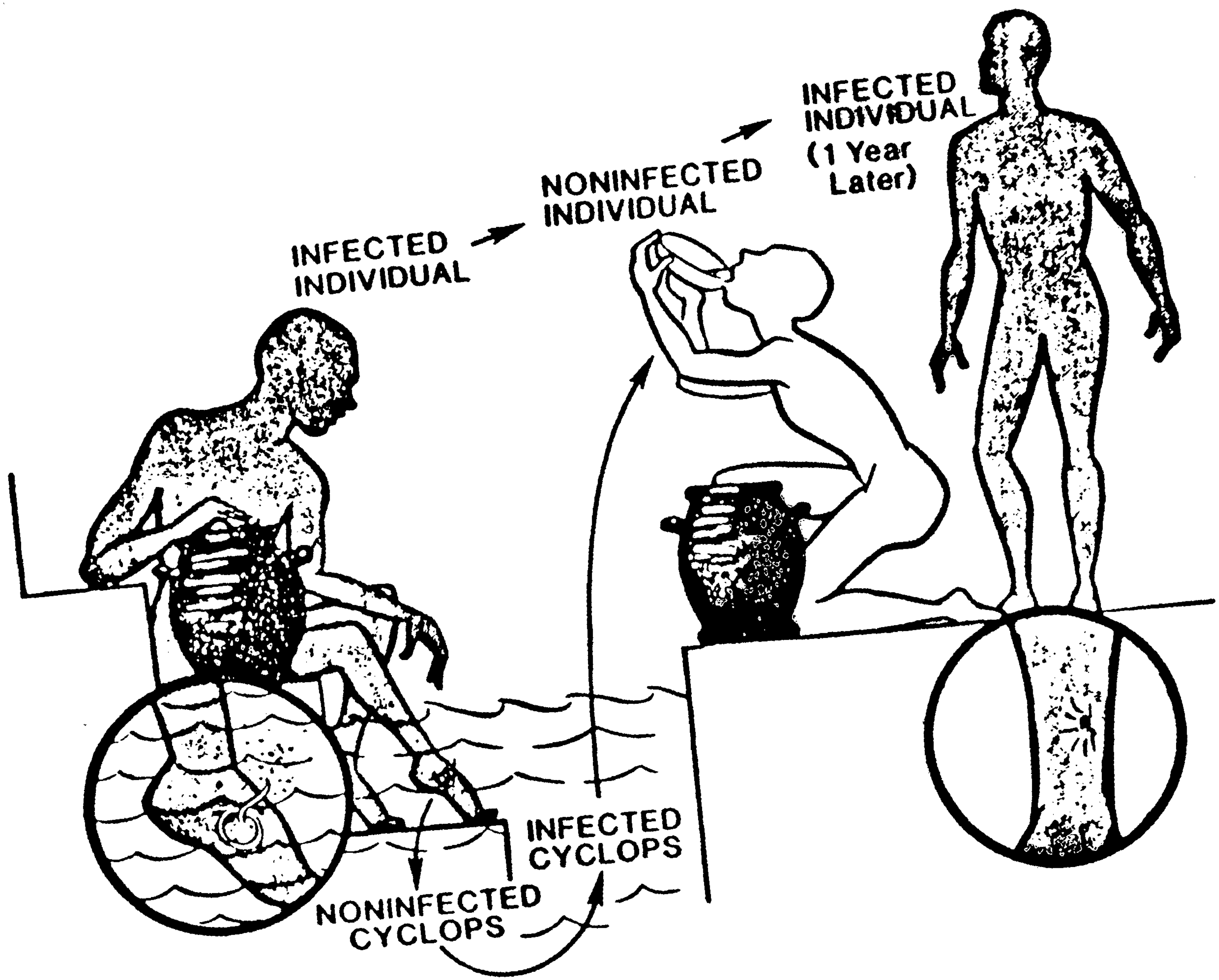

FIGURE 1 Life cycle of *Dracunculus medinensis*. (Source: Centers for Disease Control 1981)

STORY #1: THE LIFE CYCLE AND TRANSMISSION OF GUINEA WORM

Dale and Sina are best friends. Dale is from Idere and Sina is from Igbo-Ora. Both boys are students in form two at Okedere High School.

One day in November, Sina came to school and found that Dale was absent. After school Sina went to visit Dale to see what was the problem. He found that Dale had been knocked down by guinea worm. The disease was hurting Dale too much and he could not walk.

Sina said, "Dale, every year you get this guinea worm, but I do not. Why is this so?" Dale answered, "Our teacher says that drinking dirty water causes guinea worm. You know that Igbo-Ora has tap water, but here in Idere we fetch our water from ponds."

Sina said, "I do not believe you. My grandmother says that guinea worm is in the blood and will come out any time it wants to if blood becomes weak. I do not get guinea worm because my family has strong blood."

While the boys were arguing about the cause of guinea worm, Dale's mother entered the room and asked the boys to take food. Since Sina was hot and tired from work on the school farm and sports, he ate plenty of food and drank plenty of water.

After finishing the food, Sina looked up and saw that the sun was setting. He said, "I better reach home before dark." After thanking Dale and his mother for the hospitality, Sina started on his way back to Igbo-Ora.

Finally Dale recovered from the guinea worm after some weeks. Sina was glad to see has friend back in school. They started playing and talking and forgot all about the guinea worm. Both boys did well in school that year and passed on to form three.

In September Dale and Sina returned to school. November came around again, but this year it was Dale who found that Sina was absent from school. Dale went to Igbo-Ora right after school and found Sina on his sickbed complaining of guinea worm.

Sina was worried. He asked, "Why do I have guinea worm? I never had it before. You said that if I drank clean water I would not get the disease. I only drink tap water in Igbo-Ora."

Then Dale reminded Sina that last year in Idere Sina had drunk water at Dale's house. Dale said, "Remember that our teacher says that guinea worm takes a year to grow. The water you drank in Idere last year gave you guinea worm."

Dale explained more. "After you left our house that day last year, my mother asked me what we were arguing about. I explained that when a person with guinea worm puts his leg in water, the worm lays eggs in the water. Then when another person drinks the water, he also drinks the guinea worm eggs.

"From that day on, my mother started filtering our drinking water through a clean cloth. This year no one in our family has guinea worm. Now my father and his brothers are planning to dig a well for our compound so no one will get guinea worm again."

Sina praised the efforts of Dale's family and promised that from that day onward he would always take his drinking water from a clean source.

Discussion Questions:

1. Why did Dale and Sina get guinea worm?
2. How does guinea worm spread?
3. What happens to someone who has guinea worm?
4. How did Dale's family prevent guinea worm the next year?
5. What are some of the different ways we can make sure our drinking water is safe from guinea worm disease?

SESSION #2: PREVENTION OF GUINEA WORM

Purposes

1. To enable students to identify safe drinking water sources.
2. To enable students to identify methods for purifying contaminated water.
3. To enable students to identify methods to prevent the contamination (or recontamination) of drinking water supplies.
4. To demonstrate the necessity and effectiveness of community action in providing safe water supplies.

Materials

Handout: Story #2 Prevention of Guinea Worm

Time: 75 Minutes.

Advance Reading for Teachers

Background Reference #2, page 57:

The Problem and Control of Dracunculiasis (Guinea Worm Disease) in Nigeria: The Operational Aspects by L. D. Edungbola.

Background Reference #4, page 73:

Impact of Guinea Worm Disease on Children in Nigeria by V. A. Ilegbodu et al.

Background Reference #5, page 75:

Using Teachers as Change Agents in the Control of Tropical Diseases--an Extra-curricular Approach by H. E. Ekeh and J. D. Adeniyi.

Procedures

1. Introduction. Introduce the topic by reviewing the main points of the previous segment on the life cycle and transmission of guinea worm.

2. Discussion. Proceed by introducing the discussion exercise. Read Story #2 from the Handout. Following the story, conduct a discussion based on the first set of discussion questions, which accompany Story #2.

3. Lecturette. Review methods to insure that drinking water supplies do not contain guinea worm larvae and methods to prevent contamination (or recontamination) of clean drinking water supplies. A summary of methods accompanies Story #2 in the handout. Also, Part Three of Discussion Outline may be used.

4. Discussion. Conduct second large group discussion based on the second set of discussion questions which accompany Story #2.

5. Wrap-Up. Summarize the lecturette by emphasizing the need for health education and community action to provide safe water supplies.

DISCUSSION OUTLINE

Part Two: Prevention

Prevention--Individual/Family Level:

- Sterilizing contaminated water by
  - filtering with cloth and/or special filters,
  - filtering through sand and charcoal,
  - sterilizing with solar heat, or
  - boiling.
- Selecting non-contaminated water for drinking by
  - determining which sources are "safe" and
  - devising ways to avoid drinking contaminated water when away from home.

Prevention--Community Level:

- Becoming aware of the relationship of water to guinea worm.
- Learning about the causes or transmission of the disease.
- Avoiding contamination of water sources by
  - building platforms or creating places for water-users to stand so that they don't have to put their infected limbs in the water,
  - counseling guinea worm patients to avoid submerging their wounds,
  - preventing children from playing or bathing in drinking-water sources, and
  - controlling cyclops populations.

- Making sure that contaminated water sources are not used for drinking water by

  - regulating the use of contaminated sources,

  - constructing/creating alternate, non-contaminated sources, and

  - teaching community members how to practice personal prevention (filtering, boiling or sterilizing contaminated water).

STORY #2: PREVENTION OF GUINEA WORM

The people of Ajegunle village enjoy their life most of the time. They grow cocoa, cassava, yams, maize, and fruits. The money they make from selling these crops has been used in many ways to improve their lives. Most houses have iron sheet roofs. Several farmers have bought motorcycles. Most people have radios.

The people of Ajegunle enjoy life EXCEPT in the DRY SEASON. Every year by January or February their stream goes dry. The women dig deeper, but only small amounts of water seep slowly out. If a woman or child goes to collect water in the morning, she may not return home before late in the evening.

Life is uncomfortable during the dry season. People cannot take their bath or wash clothes because water is scarce. Diseases like guinea worm and diarrhea spread because of the dirty pond water. Small onion farms grown by the women dry up because there is no water. Children miss school because it takes too long to collect water.

Wasinmi village is about five miles from Ajegunle. Farmers in Wasinmi grow cocoa, yams, fruits, and other crops--just like the farmers in Ajegunle. In Wasinmi they use the profit from their crops to enjoy life also. And the dry season in Wasinmi used to be troublesome too.

One day three years ago, the Baale of Wasinmi heard a health worker talk about improving community water supply. The Baale returned home and called his people together to discuss the idea. He said, "Every year in the dry season we suffer. Our women waste time searching for water. We cannot take our bath or wash clothes regularly. We get so many diseases like guinea worm and diarrhea. What can we do to help ourselves?"

Some people suggested that the village dig a proper well. Everyone liked the idea and promised to contribute money and labor. The Baale then contacted the health worker for help. The health worker came and helped the people find a good site for the well. He also instructed them on how to build it properly. With the cooperation of all villagers, the well was dug. Today, life in Wasinmi is enjoyable all year long. They can have their bath and wash clothes whenever they wish. They no longer suffer from guinea worm.

Discussion Questions I

1. What problems do the people of Ajegunle have in the dry season?

2. Why do people in Ajegunle continue to suffer so much?

3. What could people in Ajegunle do to solve their problem?

4. If you were a member of Ajegunle village, how would you help your people?

Review of Methods of Prevention

1. The best way to prevent guinea worm is to drink clean water that contains NO guinea worm eggs.

   a. Dig a sanitary well or borehole--give details, show pictures (where appropriate also discuss the action to take on a community basis with the Water Corporation).

   b. Make a tank (above or below ground) to collect and store water during the rainy season--show pictures of how to make a tank and collect rainwater off the roof.

   c. Filter pond water through a clean cloth to remove guinea worm eggs--demonstrate this with cloth, buckets, and water.

   d. Boil pond water to kill guinea worm eggs.

   e. Put bleaching powder or other chemicals in water to kill guinea worm eggs (and the cyclops which eat these eggs)--explain dangers and inconveniences of this method and the fact that new eggs and cyclops may come back.

2. Another general way to prevent guinea worm is to make sure guinea worm eggs never enter water in the first place.

   a. Do not allow people with guinea worm sores to go near the pond at all. Send other people to fetch water.

   b. Build a small wall or stone steps at the pond so that people do not have to enter the water when they fetch it--show diagram.

c. Discuss how villagers can be vigilant and keep guinea worm sufferers away from ponds.

Discussion Questions II

1. Under existing circumstances in our town or village, what are the best and easiest ways to prevent guinea worm?

2. When we go home after this lesson, how will we start to solve the problem?

3. How can we educate our people about this problem?

4. Remember that people have already drunk some guinea worm eggs this year. These worms will come out during next dry season. It will therefore take two years to see results from our efforts. But unless we act now, the problem will continue and may become worse.

SESSION #3: EXERCISE ON WATER FILTRATION

Purposes

1. To demonstrate that there are small organisms in the water that can swallow guinea worm larvae.

2. To provide an opportunity for each student to demonstrate and explain the procedure of water filtration to a group.

Materials

For each table: Contaminated water, bucket, cup, cloth sieve (100 mesh/cm monofilament nylon gauze), magnifying glass, poster showing cycle of transmission.

Time: 45-75 Minutes (depending on the number of students)

Procedures

1. Introduction. Divide class into small groups of six to eight students. Begin by asking the group if they are familiar with any filtering methods used by members of the community. Remind them how impurities are filtered from palm wine. Are there other similar filtering methods? Clarify with the whole group the purposes of the exercise and the sequence of events.

2. Demonstration. Proceed by demonstrating the water filtration process for the large group. Refer to the poster (if available) showing the transmission cycle and point out how filtering interrupts the cycle by preventing the ingestion of the intermediate host (cyclops). Discuss how a sieve can be constructed from local materials, specifying the type of cloth that is necessary (i.e., the weave must be fine enough to trap cyclops but open enough not to clog with sediment). Explain the difference between the "clean side" of the sieve and the "dirty side". Show how to clean the sieve after it has been used and how to dispose of contaminated water. If a magnifying glass is available, use it to show the students at one table the small organisms that were filtered from the water sample.

3. Group Work. After the demonstration, ask each student to repeat the procedure and explain it to the other students in the group.

4. Wrap-Up. After each student has had an opportunity to try the filtering method, spend a few minutes soliciting reactions from the students regarding their experience. Make the point that this low-cost, low-tech strategy enables any family to protect its drinking water supply. Encourage the students to share their experiences with family members.

SESSION #4: GUINEA WORM IDENTIFICATION AND TREATMENT

Purposes

1. To enable students to identify the signs and symptoms of guinea worm among themselves and their family members.

2. To provide students with accurate information about the treatment for guinea worm, with an emphasis on cleanliness, prevention of secondary infection, prevention of tetanus, and referral to appropriate medical care providers.

Materials

Handout: Story #3 Guinea Worm Identification and Treatment

Time: 70 Minutes

Advance Reading for Teachers:

Background Reference #1, page 53:

Guinea Worm Disease: Epidemiology, Control, and Treatment by R. Muller.

Procedures

1. Introduction. Introduce the topic by pointing out that even though prevention is better than treatment, it is still important to be able to recognize the signs and symptoms of guinea worm and to treat it. The two main objectives of treatment are to prevent further complications, such as tetanus and secondary bacterial infection, and to keep the person with guinea worm as comfortable as possible so that he can carry out necessary functions.

2. Lecturette. Proceed with a lecturette on the clinical symptoms of guinea worm, its medical complications, and obstacles to treatment. Follow Part Two of the Discussion Outline.

3. Discussion. Introduce the discussion exercise by soliciting answers from the group about some of the ways people in their villages/towns treat guinea worm. Include questions on how effective they think these treatments are.

Read Story #3. Following the story conduct a large group discussion based on the discussion questions which accompany the story.

3. Wrap-Up. The discussion exercise can be summarized by reviewing individual treatment for guinea worm, following the main points in the Discussion Outline. Emphasize the need for proper care of guinea worm sores to prevent tetanus and other infections. Encourage all who are able to seek medical attention, especially tetanus immunization. Conclude by pointing out that even though some drugs given at medical centers can reduce swelling and pain, there is no cure for guinea worm, and therefore prevention is the best and most reliable course of action.

DISCUSSION OUTLINE

Part Four: Symptoms and Treatment

Clinical Symptoms:

- No signs or symptoms until the female worm matures and is ready to emerge.

- Localized swelling at the spot where the worm will emerge. The worm can emerge anywhere, but in most cases (>90%) it emerges on legs or feet.

- The swelling is accompanied by intense burning or itching (people report feeling the worms crawl under their skin), and a blister develops in one to two days. Several days later, the blister ruptures and becomes a superficial ulcer.

- The tissues near the emergent site become swollen, red, and tender.

- The main symptom is fatigue and the incapacity to move. Other symptoms result because an infected person cannot care for himself, i.e., go to relieve himself at a safe distance, wash, etc.

Complications:

- Secondary infections are common. These can lead to severe tetanus infections.

- Infected joints can become fused resulting in arthritic conditions which often cripple.

Social/Economic Effects:

- The disease most heavily affects adults between the ages of 15 and 45, although significant rates of infection occur in children 5 to 15 years old. Thus, the disease affects the productive portion of the population and school-aged children.

- Rural populations often dependent on subsistence agriculture are most likely to get the disease.

- Peak transmission often coincides with planting or harvesting, resulting in significant losses of agricultural productivity and, consequently, nutritional and income deficits for affected families.

- Mothers can become unable to care adequately for their children.

- Psychological stress can be considerable.

- High rates of absenteeism from school.

Obstacles to Treatment:

- There are no routine diagnostic tests to detect the presence of the parasite prior to emergence.

- There are no drugs that have proved effective in killing the adult worm prior to emergence.

- Humans do not develop immunity and can be repeatedly infected year after year.

- A person can be infected by multiple guinea worms at the same time.

- One year elapses between the time of infection and the emergence of the worm. People do not remember their actions that far back; therefore, it is difficult to establish cause and effect.

Treatment--Individual/Family Level:

- Cleaning the wound, preventing infection, covering the wound.

- Preventing tetanus.

- Removing the worm.

- Lessening physical discomfort.

- Avoiding further contamination of the water source by forbidding those infected from entering ponds.

Treatment-Community Level:

- Identifying people with guinea worm.

- Contacting medical professionals for treatment (and getting sick people to them).

- Community collaborating to build a drinking-water source.

- Teaching the population home care of guinea worm (covering the wound, preventing infection, getting a tetanus shot).

- Use of chemical called Abate to treat the pond water. When used at the right time and right proportions, this chemical can kill the cyclops.

- Helping those who have guinea worm to manage their basic economic activities.

STORY #3: GUINEA WORM IDENTIFICATION AND TREATMENT

People in Owode suffer from guinea worm each year. They use many different medicines to treat the disease, but no one has found a medicine that will cure guinea worm.

Runmi was a form-four student at Owode High School. One day she noticed a swelling on her foot. In a few days this swelling became a guinea worm sore. First Runmi tried rubbing the sore with palm oil. This made the area softer, but did not relieve the pain. Runmi's father suggested that she mix some owo imi with the palm oil, Runmi did this for some days, but saw no improvement.

Next Runmi's mother suggested mixing tomato leaves with palm oil. Runmi tried this medicine, but it did not help either; Runmi's senior brother said she should mix soot from the rafters with the palm oil. Runmi collected the medicine for some days but she still saw no improvement.

Runmi's best friend Ronke said, "My uncle is a traditional healer. When we have guinea worm he mixes burned dog bone which has been ground with shea butter." Even this medicine did not help Runmi. All the while her foot continued to swell and to give her much pain. Now her foot was so swollen that she could not even wear her sandals. Runmi had to walk to school and market with bare feet. Much dirt got mixed with the palm oil on her foot and entered the guinea worm sore.

One morning Runmi was feeling uncomfortable. She could not swallow. Her mouth could not open easily. Her arms, neck, and legs felt very stiff. She could not go out that day.

By the next day Runmi began to have convulsions. Her family was so upset. The health worker said she had tetanus. They rushed her to the hospital. Runmi almost died, but the doctors finally saved her life.

Some days later Ronke noticed that she also had a guinea worm sore on her foot. She remembered all the trouble her friend Runmi had. So Ronke decided to go to the dispensary right away.

The dispenser gave Ronke some drugs to reduce the pain and swelling in her foot. He gave Ronke an immunization against tetanus. Then he showed Ronke how to dress the sore so that dirt could not enter. The dispenser reminded Ronke to wear her shoes, clean and dress the sore each day, take her medicine, and never step into pond water with a guinea worm sore.

Ronke thanked the dispenser and followed all his instructions. Truly the guinea worm took some time to remove, but all the while Ronke did not suffer too much like her friend Runmi.

DISCUSSION QUESTIONS:

1. What happened to Runmi when she did not take good care of her guinea worm sore?
2. Why did Runmi get tetanus?
3. Why did Ronke go to the dispensary?
4. What treatment did the dispenser give Ronke? Why?
5. How was Ronke supposed to take care of herself?
6. Why did the dispenser tell Ronke not to put her guinea worm sore into the pond?

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Guinea worm disease: epidemiology, control, and treatment*

R. Muller[1]

Guinea worm infection is one of the most easily prevented parasitic diseases, but it is nevertheless a common cause of disability in rural areas of Africa, south-west Asia, and India. Infection occurs when drinking water is infested with infected Cyclops, a microcrustacean. Worms up to 70–80 cm in length develop in the subcutaneous tissues of the feet or legs and larvae are liberated to renew the cycle when an infected individual steps into a well or pond from which others draw drinking water. Infection is markedly seasonal because of (a) the influence of the climate on the types of water source used and (b) the developmental cycle of the parasite. The disability may be economically very important if the period of infection coincides with busy periods in the agricultural year. Sieving water through a cloth is sufficient to remove the Cyclops, but on a public health scale improved water supplies are required for control. Once the cycle of reinfection can be broken in any district the disease disappears. Chemical treatment of water bodies with temephos is also an effective and safe way of controlling transmission. Treatment consists of rolling out each emerging worm onto a small stick, a few centimetres each day, and certain drugs reduce the pain and pruritis and enable the worm to be removed more quickly.

Infection with guinea worm (*Dracunculus medinensis*) is a common and neglected cause of disability in rural areas of Africa, south-west Asia, and India, where the people rely on ponds or wells for their drinking water. Treatment is not very satisfactory and better methods are required but the most urgent need is for well conducted control schemes aimed at making the drinking water safe.

Guinea worm disease, dracontiasis, has been known since antiquity and the current position is well illustrated by two quotations from recent reports on studies in Ghana. Regarding treatment, one worker stated "Although all the villages were within 32 km of a hospital none of the patients had sought, or been taken for, medical treatment."[a] and in connexion with the epidemiology and control of the infection another group of workers reported that "Guinea worm disease is the major preventable cause of agricultural work loss in the Danfa Project areas. Few other diseases coincide with major agricultural activities, and even year-round malaria causes little prolonged disability in relatively immune adults. In spite of its prevalence and the suffering it causes, guinea worm is one of the most easily prevented parasitic diseases."[b]

In the simplest course of the disease a mature female worm (about 70–80 cm long) lies subcutaneously in the tissues, usually of the feet or legs, provoking the formation of a small burning blister at its anterior end. This bursts and about 5 cm of worm is extruded from the resulting ulcer, particularly following immersion in water. After about 4 weeks, once the complete worm has been eliminated, the ulcer heals rapidly. However, dracontiasis can be an incapacitating disease because of the tissue reactions the parasites

* A French version of this article will appear in a later issue of the *Bulletin*.

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[a] Lyons, G. R. L. *Bulletin of the World Health Organization*, 47: 601-610 (1972).

[b] Belcher, D. W. et al. *American journal of tropical medicine and hygiene*, 24: 243-249 (1975).

may provoke. Cellulitis is particularly severe when worms are damaged in the tissues, especially when this occurs around the joints, and abscesses and chronic ulcerations can persist for months when there are many worms present, sometimes leading to permanent disability from fibrous ankylosis of joints or contractures of tendons. Secondary infection along the track of the worms in the connective tissues is also very common. It is an unusual parasite in that the same person may be reinfected year after year without developing any immunity to reinfection.

Guinea worm disease is primarily a disease of poverty, afflicting communities living in remote rural areas without adequate water supplies; it is particularly widespread in India and West Africa, but there are also foci in Iran, Pakistan, and other countries in south-west Asia, and in north-east Africa.

EPIDEMIOLOGY

The prevalence of dracontiasis shows marked variation with the season and this is closely bound up with the mode of transmission and with the extraordinary life style of the causative organism, the nematode *Dracunculus medinensis*. An important factor that reinforces the seasonal nature of infection is that the female worms in the human body take approximately one year to mature and release larvae into water to initiate the following year's infection. The larvae require a period of development of about a fortnight in a freshwater microcrustacean, *Cyclops*, before the disease can be transmitted to a new host through the ingestion of infected *Cyclops* in drinking water. Suitable conditions for infection occur only where water for drinking is taken from stationary bodies of surface water such as ponds, large open wells with steps leading down to the water as found particularly in India, or the type of covered rain-filled cisterns that provide the only source of drinking water in rural areas of southern Iran. Infection is not associated with running water or with draw-wells with a circumference of less than 3 metres. Infection is also limited to tropical and subtropical regions because the larvae develop best between 25 and 30°C and will not develop at all below 19°C.

Effect of water source on transmission pattern

Ponds

Natural or artificial ponds are used as sources of drinking water in the Sahel and Guinea savanna areas of Africa and in the Sind desert area of Pakistan and thus provide foci of transmission. In semi-arid, wet- and dry-climate areas with an average rainfall of less than 65 cm concentrated into 3–4 months of the year (e.g., Chad, northern Ghana, Mauritania, Niger, northern Nigeria, Senegal, Sind Province of Pakistan, Sudan, Uganda, in the north of the United Republic of Cameroon, and in Upper Volta), water is obtained from safe bore-wells for most of the year when the ponds are dry, and the maximum incidence of infection occurs during and after the end of the rainy season, particularly when water levels become low in the ponds. Under these conditions infection is markedly seasonal, patent guinea worm disease being confined to less than 5 months of the year with a peak during the harvesting season at the end of the rains.

In humid-climate savanna areas of Africa that have an annual rainfall of more than 150 cm, as in Benin, southern Ghana, Ivory Coast, southern Nigeria, and Togo, ponds contain water all the year and infection may be apparent in man for up to 8 months of the year. However, most cases of dracontiasis occur in the latter half of the dry season, extending to the main planting time after the early rains. There are very few cases in the rainy season because there is so much surface water.

Wells

In villages in endemic areas where draw-wells provide the only source of water, transmission of guinea worm is not commonly found. Conditions are not suitable for the breeding of *Cyclops*, and in a well-constructed well there is a surrounding parapet which prevents larvae from reaching the water.

Step-wells, however, which provide the main source of drinking water in many rural areas of India, are ideally suited for *Dracunculus* transmission. These wells are usually a few metres in diameter, providing ideal conditions for *Cyclops* breeding, and the steps leading down to the water result in affected limbs being immersed when the person dips a water container into the well. In these areas the transmission pattern is similar to that found in the humid areas of West Africa. Little or no disease is found during the monsoon season when the water level is high, and peak transmission occurs towards the end of the dry season before the main rains in June or July.

Cisterns

Large covered cisterns (known as "birkehs") filled with rainwater provide the only source of drinking water in the semi-desert areas of southern Iran. The water in the cisterns rarely dries up completely but disease occurs principally when they are half full, and ceases for the 2 months before the rains. Again there is little transmission during the rainy season when the cisterns are full.

ECONOMIC EFFECTS OF THE DISEASE

Draconiiasis is very rarely a killing disease and infection is usually followed by spontaneous recovery even in the absence of any treatment. However, it does cause a degree of disability from the painful ulcers and abscesses, which usually occur on the feet and legs, and which can last over a period of several months if there is infection with more than one worm.

It is difficult to determine the economic effects of disability among communities of self-employed farmers, but the seasonal nature of crop production means that its effect on agricultural output may be considerable.

In southern Ghana, 21 men incapacitated by guinea worm disease were interviewed in order to determine the effects on the whole household of infection in the male farmer. The average period of complete disability in untreated patients was about 15 weeks, but the peak infection rate coincided with the planting or harvesting periods, 75–80% of crops being produced in this area between June and September. A similar situation probably obtains in all endemic areas of West Africa, and in south-western Nigeria up to one-quarter of the working population aged from 15 to 40 years may be incapacitated for at least 10 weeks in each year.[e] Approximately 0.5% of sufferers become permanently disabled.

[d] Belcher, D. W. et al. *American journal of tropical medicine and hygiene*, 24: 243-249 (1975).
[e] Kale, O. O. *American journal of tropical medicine and hygiene*, 26: 208-214 (1977).

PROSPECTS FOR CONTROL

While the concept of the global eradication of a parasitic disease has rather fallen into disrepute, draconiiasis should be one of the easiest diseases to prevent. This is because the period of infectivity is only a matter of weeks, human infection has to be contracted each year, there is no important animal reservoir, and transmission is limited to small, easily defined foci. Once transmission is interrupted in an area for a single season, infection ceases entirely unless it is reintroduced from outside. Even without any specific control measures the infection appears to be rather unstable and in many areas it disappears and reappears in local communities over the course of a few years, depending on factors such as changes in climatic conditions, on the one hand, or on migration of infected individuals, on the other. For example, infection vanished completely from the Sind desert area of Pakistan in the early 1930s, following a severe drought when the ponds never filled, and the region remained disease free until infected people moved into the area following partition in 1947.

For individual protection, even a measure as simple as sieving drinking water through a cloth will filter out any infected *Cyclops*. Unfortunately, the necessity for such measures is not usually appreciated and for community control there are two possible lines of approach: (*a*) improvement of the water supply, or (*b*) water treatment.

Improvement of water supplies

When piped water is provided, guinea worm disease vanishes, perhaps not quite overnight, but certainly in a couple of years. Bore-wells and tube-wells can also provide a constant supply of pure water where their construction is technically feasible. The water is not liable to the contamination that can occur in draw-wells when full and, if used with an elevated tank, can provide the convenience of water on tap. Improved water supplies have benefits far greater than the control of guinea worm infection and help to reduce other water borne diseases such as cholera, typhoid fever, gastroenteritis, hepatitis, and poliomyelitis.

However, much can be done to interrupt transmission even in the absence of more sophisticated methods of water supply. A notable example was the elimination of the disease from Samarkand and Tashkent over 40 years ago by the filling in of step-wells or their replacement by draw-wells. Similar conversions of step-wells have been carried out sporadically in villages in India, and have lowered the prevalence of disease locally in areas of Andhra Pradesh and Rajasthan.

Chemical control

Control of draconiiasis by treatment of water sources has been advocated many times in the past but very few practical control schemes have been attempted.

Recently, organophosphorous compounds have been widely used for the control of insect larvae in potable water stores and have been shown to have good residual action and to be extremely safe. Temephos, one of this class of compounds, was found to be most active when tested against *Cyclops* in the laboratory.[f] In the field, a concentration

[f] Muller, R. *Bulletin of the World Health Organization*, 42: 563-567 (1970).

of 0.5–1.0 mg/litre of temephos removes *Cyclops* for 5–7 weeks and, in the climatic conditions of north-west Ghana, when added to ponds in a village, two applications were sufficient to control *Cyclops* for the duration of the wet season; infection in the inhabitants was reduced from 41 cases in the year of treatment to 9 in the following year, all of which appeared to have been contracted from ponds outside the village.[f]

Temephos in a sand granule formulation, at the rate of 10 g per kilogram, provides a very convenient method of adding the compound to ponds as it has a limited solubility and the quantities do not have to be dispensed with any great accuracy. The timing and mode of application of any compound is very important and varies in different endemic areas depending on the length of the transmission season. Larvae take about 2 weeks to develop inside *Cyclops* after they have been voided into the water so that the first application of chemical need not be made until 3 weeks after a pond refills, taking into account the minimum time necessary before the numbers of *Cyclops* can build up so that transmission can occur. Applications should be repeated every 4 weeks during the transmission season, the number of applications necessary depending very much on the local pattern of transmission. For instance, in the Sind desert region of Pakistan, although water is drawn from wells for most of the year, ponds are also used during the rainy season and transmission appears to be confined entirely to those months (June–September) when the ponds contain water. In the contiguous Rajasthan area of India, many traditional step-wells have been built in the rocky soil, 5–10 to each village, and the transmission season is 1–2 months longer. In endemic areas in more southern parts of India, peak transmission in step wells occurs at the end of the dry season (March–May) and there is no transmission while the wells are full for the months during and after the rains.

Temephos is already being used in vast quantities in West Africa for the control of *Simulium* larvae, which live in the flowing waters of the Volta River basin, and is proving to be very effective for that purpose with very little effect on other forms of aquatic life or on man. In these areas, villagers are adding temephos to ponds on a haphazard basis and it will be interesting to determine whether these measures have any local effect on the incidence of guinea worm infection.

TREATMENT

Until recently the only effective treatment for dracontiasis was the time honoured one of laboriously rolling out each emerging worm onto a small stick, a few centimetres each day, and this treatment is still a very effective one, provided that it is accompanied by measures to prevent secondary bacterial complications. However, in the late 1960s three compounds were tested and reported to have a marked effect on the emerging adult female worms. These are niridazole (usually given in doses of 25 mg/kg body weight daily for 10 days), tiabendazole (50 mg/kg body weight daily for 3 days), and metronidazole (400 mg for an adult daily for 10–20 days).

About 20 clinical trials have been carried out with these compounds in West Africa and India and their effects have always been very similar; a recent double-blind trial with metronidazole in India can be taken as representative.[g] In this trial, as in all others,

[f] Lyons, G. R. L. *Bulletin of the World Health Organization*, 49: 215-216 (1973).
[g] Padonu(?), D. S. et al. *Annals of tropical medicine and parasitology*, 71: 45-57 (1977).

symptomatic relief of pain and pruritis was obtained and the drug enabled emerging worms to be removed very much more quickly than in patients given a placebo, and with a marked reduction in inflammation. However, the drug had no effect on the pre-emergent worms which subsequently emerged in the usual way, although with less severe lesions than in the control patients. In a few trials in Ghana, India, and Nigeria with metronidazole, results were not so impressive and, although marked symptomatic improvement was obtained, objective evidence of drug effectiveness was not apparent. A possible explanation for the poor results obtained in a trial in Ghana is that all the guinea worm cases found in the area surveyed were treated, this giving a more representative study population than is possible in a self-selected clinic population. It is probable that chemotherapy will be most effective when given at the time the first worm begins to emerge.

Chemotherapeutic trials carried out in experimental animals have provided evidence of the probable mode of action of these compounds, this being rather puzzling as neither metronidazole nor niridazole is active against any other parasitic nematode. In rhesus monkeys infected with human species of guinea worm, none of the three compounds, even when given in high concentrations over periods as long as 30 days, had the slightest effect on the viability of pre-emergent adult female worms. All worms were active when surgically removed and appeared normal histologically when sectioned. Mature female worms when ready to emerge from the skin are non-feeding organisms which are in effect bags filled with more than one million larvae; these larvae were still active after treatment and were capable of developing to the third infective stage when ingested by *Cyclops*. All three compounds were also ineffective against the developing stages recovered from cats 5–8 weeks after infection.

It might be thought remarkable that none of the chemotherapeutic agents reported to have striking effects in aiding the emergence of female worms in man, had any direct antiparasitic effect in experimental animals on the adult worms or on their contained larvae. However, on reflection this is not so strange, as an emerging guinea worm has already lost its anterior end and it is not possible to judge from its appearance whether it is still living or not. All three compounds have marked antiinflammatory properties and it is probable that they act by lessening the intense tissue reaction that develops along the cuticle of a guinea worm once it has provoked the formation of a blister and started to emerge from the tissues. The course of events following emergence, with a rapid infiltration of polymorphonuclear neutrophils, is very suggestive of an Arthus reaction, probably followed by a delayed hypersensitivity response.[h]

Local treatment with hydrocortisone cream containing an antibiotic had an even more marked effect than these orally administered drugs on the ease of removal of worms emerging from rhesus monkeys in the laboratory, although its use has not been evaluated in man.

Thus it appears likely that in man these compounds act against the host reaction rather than on the worms themselves. It is even a moot point whether direct antiparasitic activity against such a large amount of foreign protein is desirable. The organophosphorus compound metrifonate has some action against many helminths including filarial parasites and was the only substance shown to be effective against guinea worms in infected rhesus monkeys. When given at a concentration of 25 mg/kg body weight for 4 days to a monkey with a total of 8 pre-emergent female worms, the adult worms and the

[h] Muller, R. In: Soulsby, E. J. L. ed. *Pathophysiology of parasitic infections*, New York, London, Academic Press, pp. 133-147, 1976.

contained larvae were both killed; unfortunately the monkey also died with symptoms indicative of anaphylactic shock. Rather surprisingly another new compound, mebendazole, which is active against many nematode infections, apparently has little effect against guinea worms, perhaps because it is poorly absorbed from the gastrointestinal tract.[4]

In any case, whatever the value of chemotherapy in the treatment of the individual patient, it is clear than none of the compounds at present in use will have any effect in preventing transmission of the disease.

Surgical removal of pre-emergent female worms after local anaesthetic is still practised in India and Pakistan and can be accomplished with a very small incision if the outline of the worm can be seen or palpated. However, the procedure can be hazardous if part of the worm is in deep fascia or is wound around tendons.

DIAGNOSIS

The diagnosis of dracontiasis is usually straightforward once the first mature female worm has provoked the formation of a blister at the site of emergence. Infection can be confirmed if necessary by adding cold water to the ulcer that follows the bursting of the blister and examining a drop of the water under the microscope for the active larvae. Various immunological methods of diagnosis have also been described for patients with patent infections but have little practical application at present. Techniques for earlier diagnosis have not yet been evaluated in man. The indirect fluorescent antibody test is effective with sera from patients with patent infections and in 4 experimentally infected rhesus monkeys could detect antibodies at least 4 months before the first worm emerged. However, early diagnosis is useful only if the infection can be treated and the only compound that has been tested in this way is diethylcarbamazine. This compound was given to 31 villagers about 6 months after they were likely to have become infected; 6 months later, only 2 of the treated group, but 15 of a similar control group, had worms emerging.[1]

FUTURE NEEDS

An immunological test capable of diagnosing early prepatent infections could be useful, as there is evidence that some chemotherapeutic agents are active against developing parasites; also it might be helpful to have a more effective chemotherapeutic agent capable of killing larvae inside adult female worms before emergence. However, the most urgent immediate need is for carefully monitored control schemes, based on water treatment. If such schemes are succesful in reducing or eliminating infection in the locality in the following year, they should provide useful guidelines for eradication of infection over much wider areas.

ACKNOWLEDGEMENTS

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[1] Kale, O. O. *American journal of tropical medicine and hygiene*, 24: 600–605 (1975).

[4] Bonnet, P. *Bulletin médical de l'Afrique occidentale française*, 9: 331 (1952).

THE PROBLEM AND CONTROL OF DRACUNCULIASIS (GUINEA WORM DISEASE) IN NIGERIA: THE OPERATIONAL ASPECTS

by

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A Situation Report Made To:
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Vector Biology & Control Project
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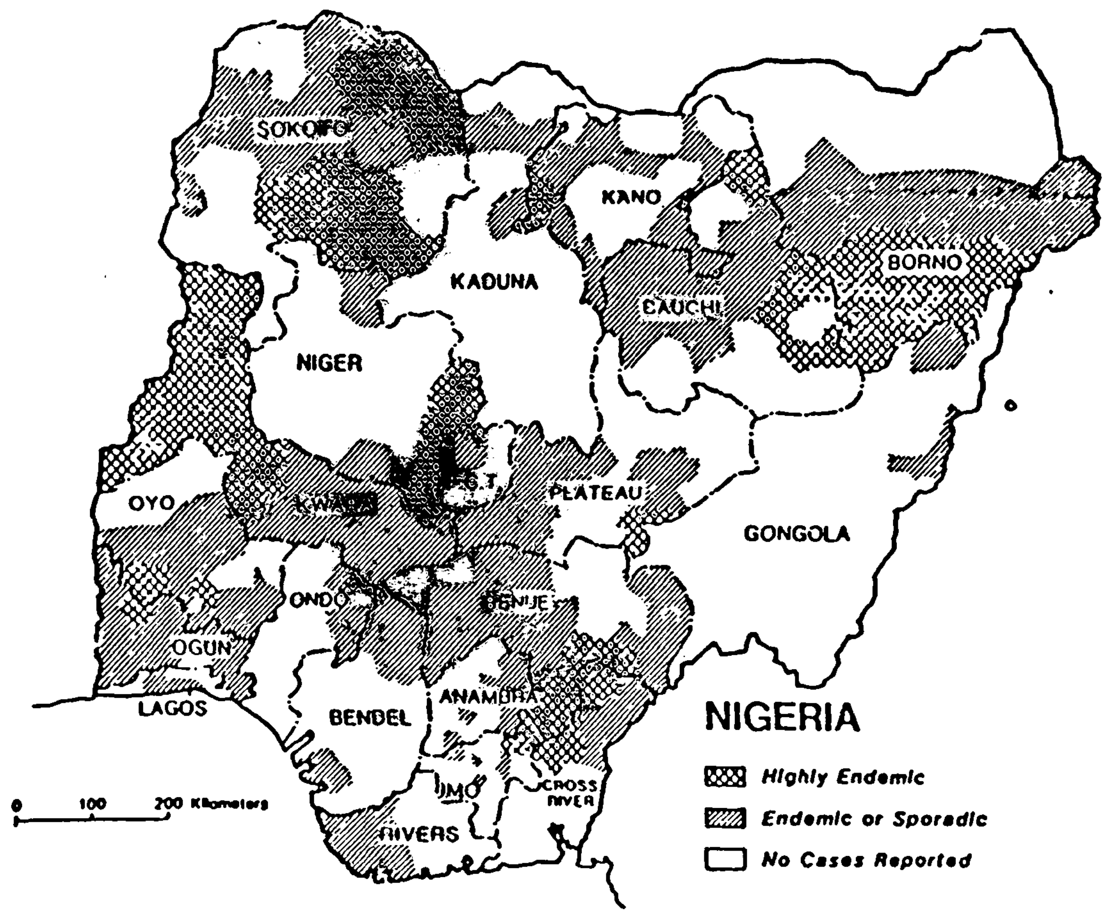
ABOUT NIGERIA

POPULATION:	Approximately 110 million people
AREA:	Approximately 1 million square kilometers
ETHNICITY:	36 major ethno-linguistic groups, over 200 major ones.
STATEHOOD:	There are 19 states and the new Federal Capital Territory at Abija.
CLIMATE:	Hot all year round; wet and rainy seasons.
VEGETATION:	Forest - Sahel Savanna.



BACKGROUND

Dracunculiasis or guinea worm disease is a water-associated infection. Characteristically, it is found in remote rural communities where potable drinking water is not available, where the people are ignorant of its mode of transmission and prevention and, where the necessary initiatives, resources, priority and commitment to tackle the problem are either lacking or unexplored.

Dracunculiasis is caused by a thread-like nematode, Dracunculus medinensis. The male is not usually seen, he dies in the human body after six months. However, the female which is responsible for overt dracunculiasis is often seen as a partly exposed worm through the ulcer which she has caused in the skin. Sometimes, it is possible to extract the entire worm (about 80 mm x 2 mm).

D. medinensis shares some close affinities with Onchocerca volvulus, a filarial worm that causes river blindness (Onchocerciasis). Both are long, slender, tissue-dwelling ovoviviparous nematodes whose vector intermediate hosts can be controlled with abate but no effective drug against the adult worm in the human host. However, there are striking differences between the two. Whereas dracunculiasis is associated with stagnant ponds in West Africa, onchocerciasis is associated with fast flowing rivers. The intermediate host of guinea worm is cyclops (crustacean) while the intermediate host of Onchocerca is Simulium, blackfly (an insect). Guinea worm is transmitted by drinking water containing and infected cyclops whereas onchocercal infection is transmitted through the insect bite. Guinea worm larvae are not usually found circulating in the human tissues but the microfilariae of O. volvulus have the propensity to accumulate in the body and to circulate in the tissues. Whereas the adult female guinea worm can be seen protruding through the skin, this is not the case with adult onchocercal worm. The life span of an adult guinea worm female is only one year, whereas an adult female of O. volvulus can live up to 6-15 years. In endemic areas, onchocerciasis is strictly an occupational disease of farmers. In contrast, everybody living and drinking from a common source, regardless of his/her occupation is liable to dracunculiasis in the endemic communities.

To get guinea worm infection, certain critical conditions must be met. Guinea worm is primarily a disease of remote, poor and rural areas without potable drinking water sources. For transmission to occur, there must be:

1. Suitable water-body for transmission. In West Africa it is a stagnant body of surface water (e.g. pond) while in India, it is stepwells.

2. There must be an actively infected person to introduce guinea worm larvae into the suitable water.

3. The water temperature must be between 25-30°C and the water must contain the right type of cyclops (water fleas) which is the intermediate host of Dracunculus medinensis. The availability of the right type of cyclops is obligatory for guinea worm to complete its life-cycle.

4. Guinea worm larvae must be ingested by the cyclops within 5 days. Otherwise, they will burn out their energy and die, or if eaten after 5 days, it will not be able to move to the right place in the cyclops and grow to a stage where they can now become infective to man.

5. The larvae must remain in the cyclops for about 14 days to moult twice, casting off its old cuticle so that it can grow and become infective to man.

6. Man must ingest infected cyclops raw i.e. with the unboiled or unfiltered contaminated water.

These are many conditions and if only one of them is missing, it is impossible to get guinea worm infection. Therefore, guinea worm is an easily avoidable disease and that the has remained with man for so long and causing so much disability, is rather unfortunate.

When a person with an active infection immerses his guinea worm ulcer in water, the temperature drop causes the contraction of the partly exposed uterus through the skin. The uterus is a long tube that stores about 3 million guinea worm primary larvae. These cannot infect the same person or another person directly if ingested. It must pass through the cyclops and reach the stage when it can be infective to man. If the right type of cyclops ingests the first stage larvae within about 5 days, the larva moults twice in about 14 days. This enables it to grow to a point when it can become infective to man. Any other stage eaten will not establish a human infection (the only reservoir host known for human dracunculiasis). In the gut, the cyclops is killed by the gastric juice while the 3rd stage larvae of Dracunculus escapes through the duodenal wall into the abdominal and the thoracic cavities. Here, they begin to mature in the connective tissue of man. In about 3 months, mating occurs and in another 3 months the male dies and becomes encysted, or absorbed. The adult female (80cm x 2 mm) lives in the connective tissue before migrating to the lower limbs (mostly) and other sites of emergence where the uterus containing the primary larvae develops to fill the entire worm. About one year after the ingestion of infective larvae, a relatively long incubation period, the adult female is ready to emerge and moves to the subcutaneous tissues where it secrets a toxic substance that provokes a painful blister and subsequently an ulcer. At this point, the symptoms of dracunculiasis are manifested and the adult female could be seen partly protruding from the body. This unique feature of guinea worm to protrude from the body makes its conclusive diagnosis relatively easier than for other parasitic helminths of man. When in contact with water, the uterus ruptures to release thousands of embryos into the pond and the whole sequence is repeated.

SITES OF EMERGENCE

The commonest site of emergence of adult guinea worm is the lower limb. This is a parasitic adaptation which ensures that the ulcer is located at an anatomical region which is most likely to be in contact with water, thereby ensuring that the life cycle continues uninterrupted. However, an adult female guinea worm can emerge from any part of the body; including the genital areas, breasts, trunks and buttocks.

The general contention is that there is no protective immunity against guinea worm. Everybody in endemic area is at risk. However, the infection rate may vary by age and sex from one place to another.

In areas where dracunculiasis is endemic, children are generally less infected than adults. Edungbola, (1983) attributed this difference in Nigeria to long prepatent period of guinea worm infection, the destruction of infective guinea worm larvae in the unconscious process of boiling children's water with medicinal products prior to ingestion and prolonged breast feeding. In Nigeria, both males and females are affected equally. Guinea worm infection is seldom fatal but it is often accompanied by serious complications that may lead to protracted but reversible incapacity. However, permanent disablement may ensue sometimes. The major causes of incapacity is dracunculiasis are:

1. Tissue reaction against the worms' products.

2. Repeated multiple infection.

3. Secondary bacteria infection resulting from negligence, ignorance and unsanitary methods of local management.
   This is a major cause of death in complicated dracunculiasis. A study in the Upper Volta revealed that 7% of villagers who died of tetanus died of guinea worm secondary tetanus. Similarly, a study in Nigeria reported that guinea worm ulcer was the third most important portal of entry of tetanus pores at University College Hospital Ibadan where tetanus was the leading cause of death.

4. The presence of guinea worm at unusual anatomical locations is a major cause, of complications: These include: ocular involvement and blindness; abortion and sterility due to retroplacental location of the worm; paraplegia due to guinea worm in the extradural space; complicated pregnancies due to the location of calcified guinea worm in the broad ligament; constructive pericarditis due to presence of guinea worm in the thoracic cavity; urinary obstruction due to bladder infection; quadriplegia due to the infection of subdural space of the cervical vertebra; Osteomyelitis of the 5th lumber vertebra causing the collapse of the vertebra; intrapulmonary calcification; acute synovitis and arthritis caused by presence of guinea worm in the knee joint.

   The severity and duration of guinea worm incapacity varies among the victims of the disease and depends on the number of infection, the anatomical location of the worm; the status of the health and personal hygiene of the infected person, the duration of the infection and the activities in which the infected person is engaged such as walking long distances or riding a bicycle.

EPIDEMIOLOGY AND PUBLIC HEALTH IMPORTANCE OF DRACUNCULIASIS IN NIGERIA

Guinea worm infection is wide-spread in Nigeria. The First National Conference on Dracunculiasis held in 1985 showed that it existed in all the 19 states and the New Federal Capital Territory of Abija (Figure 1).

At present, about 2-5 million Nigerians are infected every year. About one million of these experience temporary incapacity for a period of 1-3 months while about 12,000 suffer irreversible disablement. Every year, the infection is responsible for a loss of 80 million man days by farmers and 40 million pupil days in school attendance. In spite of this, the infection is increasing in prevalence, distribution, intensity and public health importance. The major factors enhancing the spread of the disease in Nigeria include: water scarcity, especially during the dry season; the dispersion of water collecting sites which gives rise to multiple foci of transmission; the local pattern of settlement; increased mobility and water contact frequencies; the wide distribution of cyclops in the community drinking water sources; poor water management; socio-customary observances; poverty; ignorance and the lack of initiatives; resources, priority and commitment to tackle the problem on a permanent basis.

The excessive and prolonged guinea worm incapacitations in Nigeria are largely due to multiple and repeated infections, and secondary bacterial infection resulting from negligence; ignorance and the unhygienic procedures of local management.

At present, endemic dracunculiasis is causing serious concern in many endemic Nigerian communities because of its formidable impact on the medical, social, economic, religious, educational and political development of the affected areas and the country at large. In spite of the lack of a complete assessment, the evidence is overwhelming that prolonged illness of farmers which overlaps with the critical period of farming activities, is affecting agricultural productivity and causing poverty, starvation and misery. The problem of food scarcity is compounded by the problem of unchecked inflation and economic recession.

Over 90% of infections are located below the knees. Therefore, most farmers, because of their inability to walk long distances, are abandoning their distant fertile farmlands for barren and insufficient farm areas just outside the residential areas. Likewise, women who were active harvesters, were concentrating on petty trading for the same reason, while the food crops are left unharvested.

A study of the school attendance, the performance of pupils in schools, the number of years taken to complete primary education and the overall school performance in the national and state examinations indicate that prolonged infections and the high rate of absenteeism due to dracunculiasis (reaching about 33% in some hyper-endemic areas) are affecting academic performance and threatening educational advancement and development, especially in the educationally disadvantaged communities where dracunculiasis is highly endemic.

The inability of infected muslims to fulfill their islamic obligations and aspirations of fasting and undertaking the pilgrimage to Mecca is of considerable significance in these communities. Besides, it will be difficult and probably unethical to collect taxes from poor subsistence agricultural farmers who have been incapacitated for months with barely any food to feed their families. Consequently, dracunculiasis constitutes a major economic burden and a serious handicap to the development of rural communities, especially in a system where local achievements and the provision of basic amenities largely depend on community self-initiated and self-supported

It has been frequently observed that during local and national elections; many eligible and registered voters in these endemic communities could not go to the poll because of guinea worm incapacitation (voting in absentia is not allowed in Nigeria). In addition, victims of dracunculiasis often become easy victims of economic and political exploitations and of unfulfilled promises.

FEASIBILITY AND OPPORTUNITY FOR GUINEA WORM CONTROL/ERADICATION

Whereas the control of dracunculiasis (reduction of the infection to a minimum level when it ceases to be a serious public health problem) will be valuable, it is better to aim at the ultimate eradication of the disease. This is because the infection can erupt spontaneously in a whole village by the act of a single contaminator. Besides, the resources required for control and eradication are essentially the same.

The eradication of dracunculiasis in Nigeria is feasible and advantageous. It will be in conformity with the national commitment to the implementation of the Primary Health Programme, the aspirations of health for all by the year 2000, the implementation of "Water Decade" and the ongoing campaign for the promotion of good environmental sanitation in Nigeria. The elimination of dracunculiasis will increase food production, improve school enrolment and attendance, and reduce a major cause of disability and socio-economic burden.

Theoretically, dracunculiasis is an easily avoidable and eradicable disease. It is the only disease that is transmitted exclusively through the consumption of contaminated water. It is also the only disease that can be eliminated absolutely through the provision and utilization of potable water. For this reason, guinea worm has been earmarked as the major indicator to measure the success or otherwise of the "Water Decade". At a local level, it could be used as a good indicator of assessing the priority and commitment of the Federal and/or State Government to the development and provision of basic amenities to the rural dwellers.

STRATEGIES FOR THE CONTROL OF DRACUNCULIASIS IN NIGERIA

The control of dracunculiasis in Nigeria can be based on three broad strategies: Technical, Coverage and Support.

TECHNICAL STRATEGY:

Multiple strategies are recommended for intervention in Nigeria. These are:

1. The provision of alternative potable water sources; (piped

water, boreholes or wells);

2. The improvement of the existing water sources using chemical treatment such as Abate and;

3. the promotion of health education (individuals to boil their drinking water, to filter their drinking water and to avoid wading into the ponds and thereby contaminating them with guinea worm larvae).

The choice of technical strategy to adopt will depend on the population size, the target of the intervention and the resources available. While the provision of an alternative water source is the most effective and permanent, it is fairly expensive. Ideally, the combination of multiple strategies will be most effective. The provision of new water sources will reduce the prevalence of other water-related diseases.

COVERAGE:

The first priority should be given to the endemic guinea worm villages for the provision of potable water. Because of the wide-spread of the problem and the relative easy of its dissemination, all endemic areas in the entire country should be covered. However, the choice of technical strategy and priority should be based on the degree of endemicity of dracunculiasis in each state and the amount of resources available.

HEALTH EDUCATION:

In addition to the promotion of personal prophylactic measures, health education should also focus on community mobilization and participation so that the benefitting community sees the problem and the maintenance of the intervention as theirs. School children and mothers, the chief contaminators should form the special focus of health education campaigns.

SUPPORT:

Technical and financial support for the control of dracunculiasis should embrace close cooperation between various Federal and State ministries of Health, Agriculture, Water, Science and Technology, Education, Rural Development as well as the support of International Agencies. Each participating donor or Agency may preferably focus its contribution on one or two states, rather than for the entire country, because of financial and other constraints. The involvement of the National Universities and Research Institutes will be useful in regards to the procurement of baseline data on the epidemiology, Vector Biology and economic impact of the disease.

ONGOING ENDEAVOURS AND PLANS IN NIGERIA

Active research studies on different aspects of dracunculiasis are going in different Universities, including those of Ilorin, Ibadan and Calabar.

The First National Conference on Dracunculiasis in Nigeria was held in 1985 to assess the status of the disease in the country and to recommend appropriate steps to control or eliminate it. The report and the comprehensive map of guinea worm distribution (Figure 1) produced for the whole country (by the participants drawn from all states, Universities, Research Institutes, many ministries and International Agencies), provided the national data on dracunculiasis at a level of details which far exceeded any that ever existed before in Nigeria. Thereafter, to implement one of the conference recommendations, the National Council on Health adopted a resolution in March 1986 that dracunculiasis is a leading national health problem that should receive a high priority for control. Besides, varying degree of activities and commitment towards controlling guinea worm at state levels have been initiated. In Anambra State, Japan has agreed in principle to compliment the effort of the State Government with about $5 million. UNICEF has drilled about two hundred boreholes in Kwara State in collaboration with the State Government.

Meanwhile, the Federal Government is completing the arrangement to reconstitute the National Task Force for the Eradication of guinea worm disease in Nigeria. Members will include those from Universities, Research Institutes, the relevant Federal and State Ministries and willing International Agencies.

There are numerous Federal Structures uniquely conducive for the control of guinea worm in Nigeria. These include: the newly established directorate for the rural development, the Ministry of Health and the National Youth Service Corps Directorate. These institutions are coordinated on zonal basis with a central head at the Federal level. Thus, making the planning, implementation and coordination of guinea worm control easy and fitting into an already existing structure. Each State has health workers including Community Health Aids, Community Health Assistants, CH Supervisors, and CH Officers, plus several other cadres that could be used to implement the surveillance of the disease after some training. Over 100 million naira is currently being committed by the Federal Government for Rural Development which includes guinea worm control.

CONSTRAINTS TO OPERATIONAL EFFORTS IN NIGERIA

1. Financial constraint to launch a mass rural water project, to purchase and apply Abate and to train surveillance workers and Health Educators. The availability of several project vehicles and an efficient data storing, processing and retrieving system, are also major potential requirements.

2. The existing data on the distribution of dracunculiasis, the site of its transmission and the ecology of cyclops (vector of guinea worm) is inadequate to plan and implement a country-wide control programme. Therefore, gross deficiency in baseline data constitutes a major constraint.

3. For an effective control programme, the existing man-power development has to be strengthened. Surveillance Health Workers, Abate Applicators and Health Educators need to be trained. Competent trainers and training materials (mannuals, audio-visuals etc.) will be required.

4. Rapid surveillance techniques and quantitative impact studies of the diseases are presently unknown. Similarly, an investment plan to convert the new water and reclaimed sources into economic benefits has not been identified.

5. There is an urgent need to establish a national secretariat with the necessary system for collecting, processing, storing, retrieving and disseminating data and information and for coordinating field activities at the state levels.

AREAS OF NEEDS AND INTERNATIONAL ASSISTANCE WITH PARTICULAR REFERENCE TO USAID

A. <u>USAID (LAGOS, NIGERIA)</u>.

1. Declaration of support for the National Guinea Worm Control Programme.

2. Representation on the National Task Force/Committee for the Control of Dracunculiasis.

3. Assessment of the national status of the disease with a view of identifying what kind and magnitude of assistance is appropriate. This can be done by inviting experts from USA to work with Nigerian Researchers.

4. Supporting the work shops on Guinea worm disease.

5. Providing financial assistance for the establishment of the National Secretariat for the control of dracunculiasis.

6. Funding of Field Researchers on (1) the development of rapid surveillance methods, (2) the quantitative assessment of the impact of the disease on agriculture and schools and (3) on field trials with Abate.

7. Undertaking of intervention programmes such as drilling of boreholes, promotion of Health Education and the supply of Abate for water treatment.

8. Supporting short-term consultants to liaise with the Vector Biology & Control Projects of USAID in Washington, D.C.

B. <u>VECTOR BIOLOGY AND CONTROL (USAID/WASHINGTON)</u>

1. Identification and distribution of vector species in the endemic areas.

2. Field experimental control using cyclopscides under different situations to determine the optimum effective conditions for its application.

3. Studies to determine socio-economic impact of dracunculiasis (quantitatively), especially on agriculture.

4. Establishment of information center to collect, process, store, retrieve, and disseminate guinea worm data.

5. Assistance in the provision of training materials and the training of Surveillance Workers, Abate Applicators and Health Educators.

6. Promotion and support of collaborative research with Nigerian researchers who are actively working on Guinea Worm.

GENERAL COMMENTS

Guinea worm is a wide-spread and serious problem in Nigeria. Therefore any assistance and investment by USAID towards its control is desirable and worthwhile.

The endemicity of the disease varies from state to state, therefore, USAID may wish to focus on one or two highly endemic states, depending on the amount of resources available, for a start.

The resources currently available to supplement the state efforts are largely that of UNICEF. Although CDC provides technical advice to mobilize the country at large to declare a national policy for the control of guinea worm, the relatively huge size of Nigeria, the number of its states and of its population demands far more help for effectiveness on a permanent basis.

The establishment of a National Secretariat with information center, studies to procure accurate data on the epidemiology of dracunculiasis, the distribution and types of potential vectors (cyclops) in Nigeria, and the study to determine the impact of the disease on agriculture and to carry out pilot intervention programmes (provision of new water sources and treatment of old infested ones, using Abate), seem to be the first and immediate priorities.

A LIST OF SOME KEY-PERSONS ASSOCIATED WITH DRACUNCULIASIS IN NIGERIA

FEDERAL LEVEL:

1. Dr. A. D. Kolawole, Chief-Coordinator, PHC Unit, Federal Ministry of Health, Ikoyi, Lagos.

2. Dr. Suleiman, Director, Planning, Federal Ministry of Health, Ikoyi, Lagos.

3. Mr. Lawal, Permanent Secretary, Federal Ministry of Health, Ikoyi, Lagos.

4. Dr. G. Williams, WHO-Liaison Officer, Federal Ministry of Health, Ikoyi, Lagos.

5. The Honorable Minister, Federal Ministry of Health, Ikoyi, Lagos.

6. Dr. Ogunye — Federal Ministry Sci. & Tech.
Dr. Timi-Agary — 9 Kofo-Aboyomi Street
The Honorable Minister — Victoria Island, Lagos.

AT SOME STATE LEVELS:

7. Prof. A.B.C. Nwosu, The Anambra State Commissioner for Health, Enugu, Nigeria.

8. Dr. J. O. Idowu, Chief-Epidemiologist, Kwara State Ministry of Health, Ilorin, Nigeria.

9. Dr. G. Saba, Permanent Secretary, Ministry of Health, Minna, Niger State, Nigeria.

10. Mr. H. Abe, Project Manager, Rural Water Supply & Sanitatio[n] Project, Ministry Local Government and Rural Development, Ilorin, KWS, Nigeria.

AT UNIVERSITY LEVEL:

11. Dr. L. D. Edungbola, University of Ilorin, Nigeria.

12. Dr. E. Braide, University of Calabar, Nigeria.

13. Dr. O. Kale, Dept. PSS, College of Medicine, Ibadan.

AT INTERNATIONAL LEVEL:

14. Mr. D. Bassiouni
UNICEF (Nigeria)
11A Osborne Road
Ikoyi, Lagos, NIGERIA

15. Ms. Keys McManus
AID
U.S. Embassy
Victoria Island
LAGOS

Health education aimed at children should make it possible for them to develop their physical and mental potential to the utmost and to appreciate the need to protect and promote the quality of life...[7] *Does teaching in primary schools contribute to this objective? Are teachers in a position — are they willing? — to make health education an integral part of the curriculum and to focus on local health issues?*

Primary schools: making the teaching relevant to local health issues

by W. R. Brieger, J. Ramakrishna, J.D. Adeniyi and M.U. Lekwa

The inaugural issue of *Education for Health* reported on the study initiated in 1981 by a multidisciplinary team of researchers based at the African Regional Health Education Centre, University of Ibadan, Nigeria.[8] Its object was to identify the social and behavioural aspects of four tropical diseases — malaria, guineaworm, onchocerciasis and schistosomiasis — and to develop health education interventions aimed at helping to control these diseases. Three broad educational strategies were outlined, focussing on training, school health, and adult education. This article describes how the second strategy was developed for primary schools in Idere, in Western Nigeria.

The primary health care concept upon which the programme is based advocates involvement of health, agriculture, education and all related sectors in solving health and development problems.[9] Also required for effectiveness is the integration of school and community efforts[1] and proper consideration of local values, needs, mores, and problems.[5]

Surveys among schoolchildren indicate their curiosity about diseases which affect them.[2,4] It is therefore important to identify the common health problems of childhood in a particular locality so that these may be represented in the *local* school curriculum. Such data also provides an epidemiological baseline against which the school health programme may be evaluated.[3] In reality, this ob-

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jective is often blocked by many factors — teachers' beliefs and attitudes, administrative procedures and parents' poor health knowledge, among others. This article examines critically the process of overcoming obstacles to achieving curriculum improvement and ensuring meaningful and relevant teaching and learning.

Idere is a rural community of 10,000 people of whom approximately 20% live in small satellite farm hamlets. The main town is fortunate to have five primary schools and two secondary schools. A portion of the satellite hamlets is served by four outlying primary schools. Due to transportation difficulties, this study dealt with the town schools, although the other schools also received some support. The three oldest schools in town were started by different religious denominations: Baptist, Islamic and Methodist, and have been operating for upwards to thirty years. Recent efforts to provide universal primary education in Nigeria spurred the creation of two new schools, a second Islamic school and a community school. It is estimated that 80% of the school age population is enrolled.

With the help of medical students posted at the nearby Igbo-Ora Rural Health Centre, baseline prevalence on the four diseases was established during the 1982/3 school year. This is summarized in *Table 1*.

These findings were presented to the headmasters of the five primary schools. They expressed concern and asked the research team if they could help the schools develop appropriate action.

TABLE 1. EPIDEMIOLOGICAL DATA ON IDERE CHILDREN, 1982/1983

Examination	*Population*	*Prevalence*
Blood film for *malaria* parasite (March)	Children aged 2 to 16 years	19.3%[1]
Palpable spleen (March)	Children aged 2 to 16 years	17.4%
Guineaworm ulcer site (November, retrospective for 1981/2 season)	All school attenders	39.6%
Microscopy for *schistosomiasis* ova in urine (November)	All school attenders	6.4%[2]
Skin snip for *onchocerciasis* microfilariae (March)	Children aged 5 to 19 years	15.1%[3]
Observation for nodules (onchocerciasis, May)	Children aged 10 to 19 years	6.4%

[1] Malaria would have scored a higher prevalence if the weather had not been unusually dry for two years; it was the leading cause of death (28.3% of all deaths) among children 5 to 14 years between 1970 and 1979.

[2] Idere is a very dry area; a few kilometres away, the village of Igbo-Ora has a 14.3% prevalence.

[3] Prevalence of onchocerciasis in the adult farming population was found to range upwards to 69.5%.

Teachers and pupils: many misconceptions

Team members started by having informal discussions with teachers to assess their beliefs about the four diseases. Another purpose was to probe their willingness to incorporate regular teaching about endemic diseases into their timetables. Fortunately, they seemed interested.

Of all the diseases, onchocerciasis was the one with which teachers were least familiar. In fact none had heard the scientific name before. Traditional soap containing herbs was thought to be the cure. Guineaworm was a different matter. Teachers had heard much about it, including the fact that it was caused by drinking pond water. But they had doubts about this. They felt it was a problem peculiar to Idere people. Neighbours, they said, did not wish to marry anyone from Idere for fear of guineaworm. Teachers could not easily dismiss the idea that the disease might be hereditary, even though they knew that guineaworm was no longer common in Igbo-Ora after regular pipe water had been provided to the village.

Most teachers knew mosquitoes played some role in malaria transmission, but they also blamed heat, dust, sun and hard work. Schistosomiasis was correctly associated by a few with children playing in streams, but many thought it was a type of gonorrhoea, as implied by the local name *atosi aja* or "dog's gonorrhoea".

This survey showed little variance between the beliefs of teachers and those of the community at large which had been identified in a previous survey.

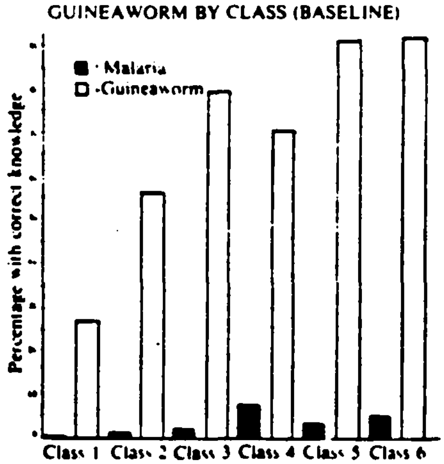
What of the schoolchildren? How much did they know? A baseline survey about the four diseases was conducted with the help of medical students at the beginning of the 1983/84 school year. A stratified sample of 1002 pupils was surveyed representing 54.1% of the children registered for that year in primary schools of Idere.

Disease recognition — Before assessing knowledge one must know if children are familiar with a disease. 88% could recognize malaria. Common symptoms given were fever, cold, headache, body ache and dark urine. Guineaworm, they said, was characterized by swelling, pain, ulcer, itching, peppery sensation and worm coming out; only 11.4% could state no symptom. Since schistosomiasis has the lowest prevalence of the four diseases among schoolchildren, it is not surprising that only 8.5% recognized it by blood in urine; a majority (88.4%) had no idea. Onchocerciasis was recognized by 68.7% with symptoms such as itching, rashes, rough skin, body pain and swelling.

Disease causation — Schoolchildren had an appreciable knowledge on the cause of guineaworm, but little on the other diseases. Drinking bad water was mentioned by 66.6% of the pupils. The 1981 survey of adults also showed them to be most knowledgeable on guineaworm. One cannot therefore overlook the effect, on both children and adults of the campaigns against guineaworm launched by health workers each dry season. The most common causes children gave for malaria were dust (16.5%) and sun (7.2%); a majority (54.3%) knew no cause; only 3.8% of them mentioned mosquitoes. Most (88.4%) had no idea about the cause of schistosomiasis though some had apparently heard that small snails were involved, but they credited the cause as eating these molluscs; bathing or wading in water was mentioned by only 5.2% of children. Aside from the large number of "don't knows" (86.3%), a wide scattering of responses were given for the cause of onchocerciasis; the black fly was suggested by 4.0%.

Class differences — If these diseases formed a regular part of the school instructional programme, one might expect a cumulative effect on knowledge over the years. A study of the school health texts[6] showed that malaria was the only disease mentioned consistently for each primary class. Guineaworm was specifically noted only once. *Figure 1* shows knowledge on both these diseases class by class: malaria knowledge remains low and variable, but guineaworm knowledge grows almost steadily from primary one to six. It would seem that teaching on malaria is not only sparse but also limited, although it appears as a regular feature in the school health texts. On the other hand, the gains in knowledge on guineaworm by each successive class are likely due to the continued exposure to educational

FIGURE 1. VARIATIONS IN CHILDREN'S KNOWLEDGE ON CAUSE OF MALARIA AND GUINEAWORM BY CLASS (BASELINE)



activities of health workers in the community.

This assessment of children's knowledge suggests a low priority for health in the teaching programme of Idere primary schools.

Training the teachers: four approaches build up knowledge and skills

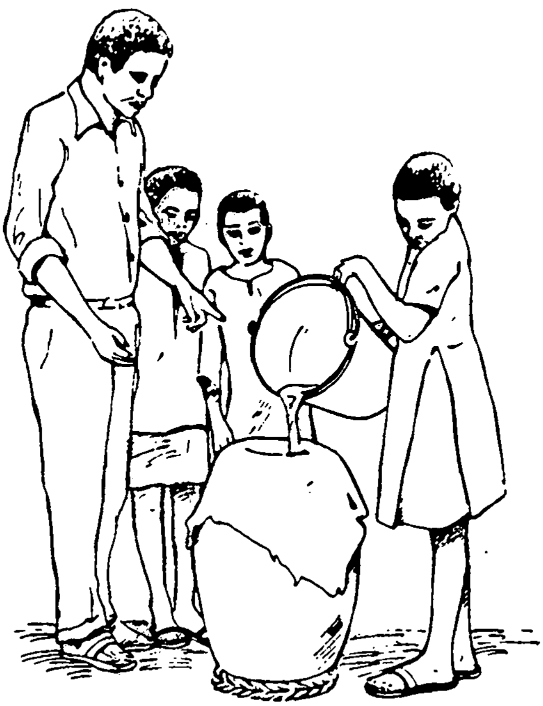
Efforts to incorporate and strengthen health teaching spanned a twelve month period. Four interrelated strategies evolved during that time: (1) in-service training workshops, (2) provision of sample teaching materials, (3) individual consultations with teachers, and (4) an annotated review of existing school health texts.

The research team organized a workshop for all Idere primary school teachers in June, at the end of the 1982/3 school year. Lesson plans prepared earlier for the training of primary health workers were modified for the purpose. Emphasis was on recognition, cause, prevention and simple care for each disease. In addition to incorporating teaching of these diseases into the school health curriculum, the workshop identified the role of teachers in early diagnosis and treatment, and stressed the importance of referring to the nearby dispensary children feeling feverish or with guineaworm ulcers.

A set of background materials which comprised simple songs, stories and proverbs about each disease had been prepared for each primary school teacher. It included directions for simple demonstrations using local materials — for example filtering of pond water with a clean white cloth — and simple drawings with local language captions which could easily be replicated on the blackboard to aid teaching.

The workshop ran for three consecutive afternoons as suggested by the teachers. Medical students, supervised by research team members, served as trainers. They were divided into five teams, one assigned to each school. Out of a population of 56 teachers, 76.8% attended the workshops, averaging 2.4 sessions each; at the end, 62.5% took an objective test on the four diseases. Only two did not score the minimum 50% pass mark. The average score was 67.4%. Extra teaching materials were left with headmasters for teachers who missed the workshop.

Overall reaction was positive. Most teachers said they could utilize their new knowledge during weekly periods earmarked for family life/nature study (two 35-minute sessions per week).



The teacher explains the importance of filtering pond water, using local materials, to prevent guineaworm.

Some school teachers remain skeptical

When the 1983/4 school year began, medical students visited the schools to conduct the baseline survey on pupils' knowledge. In addition to discovering the low level of pupils' knowledge, the medical students were surprised that many teachers seemed unfamiliar with the efforts to improve the curriculum. A closer check revealed that many teachers had been transferred during the vacation period.

Again with the assistance of medical students, a two-day after-school revision workshop was organized in October 1983. Guineaworm and malaria received prime attention, together with the teaching of practical skills.

While most teachers agreed in principle that there was a need for health education, some expressed doubt: were these specific diseases part of the approved curriculum? Was the time adequate for this teaching?

Trainers tried to counter the skepticism by explaining that these diseases were immediate threats to children, and thereby relevant to school health. Dividing material into simpler units was suggested as an answer to the time problem. The evident reluctance of teachers to break out of established patterns highlighted the need for individualized follow-up supervision.

Further transfers of teachers resulted in two major problems. First, by January 1984 the total number of primary teachers in Idere had decreased to 33. Many had been transferred to village schools and were not replaced due to financial constraints. This required doubling of classes and made it difficult for teachers to handle the regular teaching load, much more so health education. Second, the number of teachers who had attended tropical disease workshops was further reduced. Nine classes were now staffed with teachers who had attended neither workshop. At this point intensive consultation education began with each teacher. Review was also made of each teacher's timetable to find suitable opportunities to teach about tropical diseases.

The health content of textbooks: teachers are truly surprised

In order to give credence to our claim that the four diseases were relevant to the school health curriculum, we decided to review the school health texts for each primary class and pinpoint exactly where each disease fitted.

As noted earlier, malaria received the fullest coverage. Guineaworm was mentioned only once in the book for primary class three but all books included sections on clean water. Schistosomiasis was covered under the name bilharzia only in book four, though need for proper disposal of human wastes was treated in each text. There was no direct or indirect mention of onchocerciasis.

A page by page review of all six books was prepared, either to reinforce existing mention of a disease or to indicate specific ways a disease topic could appropriately fit into the available material. In the case of onchocerciasis, for example, when a text specified that some insects carry disease, teachers would be asked to mention the black fly; in a section on "eye trouble", note was made that onchocerciasis can lead to blindness; in another text referring to working on the farm, the danger of exposure to black fly bites was emphasized.

This review was mimeographed and given to every teacher and headmaster. The teachers were truly surprised that the school health lessons outlined in these standard texts offered such a wide potential for teaching. One would think that teachers had never scrutinized the textbooks. Another possibility was that they ignored health in favour of teaching other subjects for which students might be examined on leaving school. It was not just the tropical diseases therefore which were receiving little attention, but the whole area of health.

A small step forward

It would not be realistic to expect major improvements in the pupils' knowledge given the short time available in the weekly teaching programme plus the other constraints mentioned. Still, a small change was noted in the follow-up survey conducted in April 1984 among 95% of the original sample.

Pupils' knowledge — Whereas at the beginning of the school year only 3.8% of pupils knew that mosquitoes carry malaria, 18.8% had this knowledge at the end of the year ($Z = 10.64$, $p < 0.0001$). Awareness that wading in streams leads to schistosomiasis increased from 5.2% to 12.0% ($Z = 5.37$, $p < 0.0001$). While these changes are statistically significant, they still show that there is a long way to go to improve knowledge (let alone practice). But the positive direction is encouraging.

Knowledge on guineaworm remained high with no significant change. Those knowing the correct cause of onchocerciasis continued to be negligible.

Workshop impact — Since the teachers themselves had received different types of exposure, there was interest in seeing if this reflected in their pupils' knowledge. The major difference between teachers was attendance at a workshop since all of them benefited from individual consultations and received teaching materials.

Malaria knowledge among pupils was chosen as a test case since it registered the most improvement. Pupils' responses were compared according to whether their teacher had participated in a workshop or not. While both groups showed progress, 21.1% of those in classes where the teacher had attended a workshop knew that mosquitoes carry malaria, compared to 12.0% in other classrooms. The major impact was therefore realized by pupils whose teachers had participated in the more active form of training where group discussion and visual inputs could reinforce learning.

Teachers pinpoint the real difficulties

The results of the follow-up survey on pupils' knowledge were mimeographed and distributed to all teachers with a note thanking them for their efforts. Honest mention was made of the small size of gains, but encouragement was given for continuing action in the coming school session. Feedback was also gathered from the teachers who were asked for their views on how the programme could have been more successful.

All indicated appreciation for the various inputs by the research team. They felt that the review of the school health texts had clarified their responsibilities. Some expressed optimism that with the past year's experience, they would be better equipped to draw a more appropriate work plan for health education in the coming year.

A few noted the helpfulness of the films on guineaworm shown in previous years by the Health Education Unit of the State Ministry of Health. This confirmed the researchers' suspicion that children's high level of knowledge on guineaworm was not a direct result of the school programme.

Teachers outlined their real and perceived difficulties in implementing the programme. Some blame was placed on the home. It was reported that some children were discouraged from practising what they learned. For example some parents did not believe it was helpful or economic to boil or filter drinking water.

The Ministry of Education was mentioned as well — no provision for teaching aids, inadequate time allotted to health education, inadequate training in health matters at teacher training colleges, subjects not spelled out clearly in the standard syllabus, no specific directives from the school board.

Comments were also made in the direction of the local health service. Without adequate drugs in the local dispensary, teaching and early referral for these diseases became meaningless.

Teachers did not spare themselves of criticism. They agreed that in many cases traditional beliefs still hampered their teaching of modern concepts.

The central role of the individual

The teachers' comments point to several important foci for future intervention. The research team intends to share its experiences with the Ministry of Education so that improvements in both syllabus planning and teacher education can be made. Consultation with the local school board will be needed to see if disruptive transfers can be avoided. Headmasters will be encouraged to make greater use of the Parent Teacher Association as a medium for generating support for disease control activities in the home.

While these "external" changes will help, both the teachers' insights and the research team's experience point to the central role played by the individual teacher.

It may be true, as some teachers claim, that there is a lack of imagination, confidence or willingness to make adaptations and interpretations of the school health syllabus. But then, there were teachers who used their own resources to buy and make their own teaching aids, like cloth water filters. They even shared these with other teachers. On the other hand, others were waiting for financial assistance from a resource-starved parent teacher association or the local school board to purchase teaching aids.

No matter how many directives come from the ministry, their impact will remain minor unless teachers perceive health education as a natural part of the curriculum and feel it to be a matter of duty to the children. Here, support on the local level is of importance in stimulating interest and involvement.

Since the workshops and individualized follow-up did show some impact, the research team intends to build on this experience. Annual workshops on school health education will be organized and team members will meet with teachers early each session to help set out a plan of work that truly reflects local health needs. With these reinforcements it is hoped that teachers will accept teaching of local health issues as a basic part of the school curriculum. ■

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IMPACT OF GUINEA WORM DISEASE ON CHILDREN IN NIGERIA

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Abstract. School attendance records of all primary schools in a guinea worm-endemic village in southwestern Nigeria were examined to determine the cause of missed school days and school drop-outs. At the time of the survey, 1,495 pupils (768 boys and 727 girls) were registered in the 4 primary schools in the village, of which 21% of the pupils were infected with guinea worm disease (GWD). Female pupils had a higher infection rate than their male counterparts. Guinea worm-infected pupils missed up to 25% of school year days compared to a non-guinea worm-infected absence of 2.5%. At the height of guinea worm season in the study area, guinea worm-related absences contributed virtually all of the absenteeism recorded in the schools. Implications of the findings within the context of educational attainment of the pupils are discussed.

Guinea worm disease (GWD) is endemic in most rural communities in Nigeria. Efforts to control the infection in Ibarapa district of Oyo state have not been successful largely due to the paucity of sanitary water supply in the affected areas. Pipe-borne water supply to western Ibarapa district stops at the village of Idere, as a result, most villages in western Ibarapa depend on stagnant shallow ponds and wells for their domestic and main drinking water supply. These collections of surface water serve as breeding grounds for the *Cyclops* species, the intermediate obligatory host of *Dracunculus medinesis*, the causative organism of guinea worm infection.[1] Disability due to GWD may last for 3–4 months, depending on the location of guinea worm lesions and relative number of ulcers.[2,3] A high prevalence of GWD coincides with mid-school year activities and major agricultural activities when the farm lands are cleared manually in preparation for cultivation, planting and harvesting of the essential staple foods.

Although many workers have studied the impact of GWD in terms of lost work days and decreased agricultural productivity in the adult labor force, little is known of the effects of GWD on children's activities.[4,5] This study reports the findings of a cross-sectional survey of GWD among primary school children (aged 6–14 years) in Idere during the school year 1981–1982 and the impact of the disease on school attendance.

MATERIALS AND METHODS

Study area

Idere is about 117 km southwest of Ibadan, the seat of Oyo state government, and about 5 km from the Rural Health Center Igbo-Ora. Domestic water supply for Idere residents comes mainly from shallow ponds. Cisterns for rain collection and stand pipes do provide some amount of water for the people. However, while on their farms, Idere farmers and their families collect their drinking water solely from shallow ponds which contain guinea worm-infected *Cyclops*. There are 4 primary schools in Idere. When not in school, most of the boys and some of the girls between the ages of 10–14 years help on the family farms.

Primary school visits

All primary schools were visited during the months of January and February of the 1981–1982 school year, the height of guinea worm season in Ibarapa. On the survey day, each pupil present in school was visually examined for a guinea worm lesion or blister and for a palpable pre-emergent adult guinea worm under the sub-

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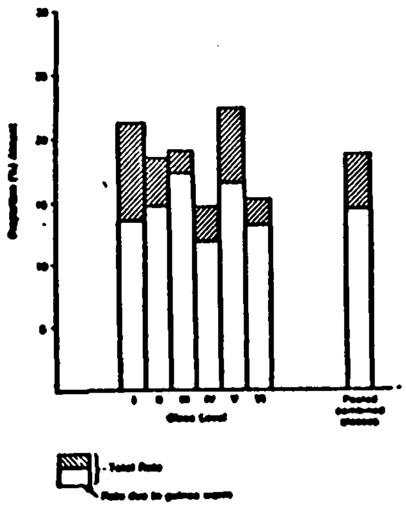

FIGURE 1. Distribution of rate of nonattendance in Idere schools by class level 1981–1982.

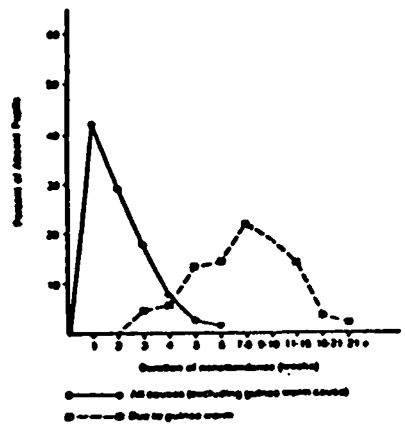

FIGURE 2. Comparison of percent duration of absenteeism (in weeks) in Idere primary schools by cause, 1980–1981.

cutaneous tissue. Attendance records of each class during the 1980–1981 and 1981–1982 school years were inspected for cause and duration of absences. Confirmation of cause for absence normally was obtained from the class teacher, but a relative of the pupil in the same school was consulted in cases of doubtful ascertainment of cause by the class teacher. Furthermore, class teachers and school headmasters were individually interviewed as to what proportion of their pupils dropped out of school each year and for what reason.

RESULTS

Registration in all primary schools in Idere during the period of the study was 1,495 pupils (768 boys and 727 girls), 68% of children (6–14 years) in the village. GWD was present in 21.2% of the pupils, with more females (22.3%) infected than males (20.2%). Figure 1 shows the proportion of pupils absent by class level during the 1981–1982 school year. Periods of high absenteeism correspond with the height of both dry season and guinea worm season in the village. GWD was the major cause for missed school days, and, during January–February, it represented almost the entire reported cause for nonattendance in schools. Absenteeism declined as guinea worm season waned. Figure 2 shows pupils with GWD were absent from school longer than non-guinea worm-infected pupils. The average absence for GWD was 9 weeks vs. 1 week for non-guinea worm absence. This represents 25% and 2.5% of missed days, respectively. School records indicated that approximately 5.7% (85) of the pupils registered in schools permanently dropped out due to guinea worm infection, while the corresponding proportion of pupils who dropped out for non-guinea worm-related reasons was 0.8% (12). GWD was the reason for the initial absence of 88% of the 97 pupils who never returned to school.

DISCUSSION

Importance of clean water supply and proper waste disposal is a difficult concept to teach the pupils in Idere primary schools because sanitary facilities are absent in the entire community. This study found that as a consequence of guinea worm infection, over 21% of Idere pupils in primary schools did not benefit from the educational opportunities provided through the school system. No provision is made for home or individual

tutoring. In Nigeria there is a strong link between literacy and attainment in leadership.

For pupils who are chronically infected with GWD to optimally benefit from the educational system, education in personal and community hygiene should become an essential component of instruction in primary schools in Idere. Collaborative effort by administrators of education and social service agencies is necessary to provide essential sanitary amenities to promote school health in rural villages, including the provision of adequate pipe-borne water and toilet facilities in primary schools and in the community. The transmission cycle of GWD is known to be interrupted in a relatively short period when adequate pipe-borne water is provided to an endemic community.[6-9]

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Case Studies

USING TEACHERS AS CHANGE AGENTS IN THE CONTROL OF TROPICAL DISEASES— AN EXTRA-CURRICULAR APPROACH

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ABSTRACT

For years the teaching of health education has always been a problem in the Nigerian schools either due to the absence of the subject on the curriculum or inadequate professional preparation of teachers to handle it. This study introduces an extra-curricular approach using four endemic diseases as an example in the teaching of health education in five secondary schools. The findings revealed that: 1) teachers can be successfully used as informal agents in the school environment if exposed to appropriate health education techniques, and 2) endemic diseases can be controlled through the provision of learning experiences in the school environment where feasible.

THE SCHOOL CURRICULUM AND THE CONTROL OF TROPICAL DISEASES IN NIGERIA

The colonial government paid little attention to the educational needs of the people. Education was left entirely to the Missions who, according to Lord Lugard assumed that the African culture and religion had "no system of ethics, and no principles of conduct" [1]. Before the turn of the nineteenth century

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many schools were founded in Nigeria by the missions with no clearly defined educational policy by the colonial rulers to guide them [1].

Formal education made significant impact in Nigeria in the late nineteenth century with the activities of the missionaries and the colonial government. The primary objective of the early missionaries was to convert the "heathen" to Christianity through education. Hence their efforts were concentrated on English grammar, Latin, Catechism, and writing—with the Bible as a major text book [2].

It was only in 1899 when the Northern and Southern Protectorates were established under the British Government that the government got involved in the education of the people [1]. Government schools and education departments were created and educational requirements and regulations were promulgated in the early twentieth century.

By 1925 it was soon evident through the Phelps-Stokes Reports on Education in Africa that the content of the curriculum in schools was not relevant to local needs [1]. Instead it was centered around the needs of the colonial government. The secondary school curriculum was based on the syllabus for the Cambridge Junior and Senior Local Examinations Syndicate and the Matriculation Examination of the University of London [1]. After the Phelps-Stokes Report, the colonial government made efforts through the years to adapt the school curriculum to local situation but these efforts were generally unsatisfactory.

In 1969, nine years after Independence, a National Curriculum Conference was convened by the National Education Research Council (NERC) to deliberate on curriculum planning in Nigerian Schools [3]. The aftermath of this conference and a subsequent one in 1977 culminated in the formation of a national policy on education which took into consideration the "psychological and emotional needs of the Nigerian Child." In all these deliberations and activities, health education was never featured as a subject. Where it was mentioned by contributors, its content was usually related to biology [4]. The education experts continue to joggle health education around biology, physical education, and hygiene curricula.

Up until today, health education in Nigerian schools is yet to be properly recognized and appreciated by the education experts and school administrators. Because of this lack of enthusiasm, teachers continue to receive little or no professional preparation in the teaching of health education. Health education is combined with physical education in teacher training colleges—a situation which deters the effective teaching of health education, according to popular reasoning among health educators [5].

In Nigeria, communicable diseases are responsible for substantial rates of mortality and morbidity, loss of manpower, and impaired productivity. Although there are several measures to control some of these diseases at the one through four age group level in maternal and child health clinics—the latest of which is the Expanded Immunisation Programmes (EPI)—very little attention is paid to the school-age child. The only education the school age child (five through sixteen years) receives at his/her level on communicable diseases is in biology, health science, or hygiene courses. Health education is not offered as a subject.

At the secondary school level, the biology curriculum focuses more on the physiology and anatomy of living things than on diseases or health-related needs. Where diseases are mentioned, they are usually treated in relation to entomology and zoology under such headings as arthropods, multicellular animals, and disease vectors without any bearing to the local health problems and diseases to which the students are susceptible [6].

Many studies have highlighted the need to include health education in the school curriculum but the call has always not been heeded by the school authorities [7,8]. This experience calls for a need to develop alternative strategies that will by-pass the school curriculum in order to incorporate health education into the activities of the school. The present study describes an extra-curricular approach to the introduction of health education in secondary schools in Nigeria. The aim of this study is to assess how effective secondary school teachers could be as informal change agents in the school environment if exposed to health education strategies in which they acquire specific skills, techniques, and learning experiences which are relevant to the health needs of the school child.

METHODOLOGY

The study was carried out in five randomly selected rural secondary schools created in 1979. Four endemic tropical diseases prevalent in the area of study and targetted by the World Health Organization special program on the control of tropical diseases (TDR) were the main focus. These include malaria, schistosomiasis, onchocerciasis, and dracontiasis (guinea worm) with prevalence rates of 56 percent, 5 percent, 20 percent and 34 percent respectively.

For the purpose of teaching, second year students were chosen as the target population. Baseline data on the knowledge of the four diseases were collected from teachers and their students. Methods of data collection included a self-administered questionnaire, informal interviews, and personal observation. The questionnaire for teachers was designed to provide information on their knowledge of school health education, broadly classified into healthful school living, health instruction, and school health services. The questionnaire was pretested in a school similar to those being used for validity and reliability.

Based on the results obtained from teachers and students, a curriculum which laid emphasis on experiential learning was designed for the students. After seeking the consent of the Ministry of Education, a four-day workshop on the use of the curriculum was held for teachers. Method of instruction was facilitated by the use of demonstration, lectures, story telling, role playing, and

the use of visual-aid materials. Progress evaluation was initiated two weeks after the workshop, while the final evaluation followed about seven months later. This period of time allowed the teachers involved sufficient time to teach and implement the various activities required of them.

Results of Baseline Data for Teachers and Their Students

Responses were obtained from fifty teachers. The teachers displayed very little knowledge of causes, prevention, and treatment of schistosomiasis (4%) and onchocerciasis (2%), a fair knowledge of guinea worm (63%) and a good knowledge of malaria (81%). Analysis of the teachers' background revealed that most of them have had little or no formal preparation in the methodology of health education as a subject.

Data were collected from 632 students. They portrayed little knowledge on the causes, prevention, and treatment of onchocerciasis, (0%), schistosomiasis (5%), and guinea worm (34%) and only 25 percent had some knowledge of malaria.

INTERVENTION

The workshop for teachers was held at the rural health center and lasted four days. The purpose of the workshop was to introduce the teachers to the methodology of teaching school health education, using the four endemic diseases as examples. The participants were the seven biology and health science teachers in the five schools. The limitation on attendance was imposed by the Ministry of Education to prevent significant disruption of classes. An attempt to hold the workshop after school hours in order to include more teachers a few months earlier had failed. Teachers apparently were not willing to spare their free hours for what they considered an inservice training. Two of the seven teachers were university graduates, while the others were products of colleges of education and polytechnics. There was only one female teacher (an expectant mother) in the group.

Before the formal presentation of the diseases to teachers, there was a session on school health, which included materials and method in the teaching of school health education. The following was the format of presentation:

Stage I

(a) Presentation of educational and behavioral objectives relevant to each disease. The facilitator describes the mode of transmission of each disease, the symptoms, control and treatment, and then relates it to local conditions. Teaching materials and methods used included role playing, story telling, demonstrations, and visual aids (drawings, slides, and posters).

(b) Teachers make sketches of selected visual aids which they will reproduce at home and use for their health education projects when they return to their schools.

Stage II

(a) Teachers discuss the local beliefs, attitudes, and practices which contribute to the spread of the four diseases and other diseases of interest.
(b) Teachers discuss control measures for the disease, especially those that are feasible within the school environment.

Stage III

(a) Teachers suggest and discuss appropriate strategies to change or influence the beliefs, attitudes, and practices of the school children to control the diseases.
(b) With the guidance of the facilitator, teachers list and discuss the specific disease control activities they will carry out when they get back to their schools.
(c) *Review and evaluation.*

Teachers' Performance at the Workshop

The teachers contributed and participated fully in all discussions on the four diseases. They were particularly active during discussions on traditional medicine, local beliefs about the four diseases, and predisposing habits of the *community. Other health issues of interest to the teachers were sex education in* schools, hypertension, and stress in the society. The teachers were very concerned about the poor living conditions in the community.

Of the four diseases, onchocerciasis appeared to capture their interest most. Only one of the teachers (a Ghanaian) was familiar with the disease. They were excited to have a skin snip test at the laboratory in the health center during their field visit. The teachers were proud to display the teaching aid materials which they prepared during the workshop.

Evaluation of teachers indicated significant increase in the knowledge of the four diseases after the workshop. The teachers involved indicated a desire for: 1) more of their colleagues to be involved, 2) films to be produced on the four diseases to enrich workshops in future, and 3) the facilitator and other members of the health team to visit schools to give health talks to the pupils.

At the end of the workshop, incentives comprising information pamphlets and booklets on the diseases studied and copies of the book *Where there is no Doctor* were given to the seven teachers and their principals.

Before departing, the teachers agreed that their immediate assignment for the next few weeks would be to:

1. Provide leadership in the formation of a school health committee with the cooperation of their principals;
2. Organize methods and materials for teaching the four diseases;
3. Work on the improvement of the environmental conditions within the school with assistance from the Parent-Teacher Association (PTA) and technical advisers; and
4. Ensure both the adequate supply of potable water and the provision of toilet facilities in their respective schools.

EVALUATION OF TEACHERS' POST-WORKSHOP ACTIVITIES

School 1 — Okedere High School

The teacher who participated in the workshop from this school is a biology graduate with eight years teaching experience. Of all the teachers, he made the most significant contributions in class during the workshop. After the workshop he was able to incorporate lessons on the four diseases into his biology lectures for several classes apart from the target group. The diseases were used as topics of debate during weekly extracurriculum activities. Examples of topics for such debates included: "Should we demand that the government grant us regular water supply from the taps or should we dig wells or bore holes?" This kind of topic according to him, was with relevance to causes of guinea worm infection. On malaria treatment, the topic was: "Should we practice self-medication or should we rely on the dispensary for drugs?" The school has a pit latrine. They have a standing pipe which is broken. Water does not flow regularly in Idere town, so the urgency for repairs is lacking. The PTA is aware of the project in the school. They contributed to the full equipment of the first aid box. As much as they appreciated the need for a well, there were more pressing issues (i.e., the building of more classrooms and temporary walls for students who are presently studying under trees and temporary sheds). A school health committee has been formed. The students were organized to take turns in taking care of the toilets and in the maintenance of a clean compound. The school maintains a clean environment with beautiful flower gardens. Until a well is sunk, the students are instructed to bring drinking water from home in small containers and to ensure that the water is cyclop-free through boiling and filtering.

School 2 — Ayelogun Grammar School

The teacher from this school is a graduate of a technical college with a public health engineering background who has been teaching for only eighteen months.

The principal of the school has been supportive of the project from its inception. At the end of the workshop, the principal asked the teacher to share his experiences with members of staff during one of their staff meetings. It was the principal's hope that the teachers would incorporate the four diseases in their teaching.

At the time of the final evaluation, the PTA had pit latrines half-completed and were in the process of digging a well. Funds are major constraint in these projects. The PTA is responsible for completing and equipping blocks of classrooms and equipping the school science laboratory. The teacher in charge had completed imparting knowledge of the diseases to the students concerned. According to the principal, the students no longer go to nearby streams for washing and drinking after school meals. It was guinea worm season and those affected were being sent to the health center daily. Only 18 cases of guinea worm were reported at the time of data collection. This number, according to the principal, is small compared to the previous year when guinea worm accounted for 50 percent of absenteeism in the school. The school has no immediate plans to erect a pipe-borne water tap because of funding difficulties. The compound is neat and tidy with beautiful gardens.

School 3 — Lajorun High School

The teacher from this school is a graduate of physical and health education with twenty-two years of teaching experience behind him. He was the acting vice-principal of the school.

This teacher began his activities in the school after the workshop by giving short health talks during morning assemblies. On World Health Day, he used the opportunity to speak on onchocerciasis to the whole school. His achievements included the teaching of the four diseases to the target group.

The school had no well and so students relied on nearby streams for washing. After the workshop, the teacher requested technical assistance in the siting of a well. Since then, a geologist and an environmental health expert visited them but the school still is without funds to sink a well. Meanwhile the PTA donated a tank for storing of water supplied weekly by the water corporation. The teacher made arrangements for the provision of plastic pot containers in each class with funds contributed by students. Each class gets its daily supply of water from the tank eliminating the need for the students to visit the nearby streams. At the moment, arrangements for the regular supply of water from the water corporation in town is being hampered by lack of funds to pay for the services. The school is in dire need of funds to run the school. They have intensified their agricultural project in order to generate funds from the sales of farm produce. The school has employed the services of an agricultural extension superintendent to assist with the farm. All the schools in the rural areas have large corn fields. There are no good toilet facilities but the school authority is

now working with the PTA development committee to construct pit latrines. The teacher has completed the teaching of the diseases to the target group and a school health committee has been formed.

School 4 — Isale Oba Grammar School

Two science teachers, each with about five years teaching experience, participated in the workshop from this school. These teachers started implementing programs before the other five teachers. During our visit, the teachers demanded that we should have a brief session with their students. The responses from the students on the knowledge of the four diseases were encouraging. During our brief interaction with the students, six children informed us that they had experienced blood in their urine (schistosomiasis), and one boy mentioned that he had blurred vision. They were all referred to the health center. Other achievements in the school included the formation of an active health committee, the construction of urinals, and half-completed pit latrines (with student labor). The completion of the latrines and the construction of a well are on the PTA agenda as priorities as soon as the tasks of equipping science laboratories and finishing uncompleted classroom blocks were accomplished. There is no well in the school compound, so students were asked to bring drinking water from home in small jerry cans on a rotational basis because the tank donated by the PTA a few months earlier was rarely filled with water. According to the school authorities, only one case of guinea worm was reported so far. The compound is kept clean by students and the flowers are well tended. Sometimes during visits students can be seen busily working on the school farms which the school authorities looked to as a source for funding school projects.

School 5 — Lasogba High School

The teacher from this school was a young expectant mother and the only woman in the project. She is a graduate of the National College of Education and has been teaching for ten years. She was the last to begin executing the workshop assignments due to ill-health. The principal, a keen supporter of the project was disappointed that their school's progress was slow compared with other schools. At the time of our visit, funds had been provided for the purchase of materials for the first aid box. The principal requested other staff members to work with her in the formation of a health committee. Water has always been a major problem since the school is not close to any flowing streams and is some distance from the community. The school has a shallow well which dries up during the dry season, and it has been found that the topography of the area is an obstacle in the siting of deep wells. The school requested technical assistance in siting another well. One unique example of the workshop's impact was the display of drawings of the life-cycle of the four diseases prepared by the science teachers during the workshop on the walls of the school laboratory. Another innovation was the provision of plastic buckets for storage of water for school and students' use. According to the principal there are plans to construct pit latrines in addition to the well and the PTA was eager to render assistance.

The school environment is kept tidy by students. The achievements of this school were made possible through pressure exerted from the principal on the science teacher.

DISCUSSION

The job of each teacher after the workshop was to organize the teaching of the diseases to certain groups of students, to provide leadership in the formation of a school health committee, and the working on the improvement of the environmental conditions within the school environment, with the cooperation of the PTA where necessary. From the findings all teachers attempted to accomplish all of these at their own pace. They all showed a high level of interest during the post-workshop intervention. One example was their ability to accommodate the project at a time when Military Government announced a change of currency as one of the measures to arrest the country's battered economy and foreign exchange. Every citizen had to queue endlessly in the banks for long periods in order to have their old currencies exchanged for new ones within two weeks deadline. There was difficulty in generating funds for the implementation of activities due to the general economic recession which transferred additional responsibilities from the government to parents and the community. Government directives were that the PTA should handle all the unfinished projects by the last civilian regime. This implied that funds contributed by the PTA to improve the schools' environmental conditions were diverted to the equipment of science laboratories and for completing blocks of classrooms in readiness for the new entrants the following session.

Despite all the difficulties encountered by the teachers either within the school system or without, the findings show that health education can be successfully introduced into schools through an extra-curricular approach thus by-passing the educational policy. This alternate approach has made significant contributions to areas of school health which were hitherto neglected in the schools concerned:

1) It has increased the level of awareness on the control of tropical diseases through adequate health education, among school personnel and students.
2) It has created the need to improve conditions in the school through the organized efforts of school personnel, PTA, and students without relying solely on the government—especially when funds are inadequate.
3) Since health education is not catered for on the time table, this extra-curricular approach has afforded students the opportunity to gain knowledge of prevalent diseases in their environment through various learning experiences.

CONCLUSION

Reports from the involved teachers indicate the children seemed to enjoy *the brief sessions of health education. According to them* "the students wanted more but there was no time." The project demonstrated that in the absence of health education on the curriculum or time table, the present approach can be adopted to effect positive change in the school environment. Finally school authorities recognize the need to improve the health status of the school child through health education, but the educational policies were sometimes, inadvertently militating against the implementation of health education activities.

Presently the country has just introduced a new educational system with health education termed health science in the secondary school curriculum [9]. The execution of the subject on this new curriculum will remain a problem for some time since professional training of teachers and production of school health text books will take a while.

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Targeting school children for tropical diseases control: preliminary findings from a socio-behaviour research in Nigeria

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Summary

This paper reports one study carried out among school children in Nigeria to investigate some of the social and behaviour factors contributing to the transmission of malaria, guineaworm, schistosomiasis and onchocerciasis. Data were gathered from 1310 secondary school children in a rural community. Analysis of data revealed that 70% of students wash and fetch water in the streams and ponds for domestic purposes. More than 70% claimed that their drinking water was pipe borne even though we knew that the taps had been dry for months. Only 29% specified streams, wells, ponds and water holes as sources of water supply. More than 30% claimed to treat their water before drinking in their homes. There is evidence from home visits in the community that a large proportion of the population do very little to improve the quality of drinking water before consumption.

With the exception of malaria, the student's knowledge on the causes and prevention of schistosomiasis, onchocerciasis and guineaworm is virtually nil.

All of these had implications for an educational intervention plan which was the next phase of the project.

Introduction

The school age population is one of the vulnerable groups known to suffer serious consequences from environmental hazards. High rates of morbidity among school children are well established. Infective and parasitic diseases, especially malaria, are responsible for high rates of absenteeism in schools in Nigeria. Bruce-Chwatt in a comprehensive malaria survey in Nigeria as far back as 1951 recorded a parasitic rate of 92% among school children (Bruce-Chwatt 1951). Since then numerous studies on prevalence and epidemiology of malaria among school children revealed that the rate has not decreased significantly. The morbidity rates for schistosomiasis are quite high in endemic areas. Infection rates range from 58 to 93% in school children. (Gilles *et al.* 1981; Siegal 1968). Guineaworm infection exists in most rural communities where the people depend on surface water holes for domestic and drinking purposes. Kale (1977) recorded a prevalence rate of 22–27% among the 10/14 years age group, while a rate of 13–23% absenteeism from schools was reported by Nwosu *et al.* (1982). Onchocerciasis has been known in Nigeria for more than 70 years. Blindness rates of up to 15% have been reported in heavily affected areas (Crosskey 1981). In some communities some children are already blind by the age of 9 years (Albiez 1981).

There is no doubt that much of the human behaviour that contributes to the transmission of disease has its roots in the practises, health beliefs and perceptions learned early in youth. Many diseases are strongly linked with people's life styles, occupation and poor living conditions and are complicated by ignorance and poverty.

In 1981, the UNDP/World Bank/WHO special programme supported a multidisciplinary research project for the control of

malaria, schistosomiasis, dracontiasis and onchocerciasis at the University of Ibadan, Nigeria. The main objective of the project is to assist the efforts of the biomedical scientists by examining the social, economic and behavioural factors in the transmission of these diseases. The school age group (5–18 years) in the community where the research programme (TDR) is based comprise 35% of the population and constituted the target for this study.

Study area and background

The project is being carried out in the Ibarapa district of Oyo State in western Nigeria. Ibarapa Division, as it is popularly known, covers about 2883 square km and has at present a population of 194 612. Ibarapa extends towards the savanna region in the north and the rain forest zone in the south. Hills and rocks occupy 4–5% of the land surface. The division comprises seven major rural towns, namely Eruwa, Igboora, Igangan, Idere, Tapa, Aiyete and Lanlate. Ibarapa has no acknowledged capital; Igboora, one of the larger towns, is the head of the Ibarapa District, while Eruwa is the divisional headquarters. The lack of a recognized Oba (a constituted traditional king with royal apparatus) has hindered Igboora or any of the larger towns from claiming to be the natural capital of Ibarapa Division. The population of Ibarapa is unevenly distributed, with about 70% in the seven major towns and 30% living in more than 700 villages or farm settlements scattered throughout the area. The farm settlements are temporary residences where the people camp in order to carry out their daily occupation of farming, crafts etc. At weekends, festivals and ceremonial periods many village residents return to their family compounds in the town or to their permanent home settlement.

There is a dispensary in each of the rural towns, a health centre at Igboora and a district hospital at Eruwa. The larger towns, like Eruwa and Igboora, have piped water whose supply was intermittent while the remaining towns and villages rely on wells, ponds, water holes and streams which as sources of water supply are heavily polluted.

Methodology

A few years ago, the Oyo State Government declared free, and compulsory, education—from primary school to university level—for all in the State. In order to cope with the annual intake more secondary schools were created.

The study was carried out among secondary school students from 10 newly created schools randomly selected in five of the rural towns within Ibarapa district. The sample consisted of second year pupils of the 1981/82 session in all the 10 schools. Each class had an average of 140 students thereby making a total of 1400 students for inclusion in the study. Data collected included the children's socio-demographic data and their knowledge about causes treatment and prevention of malaria, schistosomiasis, dracontiasis and onchocerciasis as well as their beliefs and practices in relation to these diseases. Methods of data collection included: informal interviews with pupils, school personnel and parents; general observation in schools and in selected homes in the community; and a self-administered questionnaire completed by the pupils.

The questionnaire included questions on the pupils' notions of causation, preferences for treatment (traditional or modern) and notions of prevention. Other items related to recognition of disease symptoms, practices and behaviours known to be associated with transmission of the disease, personal protection measures and past experiences.

The purpose of the informal interviews and observation was to cross-check information given by the pupils when there was a need for clarification or confirmation of any sort. Four field assistants were trained to assist in the data collection.

Findings

DEMOGRAPHIC INFORMATION

Out of 1400 pupils in the 10 schools, data was collected from 1310. Most of the absenteeism in many schools was ascribed to an outbreak of guineaworm infection. A few others who were absent were preparing for the annual sports competition. Of the 1310 pupils, 60% were

Table 1. Causes of malaria and guineaworm

Causes	Malaria (%)	Guineaworm (%)
Dust	7	—
Mosquito bite	36	—
Swimming in dirty water	—	8
Groundnut oil or palm oil	3	—
Bite of small insects	8	—
Working in the sun	4	—
Drinking impure water	—	43
Don't know	42	49

n = 1310.

Table 2. Prevention of malaria and guineaworm

Prevention	Malaria (%)	Guineaworm (%)
Insecticides (spray and coil)	1	—
Native medicine	6	2
Clear away bushes	4	—
Preventive drugs	18	4
Mosquito net	2	—
Injection	1	—
Boiling of water	—	6
Don't know	68	88

n = 1310.

males and 40% females. Their ages ranged from 11 to 23 years, with a large proportion (over 55%) of the children between 14 and 16 years. About 50% were Christians while 45% were Muslims. Seventy per cent of the parents had received no formal education. Over 64% of their fathers were involved in subsistence farming, while 60% of their mothers were engaged in trading.

STUDENTS' NOTIONS OF CAUSATION, TREATMENT AND PREVENTION OF MALARIA, GUINEAWORM, ONCHOCERCIASIS AND SCHISTOSOMIASIS

The findings are presented in Tables 1 to 6. They show that, except for malaria and guineaworm in which 36% and 43% of the pupils respectively had the correct notions of causes, the percentage of pupils with correct notions of causes, treatment and prevention of the four diseases was generally low, with 'don't know' responses ranging from 51 to 99%.

Table 3. Treatment of malaria and guineaworm

Treatment	Malaria (%)	Guineaworm (%)
Hospital	41	26
Native medicine	2	1
Drugs	4	1
Palm oil	—	1
Chemist	1	1
Traditional healer	1	1
Don't know	51	69

n = 1310.

It should be noted that the local name for schistosomiasis, which has a symptomatic origin (blood after urine), was used. By the same criterion, onchocerciasis was recognized as four different diseases—chronic itching, nodules, blurred vision and blindness.

BEHAVIOURAL DIAGNOSIS IN RELATION TO WATER CONTACT AND ITS USE

In relation to behaviour associated with guineaworm infection, the majority of pupils (71%) claimed to depend on pipe borne water as their source of drinking water in the home, while 29% indicated streams, ponds and wells. When asked in what form their water was consumed, 39% said they drank their water untreated all of the time, 26% claimed they only boiled their water sometimes and 31% said that water consumed in their homes was always boiled. More than 50% did not seem to associate the drinking of polluted water with guineaworm.

With respect to behaviour associated with the transmission of schistosomiasis, 70% of respondents said that they went to streams and ponds to bathe, swim, wash and fetch water for domestic use. When asked leading questions on the causes of schistosomiasis a few (26%) believed that bathing and washing in water could cause blood in urine but the remaining 74% did not think the two were connected.

Thirty-nine per cent of pupils believed that the bite of the black fly (*Similium damnosum*) could cause nodules in the hips and groin, blurred vision and blindness, all symptoms of onchocerciasis. They had no knowledge of

Table 4. Causes of schistosomiasis and onchocerciasis

Causes	Schistosomiasis: Blood after urine (%)	Onchocerciasis: Chronic itching (%)	Nodules (%)	Blurred vision (%)	Blindness (%)
Evil doers	—	—	—	1	1
Dust	—	—	—	1	3
From God	—	—	—	1	—
Swimming in dirty water	4	—	—	—	—
Flirting	1	—	—	1	—
Skin diseases	—	—	—	1	—
Anaemia	—	—	—	1	—
Groundnut oil or palm oil	—	2	—	2	—
Cheese (local)	—	10	1	—	—
Bite of small insects	—	—	2	1	1
Using dirty lamps for reading	—	—	—	1	1
Chronic itching	—	—	2	5	2
Bad blood	—	—	—	1	—
Working in the sun	—	—	—	5	1
Don't know	95	88	95	79	91

n = 1310.

Table 5. Prevention of schistosomiasis and onchocerciasis

Prevention	Schistosomiasis: Blood after urine (%)	Onchocerciasis: Blurred vision (%)	Chronic itching (%)	Nodule (%)	Blindness (%)
Native medicine	1	2	—	—	—
Preventive drugs	3	2	3	1	2
Pray to God	—	—	—	—	1
Blood tonic	—	1	—	—	—
Avoid heat	—	1	—	—	—
Read with recommended glasses	—	1	—	—	1
Don't know	96	93	97	99	96

n = 1310.

Table 6. Treatment of schistosomiasis and onchocerciasis

Treatment	Schistosomiasis: Blood after urine (%)	Onchocerciasis: Blurred vision (%)	Chronic itching (%)	Nodules (%)	Blindness (%)
Hospital	12	16	15	11	11
Native medicine	1	1	1	—	—
Drugs	1	1	1	—	—
Church/faith healer	—	—	—	—	1
Traditional healer	1	—	2	1	—
Chemist shop	1	1	—	—	—
Don't know	84	81	81	88	88

n = 1310.

protecting themselves against the bite of the fly.

When asked if they thought the bite of the mosquito could cause malaria, 89% answered in the affirmative, whereas earlier on (Table 1) only 36% linked malaria infection to mosquito bite in response to a non-leading question on the causes of malaria. Seventy-five per cent failed to specify what to do to protect themselves against the bite of the malaria vector.

PAST EXPERIENCES WITH THE FOUR DISEASES

When asked to list diseases from which they had suffered within the past year, malaria, guineaworm, blurred vision, stomach upset and headache topped the list of diseases identified.

SALIENT POINTS ON OBSERVATION OF ENVIRONMENTAL AND CONDITIONS OF SCHOOLS AND COMMUNITY

Eight of the 10 schools were situated about 5 km away from the town. All 10 schools had spacious well maintained surroundings with beautiful gardens. The students did their own cleaning and clearing of the bushes. All the schools had inadequate toilet and water facilities. In schools where pit latrines were not provided, the pupils made use of the surrounding bushes for defaecation and urination.

Sources of water supply in many of the schools were nearby streams. Children depended on these streams for drinking and washing their utensils after meals during the break period. Some schools had wells, but these usually dried up in the dry season. One of the schools had a tap installed but it hardly functioned since there was a perpetual shortage of water in the area. Asked informally what they were doing about the water problem teachers said that they advised students to bring water from home. According to one teacher, students found this cumbersome and so never complied. Discussions with many of the students revealed that they did not associate washing in the polluted streams and drinking from them with transmission of schistosomiasis and guineaworm infections.

Classrooms were overcrowded because of limited space. More classrooms, furniture and teaching facilities are needed to cope with the growing population of the schools. Teachers and principals complained of insufficient funds for the daily administration of the schools. According to the principals, one problem facing the schools was the constant transfer of teachers by the State Government. In addition there was a shortage of trained teaching personnel in the different subjects.

The only science subject offered by most of the schools was Biology. The schools lacked well equipped laboratories to teach Physics and Chemistry. Health Education was not on the school curriculm. Furthermore the first aid boxes in all the schools were empty. Teachers claimed that children were sent to the health centre dispensary in case of sudden illness or other emergencies.

It is obvious that the financial needs of the schools are urgent. Some schools had intensified their agricultural programme with the intention of generating funds from the sales of their farm produce. The school personnel fully appreciated their role in the control of tropical diseases, however there were more pressing needs, and the Parents Teachers Association (PTA) already had its hands full in its efforts to cater for the children's educational needs.

A few homes visited in the community maintained clean compounds. Almost none had toilet facilities. There were taps in all of the communities but they were dry. Many of the homes visited utilized streams, ponds, water holes and wells as sources of water supply. Igboora, Eruwa and Lanlate, where six of the schools are located, enjoyed a potable water supply more frequently than Idere and Igangan where the remaining schools were located. The incidence of guineaworm was low in some communities, for example Igboora, during the guineaworm season when compared to others, such as Idere. It was found that in Igboora there was a sanitary well in almost every compound. In some of the homes the common breeding places for mosquitoes were pots of water containing cassava flour left to ferment for many days before processing.

Parents in the community said they protected themselves against mosquito bites by using insecticides and coils. On the farm, some

farmers said they protected themselves from the bite of the blackfly (Amukuru) by rubbing kerosene and lime on their arms and legs.

Discussion

From the results there is no doubt that compared with malaria and guineaworm, onchocerciasis and schistosomiasis were diseases unfamiliar to the students. There is evidence that all four diseases are prevalent in Ibarapa district with malaria and guineaworm more common among school children. The students had little knowledge of the causes, prevention or treatment of the diseases, especially schistosomiasis and onchocerciasis. Although more than 25% claimed that they would go to the hospital for treatment of the diseases, utilization of health services was considered to be very poor among students. Many students resorted to home remedies and over-the-counter drugs. Malaria was usually treated with a traditional drug (agbo) made from boiled medicinal leaves. The rubbing of palm oil on the leg ulcer resulting from guineaworm infection was found to be widely practised.

The inability of many of the students to associate guineaworm infection to drinking of polluted water has its roots in the community. In the Idere community for instance, one of the worst affected areas, there was a popular belief that guineaworm is a 'curse from the gods'. An elderly traditional healer who was interviewed had this to say 'We have the ability to cure any kind of ailment, but that of the guineaworm beats us'.

A majority of pupils (71%) claimed to have pipe borne water as a source of water, even though we knew that the taps had been dry for months at the time of data collection. Similarly we had no evidence to support the claims of 31% who said that they filtered and boiled their water before consumption. The heavy infection of guineaworm during the season 1982 (when data was being collected) and recent occurrences testify that water collected from doubtful sources is consumed without adequate treatment.

The difficulties and financial problems being experienced by schools in the Ibarapa district are common to many secondary schools in Nigeria. They are due to the prevailing economic recession in the country. Unfortunately the newly created schools which are just beginning to establish their *foundations* are the worst affected.

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DRACUNCULIASIS IN AFRICA IN 1986: ITS GEOGRAPHIC EXTENT, INCIDENCE, AND AT-RISK POPULATION

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Abstract. This paper presents a preliminary assessment of the geographic extent and estimates of the incidence and the population at risk of dracunculiasis in Africa. Nineteen countries are known to be affected, in a belt extending right across the northern part of the continent south of 18°N, and in east Africa extending almost to the equator. Annual incidence is estimated to be 3.32 million, and the at-risk population is approximately 120 million. These data provide an initial baseline on which the success of control measures now being initiated in Africa can be assessed.

Dracunculiasis, infection with guinea worm (*Dracunculus medinensis*), is a disease found in remote rural areas of Africa and the Indian subcontinent. As it can only be transmitted by drinking contaminated water, its ultimate global eradication is feasible.[1] India has an active national campaign to eradicate the disease by 1990.[2] International determination to control dracunculiasis is illustrated by the passage of a resolution at the World Health Assembly in Geneva in May 1986, in support of the elimination of the disease.[3]

Nine of the 19 African countries in which the infection is endemic (Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Mauritania, Niger, Nigeria, Togo, and Uganda) were by July 1986 actively considering, or had recently begun, national control programs to combat the disease. The data presented here provide an initial baseline for assessment of future surveillance and of the impact of current and future control programs.

MATERIALS AND METHODS

Information about dracunculiasis in known endemic countries was collected from delegates at the African Regional Workshop on Dracunculiasis, 1–3 July 1986, in Niamey, Niger. The workshop was sponsored by the Carnegie Corporation of New York, the World Health Organization, the U.S. Agency for International Development, and the USA for Africa Foundation. Delegates from 14 of the 19 affected African countries attended, and provided data on the extent of endemicity and the estimated number of cases of guinea worm in their respective countries.[3] Current data were also available for 2 of the 5 countries which were not represented, Mauritania and Ghana. No information was available for Kenya (where the disease appears to be restricted to the extreme northwest[4]), for the Central African Republic, or for Gambia.

The methods of data collection and mapping at the Niamey conference were closely modeled on those used at the first Nigerian National Conference on Dracunculiasis, held in Ilorin, Nigeria, in March 1985. At that time a map of Nigeria showing the extent and endemicity of dracunculiasis in 303 local government areas and the Federal Capital Territory of Abuja was prepared.[5,6] Delegates to both conferences were asked to identify regions within their respective countries where dracunculiasis was considered to be either highly endemic, endemic or sporadic, or not reported or absent. The blank areas on the map will in the future be distinguished either as areas in which there is no guinea worm, or areas in which guinea worm is present but, as of 1986, not recorded. Information available in 1985 and 1986 was insufficiently detailed to distinguish between areas where exogenous guinea worm cases only were found, and areas where transmission occurred.

The map (Fig. 1) incorporates data from Nigeria, collected in March 1985, and from the rest of Africa, collected in July 1986. It is considered to be only a provisional representation of the extent and endemicity of dracunculiasis in Af-

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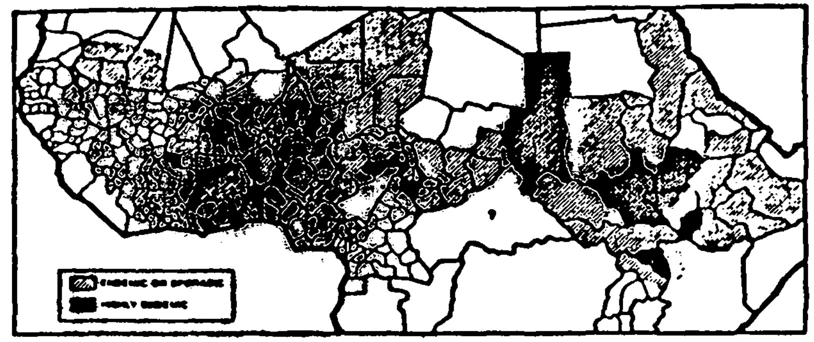

FIGURE 1. Areas of Africa in which dracunculiasis is reported or known to exist. Based on information presented at the African Regional Workshop on Dracunculiasis, July 1986, and the First National Conference on Dracunculiasis in Nigeria, March 1985.

rica, as information about the disease was often difficult for the country delegates to obtain, and the reliability of the data varied from country to country. The reporting system is deficient, for few sufferers anywhere attend hospitals and clinics, as they do not perceive the infection to be amenable to modern medicine and they frequently live in remote areas far from medical facilities.

The estimates of the incidence of dracunculiasis were derived in most cases from officially reported cases, which represent only a very small and variable proportion of the actual number of cases in each country. The disease is only officially reportable in 8 of the affected countries: Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ethiopia, Ghana, Togo, and Uganda. Even where official case reporting exists, often it has been introduced very recently and is not always geographically comprehensive. In 1986, in Burkina Faso, a country with a recently initiated control campaign, it was estimated that only 5%–10% of the actual cases were reported. For West Africa as a whole, Hopkins estimated that only 1% to 5% of the actual cases were reported.[7] I used an intermediate figure, 2.5%, i.e., multiplied the reported figures by 40, in order to calculate an estimated incidence for endemic countries in Africa which based their figures on passive case reporting.

The case of Togo is complex, for the national epidemiological unit reported a staggering incidence of over 440,000 cases in 1982, out of a total population of about 3 million (i.e., 15% of the total population suffered from dracunculiasis in that year). Yet in 1985 only 1,456 cases were reported in the whole country, which multiplied by 40 gives a total of 58,240 cases. I have used this figure in lieu of any other, as there has been a marked decline in incidence reported in highly endemic areas of the country as a result of dracunculiasis control measures.[3] Of all reporting countries in Africa, only Côte d'Ivoire undertakes active surveillance of guinea worm, and I used their figure, 592 cases reported in 1985, as the actual number of cases reported. In Nigeria local field assessments provided an alternative estimate of the annual incidence.

For our purposes here, the at-risk population is defined as the rural population of districts, states, or provinces where at least one case of guinea worm is reported to occur. In order to arrive at the estimated size of the current at-risk population in each country, I first consulted the last extant census, which might be several years out-of-date, and determined the total rural population of that country and of each affected district/province. I then obtained total population estimates, and the proportion of the population which was rural from the 1986 *World Population Data Sheet*, produced by the Population Reference Bureau, and calculated the overall percentage rural population growth rate between the most recent census and 1986. I used this as a multiplier to obtain the approximate rural population of affected areas in 1986. In compiling the estimates

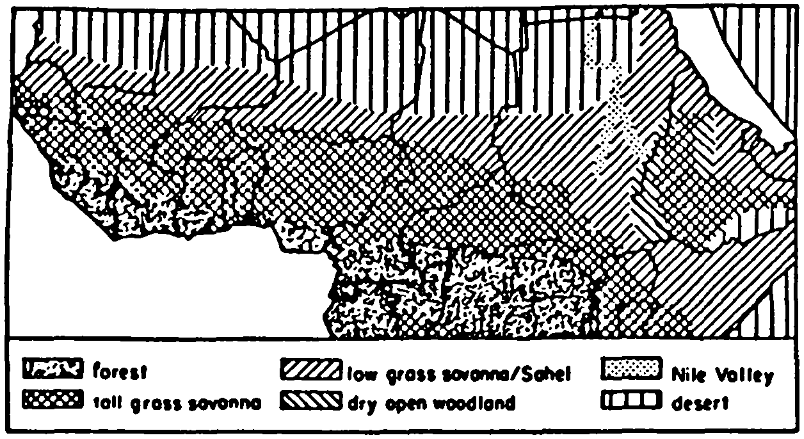

FIGURE 2. Vegetation and rainfall in the general area of Africa affected by dracunculiasis.

of at-risk populations, it was essential to use rural population growth rates. Due to high levels of rural-urban migration, rural rates of growth are usually considerably lower than a nation's overall growth rate.

The basic population data was not without its problems. Censuses varied in reliability. Some were relatively recent, such as those for Ghana (1984), Burkina Faso and Mauritania (1983), while others, notably for Nigeria (1963), the largest single affected country, were very out-of-date.

In Nigeria, I used official population projections based on the 1963 census data and given for all 303 local government areas of the 20 states and the Federal Capital Territory of Abuja, and the material collected at the 1985 Nigerian meeting, rather than material collected at the Niamey workshop. In the case of Chad, with a 1968 census and a recent history of civil disturbances, and Guinea (last census 1954–55) I used the most recent official estimates of the populations of the civil divisions as given in the *Europa Yearbook*. All official 1986 population estimates are derived from an estimated annual growth rate for each affected country since the last census; in the countries studied, continuous records of births and deaths, such as would be used in industrialized countries to compute growth rates, are either absent or unreliable.

Another problem is that the census definition of rural population, i.e., the population which is not urban, is not consistent for all countries. The criteria used for identifying an urban settlement are usually size and/or urban functions, such as piped water supplies. In Chad, Kenya, and Ghana, any settlement with over 5,000 people is considered urban, while in Nigeria 20,000 is the lower limit. Such differences reflect local perceptions of what constitutes an urban center, and in practice such urban areas often have some form of protected water supply which usually prevents the transmission of dracunculiasis locally. Although only rural populations have been considered at risk in this paper, transmission has been documented in some urban areas, for example in Ilorin, Nigeria (population ≈400,000).[7]

RESULTS

Figure 1 indicates that areas affected by dracunculiasis in Africa extend right across the northern part of the continent south of 18°N and, in East Africa, extending almost to the equator. The infection is endemic in 19 countries, and is found in all ecological zones from the forest, through the savanna to the semi-desert sahel, to the desert, as shown in Figure 2. In Africa, cases recorded in the desert may originate elsewhere. Transmission in desert areas is not documented in Africa, although it is known in Pakistan.[8]

TABLE 1
Dracunculiasis in Africa

	1986 population millions	1986 population at risk millions	Population at risk as % of rural population	Reported cases	Estimated annual incidence
Benin	4.1	2.5	100	1,480 (1972)	60,000
Burkina Faso	7.1	5.75	100	4,362 (1983)	175,000
Cameroon	10.0	1.17	23	691 (1985)	27,640
Central African Republic	2.7	?	?	?	?
Chad	5.2	3.17	78	55 (1978)	2,200
Côte d'Ivoire	10.5	4.21	59	592 (1985)	592
Ethiopia	43.9	30.4	81	770 (1984–5)*	30,800
Gambia	0.8	?	?	?	?
Ghana	13.6	9.38	100	4,244 (1984)	170,000
Guinea	6.2	0.45	9	?	?
Kenya	21.0	0.18	1	5 (1980)	200
Mali	7.9	1.9	29	510 (1985)	20,400
Mauritania	1.9	0.8	65	1,241 (1984)	50,000
Niger	6.7	5.63	100	?	?
Nigeria	98.2	30.43	40	1,693 (1980)	2,500,000
Senegal	6.9	0.26	6	161 (1980)	6,500
Sudan	22.9	17.0	93	c1,500 (1985)	60,000
Togo	3.0	1.92	80	1,456 (1985)	58,240
Uganda	15.2	4.83	37	4,070 (1985)	162,800
	287.0	119.98		22,830	3,324,372

* Ethiopian year follows the Gregorian calendar and begins in August.

A comparison of Figures 1 and 2 shows that savanna vegetation, dominated by grasses, scattered trees, and shrubs, and associated with a tropical wet and dry climate predominates where dracunculiasis is present. Here seasonal variations in the availability and sources of drinking water are a feature of many rural communities and are often associated with seasonal changes in dracunculiasis transmission.

The total at-risk population in Africa, as shown in Table 1, is estimated to be 120 million, about 42% of the total population of affected countries. The estimated annual incidence is 3.32 million, 2.7% of the at-risk population.

The infection is most serious in 8 countries in West Africa, namely Benin, Burkina Faso, Ghana, Mali, Mauritania, Niger, Nigeria, and Togo. All 13 regions of Burkina Faso, all 35 in Niger, all 10 in Ghana, all 6 in Benin, and 24 of the subprefectures in Togo are affected. As of March 1985, 130 of the 303 local government areas in Nigeria were known to be affected. Nigeria, with a total estimated population of 92 million, has an estimated 75% of the annual African cases (2.5 million) but, as indicated earlier, the basis for this estimate is detailed field studies rather than passive case reporting. Thirty million Nigerians are thought to be at risk from the infection, 25% of the African total.

The disease is present, but less widespread, in a number of other West African countries, in Chad, Côte d'Ivoire, Cameroon, Gambia, Guinea, and Senegal. Côte d'Ivoire, which probably has the best data in Africa, based on active surveillance, has recorded a dramatic reduction in the number of cases as a result of an effective control program, from 67,123 in 1966, to 4,971 in 1975, to 592 in 1985.[3] However, as cases are still recorded from scattered locations throughout the country, the at-risk population, according to the criteria used in this paper, is still high.

Another cluster of affected countries forms an East African endemic focus, centering on southern Sudan, Ethiopia, northern and eastern Uganda, and northwest Kenya. The disease appears to be particularly widespread in Ethiopia and southern Sudan, but very little is known about its distribution and endemicity. In Ethiopia in 1984–85, 770 cases were reported from 11 of the 14 provinces; earlier, in 1969, isolated cases had been reported from Eritrea.[9] In the Ethiopian highlands, although cases have been found, active transmission is probably rare since open water cannot often reach and sustain a temperature high enough (19°C) to support the guinea worm larvae.[10] However, transmission is much more frequent in the lowlands of Ethiopia. In Sudan, several hundred cases were said to occur in each of the 8 affected regions.

In Uganda the disease has recently increased in significance and areal extent. A 1983 WHO dracunculiasis survey focused on northern Uganda,[11] but in 1986 the disease was said to occur further to the south and east. The small affected area in Kenya, in the Turkana district, adjoins the affected part of Uganda. The cluster of Kenyan cases among nomadic Turkana, some of whom had previously been to southern Sudan, was reported in 1981.[4]

DISCUSSION

We now have at least a preliminary overview of the endemicity and extent of dracunculiasis in Africa. The map of affected areas in Africa indicates the general outline of the areas affected by dracunculiasis. Its accuracy depends on the scale of the regional data available for each country. For example, in the vast country of Sudan, it was reported that 8 of the 9 principal civil divisions were affected, and, in consequence the map almost certainly overestimates the geographic extent of the disease in that country. Some case reporting in the Sudan appears to occur in nonendemic areas as a result of widespread population mobility. Were information available for smaller subdivisions at the district level, and related to transmission rather than occurrence, true endemicity would probably be limited to a much smaller geographic area. However, underreporting of cases is also significant. In contrast to the situation in Sudan, in Nigeria data for mapping and for estimating at-risk populations were available for 303 local government areas in 19 states and Abuja. Similarly, in the small country of Togo, data were available for all 30 subprefectures. Table 1 suggests an at-risk population of about 120 million persons and an estimated annual incidence of at least 3.32 million cases. The latter figure is almost certainly an underestimate. No figures on which to base an estimate of incidence are available from the Central African Republic, Niger, Guinea, or Gambia, and those from the Sudan are very approximate. Côte d'Ivoire is currently the only country in Africa conducting active surveillance for dracunculiasis. This lack of information does not necessarily reflect a low level of infection, or its absence.

Political disturbances and population movements associated with drought and civil strife adversely affect the reliability and frequency of data collection in parts of Sudan, Ethiopia, Chad, and Uganda. Yet, in these countries population movements associated with war and famine, and in Ethiopia with resettlement, provide ideal conditions for further dissemination of the disease through impoverished populations which rarely have access to protected water supplies.

Even where cases of dracunculiasis are reported, the use of a 2.5% multiplier may result in a serious underestimate of the number of cases. In both Ghana and Benin all provinces were known to be affected, and high community level prevalence rates have been recorded.[2,3] Yet, in Ghana, only 4,244 cases were reported in 1984, giving an estimated incidence of 170,000, and in Benin 1,480 cases were reported in 1972, giving an estimated annual incidence of 60,000. These figures give a ratio of 18 cases per 1,000 at-risk population in Ghana and 24 in Benin. Yet, in Nigeria, where similar ecological conditions prevail, but where detailed research provided a more realistic figure for the incidence, the ratio of estimated incidence to total at-risk population is 82:1,000. The fact that the Nigerian figure constitutes 75% of the African total incidence, but only 25% of the total at-risk population, suggests that estimates for other countries, based on officially reported figures multiplied by 2.5%, may be far too low. For if Nigeria had 25% of the total number of cases, the same as the proportion of the at-risk population, this would suggest a total African incidence of approximately 10 million, compared to the estimate of 3.32 million presented here.

The current ratio of cases to at-risk population in Nigeria (82:1,000) may appear high, but such a figure might more accurately reflect the situation in the most seriously affected African countries than figures for Ghana and Benin, 18 and 24, respectively. Community level incidence rates in seriously affected areas of West Africa can be very high, ranging between 50% and 80%,[14-16] and few rural settlements have access to protected year-round sources of drinking water. As programs to eliminate or control dracunculiasis intensify, improvements in data collection will provide a more precise identification of the most seriously affected areas and the populations most at risk from the disease. This will almost certainly result in an increase in known cases, over and above current estimates.

At-risk populations and the number of cases a year are probably greater in Africa than in the Indian subcontinent, including Pakistan, which appears to be more seriously affected than India.[8] In January 1985 an Indian appraisal team estimated that the actual number of cases of dracunculiasis in India was 440,000 (about 10 times the number of reported cases after 3 years of active case search), and that 10 million people were at risk; in India the at-risk population is defined as the population living in affected villages. Thus, it appears that the preliminary estimate of incidence for Africa presented in this paper indicates a greater number of cases in that continent than in India and Pakistan. If the current WHO figure of 10 million cases of dracunculiasis worldwide is found to be an underestimate, it will be because improved surveillance methods reveal a far greater number of cases in Africa than our preliminary survey suggests.

In conclusion, it is clear that the estimated figures presented here for both incidence and at-risk populations are very approximate; estimates of incidence are especially likely to increase as a result of improved surveillance. Yet the 120 million people estimated to be at-risk of dracunculiasis in Africa and the estimated minimum of 3.32 million cases annually, represent considerable actual and potential suffering from a disease which is relatively easy to control.

The presence of areas affected by dracunculiasis on either side of national boundaries in Africa, such as in contiguous areas of northern Cameroon, southwest Chad, and northeast Nigeria, is evidence of the need for international cooperation in the control of guinea worm. Such cooperation is also essential in view of the widespread distribution of the disease, the large number of people affected annually, and its occurrence in a wide range of ecological zones. It is hoped that the African Regional Workshop on Dracunculiasis held in Niamey in July 1986 will facilitate the pooling of health education materials, research findings, and the experience gained in putting into practice the wide range of possible control measures.

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CHAPTER 8

The Distribution and Ecology of Guinea-Worm Disease in Nigeria, with Special Reference to Kwara State

S.J. WATTS AND L.D. EDUNGBOLA

Introduction

Dracunculiasis, caused by a tissue-dwelling nematode, *Dracunculus medinensis*, is a painful and debilitating disease which is still a major public health problem in certain tropical countries. It has been widely reported in India, the Middle East and West Africa[1]. Its common name, guinea-worm, reflects its prevalence in West Africa and early travellers' observations of the disease along what was then called the 'Guinea Coast'. It is widespread in Nigeria today and active transmission of the disease has been recorded in all the nineteen states of the country at varying levels of endemicity.

Among all the communicable diseases affecting humans, dracunculiasis is the only one that can be entirely eliminated by the provision of a constant, reliable supply of safe drinking water. Its eradication is a target of the UN Water Supply and Sanitation Decade initiated in 1980. There is an on-going program to eradicate the disease in India by 1990, but in many other parts of the world it has, until recently, been neglected. In Nigeria, policy-makers still underestimate the extent and impact of the disease because it is usually thought of as being a problem of remote rural communities. However, the commitment to primary health care, following the 1978 Alma Ata Declaration of WHO, should encourage preventive measures aimed at eliminating guinea-worm. A first major step in eliminating this infection is to identify the distribution and various ecological conditions associated with the disease.

FIGURE 8.1 Infected school children who could not attend classes due to guinea-worm incapacity.

Etiology of dracunculiasis

Guinea-worm is contracted as a result of drinking water, usually from a stagnant pond, containing the minute aquatic crustacean, *cyclops*, infected with the infective larvae of *Dracunculus medinensis*. The cyclops are then dissolved by the gastric juices in the human gut and the larvae escape into the tissues. The female worm matures and migrates to the epidermis where, 10–12 months after ingestion, it emerges, causing a painful abscess. When the abscess is submerged in water, the guinea-worm embryos are released into the pond and thus the transmission cycle is continued.

Many sufferers have multiple worms and are infected year after year. FIGURE 8.1 shows guinea-worm abscesses on the feet of children in Igbu Emu village, Moro Local Government Area of Kwara State. Sufferers may be incapacitated for as long as three months, and the disease often has a serious impact on agricultural, school and social activities.

The severity of the infection depends largely on the number of infections

FIGURE 8.2 A pond where active transmission of dracunculiasis occurs.

and their anatomical location on the body; up to 80% of the worms emerge at or below the knee but they may also involve the central nervous system, the eye, the genitalia and the mammary glands. The disease is especially incapacitating when the worm emerges around the ankle or knee joint, or when it is complicated by secondary pyogenic infection. Although some individuals who swallow infected cyclops do not suffer from the infection, the overwhelming majority of the individuals who drink from the same untreated water source are prone to guinea-worm infection[2].

The likelihood of infection by guinea-worm is usually related to the number of infected cyclops swallowed. Cyclops densities are low in fast-flowing water and very few embryos are likely to be swallowed by the intermediate host before they die. Hence the danger of contracting dracunculiasis from a rapidly flowing water source is minimal. In India, unprotected step wells, in which people immerse their arms or legs when they collect water, are a common source of infection[3]. A properly protected well is extremely unlikely to be a source of infection. In Nigeria the commonest sources of guinea-worm are stagnant ponds, such as that shown in FIGURE 8.2, ditches, roadside pools and stream remnants used

for drinking water during the dry season, and incomplete or improperly constructed dams into which people wade to collect water or wash.

Data sources

Published information on the distribution of guinea-worm infection in Nigeria is limited to a few states. It is not recorded in official returns and sufferers rarely attend clinics, for the disease is not perceived as one which responds to Western-style medical treatment. Recently, however, indications from schools, news reports and the Ministry of Health have shown that guinea-worm occurs in all states of Nigeria. Detailed studies have been undertaken in Oyo, Ogun, Anambra and Kwara States. These indicate the ecological circumstances associated with the transmission and endemicity of the infection; this knowledge is vital for the detailed planning of prevention and eradication strategies.

This paper will focus on the preliminary results of field research carried out in Kwara State between 1979 and early 1984. Villages affected by guinea-worm were identified from various sources, including field reports by local medical and paramedical personnel, newspapers and television reports. Because of the highly localized distribution of the disease and the absence of reliable census data, the study could not be based on any form of statistical sampling. In any case, our aim was to identify settlements where active transmission of guinea-worm occurred, in order to make recommendations for the control and possible eradication of the disease to the local authorities.

Prevalence surveys of over 80 settlements were conducted during the late dry season, the peak patency period, which was also the peak period of transmission. Drinking water sources were also identified and samples taken for laboratory determination of cyclops densities and infection rates with guinea-worm larvae. As reports of settlements badly affected by dracunculiasis continued to come in throughout the research period, this survey did not, by any means, encompass all settlements in the state where the disease was a serious problem.

Distribution of guinea-worm in Kwara State

Guinea-worm infection is endemic in many areas of Kwara State and present, though not apparently actively transmitted, in many other places.

Prevalence rates vary markedly from settlement to settlement in highly endemic areas and more than half of the residents may be infected in any one season. If the level of hyperendemicity is to be established at a prevalence level of 20% or more during the peak transmission season[4], then 75 (90%) of the 83 settlements studied in 1980 can be rated as hyperendemic communities. Also, using this criterion, four of the twelve local government areas in the state can be classified as being hyperendemic areas. These are Borgu, in the extreme north and west, and Ilorin, Asa and Moro, around the city of Ilorin, the State capital.

The major towns of the State, which have protected, piped water sources, are usually free from guinea-worm. However, Edungbola reported the danger of transmission of guinea-work infection and other parasitic diseases in the State capital, Ilorin. Here local ponds and streams are used by people who do not have access to the city's piped and treated water supply, or when this supply is irregular[5]. A survey of 696 people in the Kuntu area, on the western edge of the city, in 1980, revealed a prevalence rate of 47.4%. In the surrounding rural areas, where the disease is highly endemic, few settlements have protected, year-round water sources. In one peri-urban community, a new outbreak of dracunculiasis was traced to a stagnant dry season backwater of the lake created to supply piped water to the city of Ilorin[6].

Basement complex rocks underlie most of Kwara State. Here wells yielding a year-round supply of potable water are expensive to excavate and the failure rate for both wells and boreholes is high unless sophisticated equipment is carefully used. In contrast, the riverine area along the River Niger is underlaid by alluvium and by Nupe sandstone, an excellent aquifer[7]; here boreholes and wells generally yield excellent year-round water supplies and only exogenous guinea-worm cases were recorded.

High prevalence rates within a particular community can be related to the use of infective sources of drinking water by a large proportion of the population. There is widespread ignorance of the mode of transmission of the disease; people continue to wade into ponds to collect the water even when they have guinea-worm abscesses, and they are ignorant of the role of the cyclops in the life cycle of the parasite. The vast majority of the rural population draw their water from unprotected sources, especially in the dry season, and fail to treat the water before drinking it.

Ecological Relationships in Kwara State

A crucial factor influencing the occurrence of guinea-worm infection is the length of the dry season. This ranges from more than seven months in the extreme north-west of Kwara State to under five months in the south. In the areas away from the major rivers, the Niger and its tributaries, there are few perennial rivers and streams. During the dry season many water sources dry up, or are reduced to a series of stagnant ponds which form an ideal habitat for guinea-worm. Throughout the State, guinea-worm transmission occurs towards the end of the dry season and in the early part of the wet season, before annual streams have begun to flow or the ground water level has risen to replenish seasonal wells. As this is the main period of farming activity in the year, the effect of this disease on agricultural productivity can be considerable.

In the drier western and extreme north of the State, in Borgu, there is an absolute shortage of water at the end of the dry season and the people have to travel long distances in search of water, regardless of quality. Under such circumstances, a single water source can become the focus of infection for people living in a very large area. Cleaning ponds to remove mud and aquatic vegetation would help to control the cyclops numbers, but this is seldom done because of the fear of ponds drying up. The shortage of water is so severe during the dry season that people often dig holes in dry stream beds into which water will slowly percolate[8].

In the more densely populated south-central part of the State, around the State capital of Ilorin, the dry season is shorter than in Borgu and water scarcity less acute; the problem here is poor water management. Towards the end of the dry season, when many wells and streams dry up, people are forced to use stagnant ponds which support guinea-worm transmission.

In the densely peopled south-eastern part of the State, the presence of scattered cases indicates the danger of future infection. Here, as elsewhere in Nigeria, because isolated cases occur almost everywhere and most rural areas are without protected water supplies, there is concern that new areas of high endemicity will develop unless control measures are taken in the near future.

Ecological Relationships in Other Areas of Nigeria

Active transmission of guinea-worm appears to occur in all areas of Nigeria regardless of the length of the dry season, and in all vegetation zones. In Kwara State and the states to the south and east, the sources of infection are commonly found to be stagnant ponds or the stagnant remnants of annual streams which are used as dry season water sources; the habit of wading into the pond to collect water sustains the disease cycle here. Although little is known of the ecological relationships associated with the disease in the north of the country, where the dry season is longer, stagnant ponds are also common dry season water sources, for example in the Kano closed settled zone[9].

Onabamiro identified stagnant ponds as the main sources of guinea-worm infection in the former Western Region. He stressed the considerable local variations in prevalence and pointed out that, in a few cases, wet season transmission occurred at small ponds which dried up in the dry season[10]. A more recent study of the area around Ibarapa, in the dry western part of Oyo State where settlement is relatively recent and scattered, showed that guinea-worm occurred in 70% of the villages and was the result of using water from pits dug during the dry season in dry stream beds[11]. In the Ibarapa area and elsewhere in Yorubaland, many families live in small farm hamlets for most of the year and return to the larger settlements, which they regard as their permanent homes, for ceremonies and festivals. These people continue to suffer from guinea-worm infection acquired in the farm hamlets even though their permanent home base is provided with piped water[12].

The introduction of piped water supplies has diminished the dangers of endemic infection in and around larger settlements in Ondo, Oyo and Ogun States[13]. However, these piped water supplies must be regular. In 1975, 34% of the people of Idere (population about 10 000) in Ibarapa District, had guinea-worm although the town had recently been provided with piped water. Supplies were unreliable and continued to deteriorate; in the dry season people began to use the stagnant ponds which were their earlier, unprotected sources of drinking water. During the 1980/81 dry season of half of the population had the infection[14].

In parts of eastern Nigeria, ponds or tanks dug for water storage are a common source of year-round water supply and, unless properly protected, can become foci for guinea-worm infection. In Anambra State, which has a four-month dry season, these ponds, locally known as *okpuru*, are often not adequately protected and people wade into them to collect water. The main season for guinea-worm transmission is the dry season, between March and May, when the water level in the ponds is lowest and the density of infective cyclops is highest[15].

Conclusion

In central and southern Nigeria, the main period of guinea-worm transmission occurs at the end of the dry season and in the early wet season. The full impact of the infection is experienced approximately a year later. As this period is the main planting season, the impact of the disease on agricultural production can be considerable, for half or more of the adults in an affected settlement may be unable to farm effectively at this time. Children who suffer from multiple infections may be unable to attend school; their mothers cannot perform their full range of daily tasks, cooking, child care, fetching water and firewood, farming, food processing and petty trading. In badly affected villages, the able-bodied spend much of their time looking after those who are totally or partly immobilized. A similar pattern of dry season transmission and patency, associated with the disruption of farming, has been recorded in southern Ghana[16].

In Kwara State, after surveys were conducted in a rural community and people had become aware of the source of guinea-worm infection, they were anxious to cooperate with various authorities to improve the quality of their drinking water. In some cases, this may mean deepening and cleaning a pond and installing a simple filter; in others the deepening of an existing well or the construction of a new one will be adequate; in larger communities it may be feasible to drill a borehole. Providing people continue to use only the protected water sources, and are able to maintain them in good condition, guinea-worm can be completely eliminated from the community. In view of the relatively good prospects for the eradication of guinea-worm, and the growing evidence of increased prevalence in many parts of Nigeria, it is especially important that various local and international agencies cooperate in a programme for the control and eradication of the disease.

Note

Dr L.D. Edungbola initiated this study of guinea-worm infection in Kwara State with the aid of a Faculty Research Grant from the University of Ilorin; Dr S.J. Watts actively participated in surveys carried out around Ilorin. Dr Edungbola was the co-ordinator of the First National Conference on Dracunculiasis (Guinea-Worm Disease) in Nigeria, held in Ilorin on March 25–27, 1985.

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