SCIENCE FOR THE EYES AND MINDS – TEACHING SCIENCE TO THE DEAF

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Abstract

Introduction - The Deaf community in Brazil lacks access to scientific knowledge and to the popular knowledge of scientific facts provided by the media. This results from the language barrier as they use sign language (Libras) as their first language and have difficulty in understanding Portuguese as a written language. This communication obstacle may hinder the dissemination of preventive information in times of epidemics. Brazil, and particularly Rio de Janeiro State, has suffered, in the last years, a number of epidemics such as zica, dengue, chikungunya, yellow fever (urban cycle) transmitted by mosquitoes. Only yellow fever has a vaccine currently available and control programmes must focus on mosquito populations. Larval habitats are important sources for the maintenance of mosquito vector populations. Therefore, the Deaf community must be aware of their role as citizens in helping the prevention of the propagation of mosquito’s life cycle.

Purpose - Herein we describe a pilot study trying different approaches to increase the knowledge of deaf children and youngsters on the biology of Aedes aegypti mosquitoes and their importance to the dissemination of epidemics.

Method - The first step was to develop the interest of this group towards the subject. Short courses, lasting one week, based on characteristics and the life cycle of Aedes aegypti mosquitoes, were offered to secondary school Deaf students, using inquiry, collaborative, hands-on oriented teaching. The majority demonstrated a high motivation during the experimental course. They were free to ask the questions they wanted and to perform experiments in an attempt to answer them. One of their first questions was if mosquitoes were deaf. Despite trying different frequencies and approaches, the answer to this question became inconclusive and they were told at the end of the course that mosquitoes, male and female, could hear certain frequencies. But among the various experiments using live mosquitoes they learned to distinguish between male and female, the different phases of the cycle, their eating preferences, where they put their eggs, etc. Everything was done experimentally and not via previous information. Being able to see the various phases also led to the creation of new signs to name each stage of development, as these signs did not exist in Libras. In an attempt to engage elementary school children as well, they were offered a one-day practical course where they could see adult live mosquitoes, the way they fly, their lifecycle (eggs, larvae, pupae) distinguish between male and female. The main objective was to interest them and this was achieved. Additionally, in an attempt to cover a wider group of people belonging to the Deaf community, a short video in Libras, explaining the zica epidemics was produced and exhibited via Facebook SURDONEWS, leading to a high number of views.

Conclusion – By being able to see the subject of their study, to elaborate questions and to look for answers, Deaf students are able to develop a critical view of the problem. These various approaches led to a greater interest and understanding of the role played by the vector during the various epidemics in our country and were important for the development of new signs in Libras related to this subject.

Keywords: Deaf, science education, sign language.

1 INTRODUCTION

The diseases that are transmitted by hematophagous vectors are gaining prominence in society because of their close relationship with diseases related to morbidity and mortality in Brazil and in the world. The life cycle of vectors, hosts and breeding sites are of great relevance for the transmission of these diseases [1].

In the context of disease transmission the mosquito Aedes aegypti, originally from Africa and quite widespread in Central and South America, is a vector of several diseases. Aedes aegypti has as host...
the human being, spreading various diseases, such as Dengue, Yellow Fever, Chikungunya and Zika virus, producing recently serious epidemics, which made the mosquito a major health problem. At the present time, about 40% of the world population is in high risk of contagion by some of the diseases transmitted by the mosquito. This results from the favorable geographical conditions for the development of the mosquito [2].

When we consider the impact of diseases transmitted by the mosquito Aedes aegypti in Brazil, dengue was first recorded in 1685. Other cases were reported at the end of the 19th century and the beginning of the 20th century, however, during this period there was a greater concern with yellow fever and campaigns led to mosquito eradication control in 1955. After this period, the mosquito was reintroduced in Brazil in the late 1960's [3]. Reinfestation led to several epidemics in the following decades. Only between 2000 and 2016, more than 10 million cases of dengue were recorded in the country [3].

The symptoms of dengue are high fever, headache, pain behind the eyes and muscle pain. These symptoms usually appear in the milder form of the disease, also called "dengue fever". The most severe form of dengue infection is also known as "dengue hemorrhagic fever" leading to bleeding, abdominal pain and vomiting, being lethal in some cases [2].

The zika virus is another arbovirose of great relevance, transmitted by the mosquito Aedes aegypti. Several outbreaks of zika have occurred in areas of Africa, Southeast Asia, Pacific islands and Americas. In Brazil, the year 2016 had a very significant number of cases. Infection by the zica virus causes some symptoms considered mild, such as fever, headache, muscle pain, maculopapular eruption, arthralgia or conjunctivitis [4]. However, the recent increase in microcephalic incidents in Brazil has been strongly suspected to be associated with zika virus, as the virus could be found in the amniotic fluid of pregnant women.

The chikungunya virus causes a considerable muscleskeletal inflammatory incapacitating disease. The disease is characterized by fever, myalgia, rash and headache. The virus, which can also be transmitted by the Aedes aegypti mosquito, has a high infection rate and since 2004 is spreading to new areas.

None of these viruses have a vaccine with the exception of yellow fever. Despite of that we are faced at the moment with a new risk of yellow fever epidemic.

It is noteworthy that the Aedes aegypti mosquito has great versatility regarding the pathogens that it is able to transmit, being these viruses the potential cause of epidemics that have been devastating the population for decades, with a real impact on the country's public health.

The mosquito has a well established anthropophilic habit, very adapted to the urban environment, has opportunistic habits, living inside residences or near places with great human circulation. In its development, it presents a larval stage, which develops in places where there is accumulation of standing water, and can occur in places such as tires, canisters, cans, lids, dishes of pots of plants, bottles, gutters, among others [1].

The differentiation between male and female occurs through the morphological characteristics. In males, the maxillary palps are larger and the antennae have more bristles, giving the appearance of more "feathery" antennae in males. In addition, males are of smaller sizes compared to females [5].

Adult mosquitoes feed on the entire life of plant sap and sugary fluids. However, females of Aedes aegypti develop hematophageal habits upon reaching sexual maturity. Blood feeding is of great importance for the development and posture of eggs. They are insects of preferentially diurnal habits, but, once they have opportunistic habits, they can feed at any time of day, since there is approximation of the host and its shelter [6]. The system of localization and identification of hosts is very well developed in female mosquitoes. Substances commonly released by vertebrates such as CO2, lactic acid and body temperature are easily perceived by females [7].

In summer, the mosquito population increases considerably as a result of the elevation of temperature and high volume of rainfall. Both are excellent factors for the development of the mosquito, which has the life cycle started in the water [6]. Mosquitoes put their eggs on the walls of places above water level or potentially flooding sites, such as water boxes, potted plants, cans, tires, etc. [7]. The stages of development of mosquitoes start in water with the stages of larva and pupa. The total cycle time between the egg and pupae stages takes about 7 to 10 days until the mosquito emerges in its winged form, which survives on average 35 days [5].
Several scientific approaches are developed aiming at combating the mosquito [8], in parallel many groups are dedicated to the development of vaccines against diseases transmitted by Aedes aegypti [9]. However, raising the awareness of the population through understanding the public health problem and the role played by the mosquito is imperative. Control programmes must focus on mosquito populations. Larval habitats are important sources for the maintenance of mosquito vector populations and citizens might help prevention of the propagation if they understood more the mosquito’s life cycle.

However, it is notable that diseases, whose information is extremely widespread by social media still present recurrent endemic conditions. In this context, the role of education is believed to be very important in the process of combating arbovirus epidemics transmitted by a mosquito that has so much affinity for the urban conviviality.

But there is a group of people who are hardly reached by these campaigns. In Brazil the deaf population is about 10 million individuals. The Deaf community in Brazil lacks access to scientific knowledge and to the popular knowledge of scientific facts provided by the media [10]. This results from the language barrier as they use sign language (Libras) as their first language and have difficulty in understanding Portuguese as a written language. Communication difficulties are also observed in the health system [11] and when assessing preventive information [12]. This communication obstacle may hinder the dissemination of information in times of epidemics.

Herein we describe a pilot study trying different approaches to increase the knowledge of deaf children and youngsters on the biology of Aedes aegypti mosquitoes and their importance to the propagation of epidemics.

2 METHODOLOGY

The approach used in this work was that of a qualitative research and the results are descriptive.

2.1 Deaf sample

A total of 25 Deaf youngsters of both genders participated in this study. They were all enrolled in secondary school. Some belonged to special school for the Deaf (Instituto Nacional de Educação de Surdos – INES) and others from regular government schools, all located in Rio de Janeiro, Brazil. All participants were severe or profoundly deaf and the mode of communication was through Brazilian Sign Language (Libras).

A total of 55 elementary school deaf pupils of both genders, studying at the Instituto Nacional de Educação de Surdos – INES, participated of this study. Their ages varied from 8 to 18 years old. They were enrolled on the 3rd, 4th and 5th grades. All children were severe or profoundly deaf and the mode of communication was through Libras.

2.2 Teachers

A total of seven elementary school teachers for the Deaf participated in this study.

2.3 One Day activity

This activity took place at the Instituto Nacional de Educação de Surdos – INES. One of the classrooms at school was transformed into a mini-lab and elementary school children could see live mosquitoes flying free in their cages and male and female mosquitoes could be observed using a binocular stereoscope microscope. In addition, the whole sequence of the mosquito life cycle could be seen, there were eggs, larva and pupa. Children could ask questions and watch the explanation. Three sign language teachers participated in this activity.

2.4 Experimental Course

It consisted of a short experimental course lasting for a whole day for five consecutive days. It resembled in every aspect the courses organized for Deaf secondary school youngsters described elsewhere [13]. This short course took place at a university laboratory. Secondary school Deaf students from INES and from government public schools were asked to divide themselves into small groups, to formulate questions, suggest experiments, test their hypothesis, perform their experiments, analyze the results obtained, and present their results for the colleagues of the other groups at the end.
of the day. This lasted for a number of days, each time getting more complex questions and answers. On the last day all students had to integrate all the information obtained and present what they had learned. For these courses, Deaf youngsters that were part of a project at the Federal University of Rio de Janeiro for science trainees, helped as tutors. They were never allowed to give answers to the students or to make any kind of indication if what was being suggested was right or wrong, their main action was to help the pupil to perform the experiment. During the whole course we had the presence of three interpreters.

A number of cages with different age mosquitoes, eggs, larvae and pupae, were provided. The laboratory had all kind of equipment and glassware. The students could suggest what they wanted to know and what they should do to find an answer.

3 RESULTS

The activity with the younger children ensured great interest. The activity was extremely visual, made use of a microscope and a magnifying glass, and was able to arise children's curiosity. Many were surprised at looking through the magnifying glass, specially at the image of a larva, that they thought looked like an alien. They learned to distinguish between male and female mosquito. They found very surprising that the eggs were black. Most importantly, they understood quite well the mosquito’s life cycle and for the first time why water puddles could represent a problem. The older group from the 5th grade was so interested that they are planning to organize an activity for the younger children.

The activity with the secondary school students led, during the period of five days, to a number of different questions and different experiments. It was quite a surprise to us that one of the first questions raised by a group was if mosquitoes could hear. Despite trying different frequencies and approaches, the answer to this question became inconclusive and they were told at the end of the course that mosquitoes, male and female, could hear certain frequencies.

But various questions were raised by different groups. For example, a number of possible attractants was tested as they wanted to understand what element helped mosquitoes to find someone to bite. They experimented with a rubber glove filled with cold water compared with a glove with warm water, and verified that mosquitoes preferred warm gloves. They cut the antennae of mosquitoes and found out that they became disoriented. A dark box was placed inside the transparent mosquito cage but they found out that Aedes aegypti prefers light to dark. They tested different aliments plants, leaves, fruits and found out that only female liked blood. They tried a number of substances to repel the mosquito. They compared the susceptibility of eggs, larvae, pupae to different conditions. They tried to see how long it takes to a pupa to become a mosquito. At the end of everyday all groups presented the results obtained and discussed how did this fit or not with their own results. They also realized how the results of other groups could help to fill the gaps of their knowledge.

In the last day of the course students were asked to present in a contextualized way everything that they had observed during the week. The presentations indicated that they had learned and understood why vector control was so important and how this could be done.

The end of the course was also an opportunity to ask questions about Dengue, Zica, Chikungunya and Yellow fever. To clarify ideas about vaccination. These questions were raised as a result of the curiosity developed during the course.

An interesting development was the creation by Deaf students of new signs in Libras for terms that did not exist before. There were no signs for larva or pupa because they had never before seen one nor had the need to talk about one. It was a spontaneous development that resulted from the need to communicate to each other.

In parallel to the courses we looked for other ways to inform to cover a wider group the Deaf community. A page in the Facebook, called SURDONEWS, was created to bring important news to this group. A short video on Zica epidemics was one of the most seen item. This indicates that the interest exist but by not being properly informed puts the Deaf community at margin.

4 CONCLUSIONS

Society is unaware of the barriers encountered by a deaf person. Most people are not familiar of the reading difficulty of the deaf and that written information does not necessarily reach this group. At times when successive epidemics are being experienced, it is important to involve the entire
population in preventive measures. Education is the solution, being long lasted as opposed as to the effect of campaigns that tend to be punctual, at the height of the crisis. However, not only in Brazil, but worldwide, there is a distancing of science by the Deaf community [14]. This might represent an obstacle when teaching a topic that involves a degree of scientific knowledge. Despite this difficulty the present experience has shown that it was possible to engage Deaf students in scientific work. In this case the information gathered was not taught but discovered and clearly understood. This was obtained using an inquiry method where the students developed their questions, performed experiments, evaluated and interpreted the results and exchanged information with other students. It is important to involve Deafs in this process as they may disseminate the acquired knowledge to others in the Deaf community. Although, in a more superficial level, smaller children not only enjoyed the experience but understood the problem of vector control.

By being able to see the subject of their study, to elaborate questions and to look for answers, Deaf students were able to develop a critical view of the problem. These various approaches led to a greater interest and understanding of the role played by the vector during the various epidemics in our country.

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