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Popular Beliefs about the Infectivity of Water among School Children in Two Hyperendemic Schistosomiasis Areas of Brazil

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Abstract

This article examines changing common knowledge of elementary school children to scientific knowledge related to the relationship between water characteristics and the transmission of schistosomiasis through health education. A review of the literature and two case studies from rural elementary schools in Brazil show how the prevailing concept of dirty and polluted water, which has operated as an epistemological obstacle for acquiring scientific knowledge, may be related to symbolic thought and cultural parameters. Through an educational intervention not commonly applied to health programs involving elementary school students in two schistosomiasis-endemic rural communities in Brazil this paper describes the difficulties researchers encountered in changing the prevailing perception that very dirty and polluted water provides optimal conditions for schistosome transmission, to the scientifically accepted view that transmission occurs most often in visually clean, although fecally contaminated water. This conceptual difficulty may be largely explained in terms of the symbolism involved in clean and dirty water and the life-giving quality of water. Based on our results, we recommend that knowledge about water-related beliefs and concepts among school children should be considered in school-based health education programs in areas of endemic schistosomiasis and possibly other intestinal infections.

Keywords

Health education; common knowledge; symbolism; scientific knowledge; schistosomiasis; Brazil

1. Introduction

Schistosomiasis and other helminthic infections continue to be a major public health problem in Brazil due to their high prevalence and associated morbidity, as well as their spread into new areas lacking safe water supplies and sanitary facilities. According to FUNASA (2002), an estimated 30 million individuals are at risk of infection from intestinal helminthes, mainly children living in the northeastern region of the country. In the State of Minas Gerais, the prevalence of these infections varies from 20 to 70% in different communities (FUNASA,

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2002), with the highest prevalence and intensity levels in school-aged children and adolescents (Lima e Costa et al., 1993; Bethony et al., 2001). These age groups usually have the highest exposure indexes in the hyperendemic areas of Brazil and other parts of the world (Kloos et al., 1998).

After decades of snail control and chemotherapy campaigns, the Brazilian Ministry of Health developed in 1976 (in 1983 in Minas Gerais State) an integrated schistosomiasis control program that included medical, sanitation, water supply, and health education components (Katz, 1998; Coura and Amaral, 2004). Health education, based on information and communication developed through the mass media, print materials and drama, was not very effective in reducing exposure risk and promoting health (Schall, 1995). Even today, many teachers in public schools do not teach health education on a regular basis. Instead, this subject is most often dealt with at science and health fairs. Schistosomiasis tends to be given little importance and is rarely singled out as a health education subject in the schools, largely due to its perceived benign nature, the common absence of symptoms and the weak bioscience background of elementary school teachers (Massara and Schall, 2004; Soares et al., 2006). The major declines in all infection and morbidity and mortality indices in all parts of Brazil have been attributed to chemotherapy, with no information on impact of health education (Santos do Amaral et al., 2006).

New perspectives and approaches in schistosomiasis health education in Brazil that consider popular knowledge, self-efficacy, the environment, and community participation have been considered by various researchers in recent years (Schall, 1995; Uchôa, 2000; Massara et al., 2006). These new approaches were stimulated by the failure of traditional health education programs and the critical pedagogy of Paulo Freire (1994), which encourages a broad scope of innovative teaching methods. Nevertheless, only the preliminary and limited study by Loureiro et al. (1990) considered perceptual studies of water, the transmission medium of schistosomiasis.

Water has received considerable attention from public health officials world-wide. A PubMed search using the search words “water, public health” revealed 122,500 references. Nevertheless, little is known about the knowledge and perceptions of un- or undereducated people on this issue, putting in jeopardy interventions directed at improving water supplies with the aim of reducing exposure risk. More recently, water and sanitation improvements became an important issue in raising public health levels world-wide than any medical intervention (Ferriman, 2007). The need to study the common knowledge of people is further demonstrated by the fact that in some educational processes the generation of knowledge results from the relationship between common and scientific knowledge. It is generally accepted that the study of common knowledge and perception of water in the transmission of water-related diseases can facilitate the development of effective parasitic and infectious disease control programs (FUNASA, 2001; 2002; WHO, 2001; Rosenberg 2007).

Since ancient times, water has been a strong symbolic element closely related to myths and beliefs. In many cultures water was associated with creation myths and worshiped and venerated for its fertility and healing properties. In Assyro-Babylonian mythology, in the holy books of the Hindus, and in the Koran, all inhabitants of the earth emerged from water, and in the Judea-Christian story of creation, water was also a primordial element (Witcombe, 2007). In ancient Greece, The Tales of Miletus describe water as the source of all things on earth. Water was not only the *physis*, but included also the idea of the origin, beginning, birth and development of all life forms (Silva, 1998). The cleansing, healing power of water has received much attention. Water has been ascribed supernatural powers, is considered sacred (e.g. the power of “holy water”), and remnant spiritual forces from paganism related to water were incorporated into most higher religions. Religious writings emphasize that clean water

purifies, exorcizes and redeems. Moreover, holy water allegedly repels evil spirits and pestilential dampness, is a remedy for various diseases, and consecrates houses and foods. In Brazil, Iemanjá, the healing, cleansing, and caretaking goddess and Great Mother of the seas, has its origin in African traditions and is now identified with the Catholic Madonna and worshiped annually on December 31st on beaches and lagoons, which involves offerings to the goddess made from boats. Variants of Iemanjá are venerated in other Latin American countries, especially in Haiti and Cuba. These images and beliefs, part of cultural traditions and common knowledge of many people, are created by the individual's imagination, experiences, and interests but often originate in and are reinforced by traditions, religions, cults and other cultural institutions (Andrade et al., 2002; Witcombe, 2007).

In spite of the strong symbolism of water as a life-giving and healing element, dirty water was increasingly associated with disease after the development of the germ theory in the nineteenth century. Water filtration, storage and chemical control of impurities became widespread as a result (Panetta, 2004). Water is also considered an important element of an individual's common knowledge in all contexts and not only in the transmission of parasitic and infectious diseases. There are theories trying to explain the importance of water in the collective imaginary having as reference the different symbologies and the mystery that surrounds this element essential to life. Bachelard (1999) studied different ideas and concepts about water, including the explicit facts and images related to it, as well as mystic and subjective elements. This philosopher points to the need for more discussion about water as an essential element for everyday life and survival, and its role in man's interaction with the environment, as expressed through rituals, art, beliefs and imagination. Several authors have recognized the importance of common knowledge of water as a prerequisite in the acquisition of scientific knowledge (Struchiner and Schall, 1999; Barata and Briceño-León, 2000; Giordan, 2000; Valla, 2000; Valla and Oliveira, 2001; Bachelard, 2002; Gazzinelli et al., 2002; Rodrigues, 2005a; 2005b; Reis et al., 2006; Rosemberg, 2007). These studies contribute to a better understanding of the impediments and opportunities of changing common knowledge surrounding different quality levels of water. Dissemination of information on the quality of different types of water may allow the public to make informed and healthful choices. Streams, lakes and springs potentially infected with schistosomes continue to supply domestic, occupational, and recreational uses of water in many rural areas in Brazil (Lima e Costa, 1993; Moura da Silva et al., 1997; Bethony et al., 2001).

2. Popular knowledge of water-related diseases and the infectiousness of water

The relationship between water and intestinal infections is widely known among rural populations living in schistosomiasis-endemic areas in Brazil. Knowledge gained by populations at risk of infection through the exposure and illness experiences of their own, family members and other community members is found among different social and ethnic groups and tends to be passed on from one generation to the next. In rural Brazil, people adhere to this knowledge as a healthful guide in daily water use and as a guide in maintaining a specific social order (Reis et al. 2006).

Various studies investigating common knowledge about parasitic and infectious diseases in Brazil reported on the common knowledge people have of the role of water in the transmission of schistosomiasis and other water-related diseases. Gazzinelli et al. (2002), studying school children in one village in Minas Gerais State, observed that half of the children considered stream water to be the source of *Schistosoma mansoni* infections. Similar results come from Barbosa and Coimbra (2000) and Noronha et al. (2000) studying common knowledge about schistosomiasis in rural endemic communities in Pernambuco State and in Bahia State, respectively.

These findings indicate that water as a medium for the transmission of schistosomiasis is a part of people's collective knowledge in Brazil. This knowledge may be build on in health education programs emphasizing avoidance of surface waters, sanitation practices such as treating, filtering and using only clean water as a means to prevent intestinal infections and avoiding biting insects (Mohr and Schall, 1992; Peregrino, 2002; Reis, 2006).

Studies by Noronha et al. (2000) and Gazzinelli et al. (2002, 2005, 2006) on schistosomiasis transmission in different rural Brazilian communities showed that dirty and polluted water was generally perceived to transmit schistosomiasis. The attributes dirtiness (*sujeira*) and pollution (*poluição*) were described by students as high-risk components, as found in dark and turbid waters containing high concentrations of organic and inorganic pollutants and garbage. This common knowledge is not in agreement with the results of most epidemiological studies. In waters highly polluted with sewage, including sewage stabilization ponds (Bunnag et al., 1978; Klutze and Baleux, 1996) and in high-density urban areas (Saternik 1979), *Biomphalaria* snails were absent or eliminated. Similarly, the infectivity of miracidia and cercariae is reduced or eliminated in highly polluted streams characterized by lack of oxygen, large amounts of ammonia, and other toxic substances (Bunnag et al., 1978; Klutze and Baleux, 1996). Moreover, the results of extensive snail collections by one of the authors (HK) (unpublished data) in these two and other Brazilian rural communities (including high concentration of *Biomphalaria* snails in relatively clear, low-silt, low-level ferruginous waters during the dry season and lower snail density during the rainy season), also argue for the deleterious effect of environmental pollutants.

Nevertheless, it must be emphasized here that the visually based qualitative classification of water into clean and dirty carries inherent difficulties in schistosomiasis epidemiology that needs to be addressed through more quantitative water quality studies. Visually clean and dirty waters represent a wide range of quality and turbidity values and varying tolerance thresholds for different schistosomiasis intermediate host species and under different climatic and aquatic conditions. Further complicating the issue is the fact that waters with slight to moderate fecal and urine contamination levels comprise many transmission sites world-wide. In Brazil, *Biomphalaria* spp. tends to cluster around smaller, nonindustrial communities emitting sewage into streams, which maintain a fairly normal biota (Giovanelli et al., 2005; Teles, 2005).

The objective of this paper is to elucidate popular beliefs about the infectivity of water among school children in two hyperendemic schistosomiasis areas of Brazil and to develop and test an innovative health education approach not commonly used in health programs. This study may contribute to a better understanding of the impediments and opportunities of changing common knowledge surrounding the role of dirty and polluted stream water in schistosomiasis transmission.

3. Materials and Methods

3.1 Study areas

The two case studies were carried out in Boa União, a rural village of about 1,800 population in the Municipality of Itabirinha de Mantena and in Caju, a village of about 650 population in Jequitinhonha Municipality in the Jequitinhonha Valley, also in northern Minas Gerais State of Brazil. Subsistence agriculture centered on the staples maize, beans and manioc and raising of cattle provide the economic base of both communities. Schistosomiasis is hyperendemic in both villages, with infection rates around 70% in Boa União (Gazzinelli et al., 2002) and 63% in Caju (Gazzinelli et al., 2006). These communities have no treaded water and sewage systems. In Boa União, 80% of the houses in the village use water from wells but approximately half of those have no pipe and still need to carry water in buckets. The remaining households use water from neighbors or from the stream. In Caju, approximately 60% of the houses use piped

water from a community tank storing water from a dam and the remaining households use the stream, with only a few households using springs or wells. Although families have piped water from wells, springs or small dams, many households in both communities continue to use local streams for domestic activities that need more water such as washing clothes, for bathing, playing, fishing, and irrigating garden and field crops, for both social reasons, and of interruptions in the supply of piped water. Failure of pumps or pipes causes periodic interruptions in the potable water supply, in which case the total population depends on the streams, home wells, and other surface sources for all their water needs. The use of both natural and improved water supplies is a function of necessity and choice in many rural communities in Minas Gerais State that have multiple water sources.

3.2 Sampling

The school in Boa União had approximately 500 students from 1st to 8th grade and 27 teachers. The educational program was developed with all 235 students from 3rd to 8th grades aged 11 to 20 years from the village and surrounding rural areas and 7 teachers. These students were selected because at those ages they have a better capability to verbalize and understand instructions and demonstrations presented during the program. The teachers were selected depending on their desire to participate. In the smaller Caju School, a sample of 128 students aged 6-18 years was drawn from the student body of approximately 200 and students were randomly divided into three groups matched by age and sex. For the final sample only the 87 students who participated in all 10 educational group meetings and had taken both pre- and post-tests administered by questionnaire were included. In this school we compared three different approaches in different groups and in Boa União we used the same approach for the whole study group. In both cases activities and content of programs were adapted to the age of the students.

3.3 Projects development

We carried out educational strategies that can be both esthetic and pedagogical and take into account previous experiences and knowledge of the students and related them to their place of residence and day-to-day activities and to scientific knowledge. The educational intervention developed in Caju (Gazzinelli et al., 2006) was structured and implemented through two different approaches, one for each group, with a third group serving as a control. The first, the social representations approach, is a tool useful for the analysis of knowledge as theories of the natural and social world, its production and its perception by the different actors involved (Audigier, 1999). We used it to analyze the experience of the students with schistosomiasis and the way they perceive the disease.

This took into consideration the previous knowledge of all school children about schistosomiasis identifying possible areas for changing, the analysis of practices, attitudes, and values related to the risk of infection; and finally the student's perceptions and beliefs related to the place where they live, environment and health services. The relationship and interaction between their perception of schistosomiasis transmission and scientific knowledge were examined. The idea of dirty water and its relationship with transmission was discussed and demonstrated in classroom. Students were asked to identify all water sources used by them and to indicate if they considered them to be schistosomiasis transmission sites. They were asked to observe three glass containers with different types of water, including visibly clean water from a pond, from a local stream, and tap water containing sugar. This exercise demonstrated to the students that there are unclean elements and invisible particles in water, some of which may be dissolved, making them invisible. During that session they also observed under a field microscope a slide with a drop of visually clean stream water containing living cercariae to demonstrate that clean water can play a role in the transmission of schistosomiasis. They also observed adult schistosomes and *Biomphalaria* snails and engaged in discussions using

photographs, magazines, newspapers, plays, books, poetry and music about the role of water in health and illness and ways and means rural communities can obtain potable water.

In open discussions after this demonstration, which was guided by the first author and invited experts, issues raised by teachers and students could be addressed. The classes following these practical experiments enriched and substantiated this new knowledge. These teaching methods helped students to overcome the epistemological obstacle in which dirt and polluted water are considered synonymous with potential sources of disease.

The second approach we used, the cognitive approach was, as in other Brazilian schools, basically focused on information on the transmission and prevention of schistosomiasis using pre-existing education materials developed by the National Health Foundation (FUNASA) and the Ministry of Health. The third group, the control group, received information not specifically related to schistosomiasis but to health issues such as personal hygiene, drug problems, smoking and healthy foods, though paintings and drawings. At the end of the education process, after evaluation of the intervention, this group received information about schistosomiasis like the other two groups.

The health education trial continued for 10 months, with a group meeting every 30 days. Both pre- and post-intervention tests were administered by questionnaire and the knowledge of students was further evaluated by written reports.

In Boa União we used two different approaches with the same group of children. We began the intervention trial by using a cognitive approach based on the results of a pre-test, to search for a better understanding about the disease and the role of water in the transmission of schistosomiasis through a perspective not related to dirtiness. This intervention continued for 10 months, focusing on basic concepts of the disease, including the schistosome life cycle, modes of transmission, pathology, diagnosis, symptoms, treatment and prevention through lectures and practical exercises. In the exercises the students and teachers had the opportunity to observe a collection of *Biomphalaria* shells and worm samples (*Ascaris lumbricoides*, *S. mansoni*, and *Taenia sp.*). Using a microscope, experimental infected snails were examined to observe the presence of cercariae, schistosomes, and normal and infected livers.

After that we administered a post-test and used a second teaching approach-learning by experience (Dewey, 1971) during the following 9 months duration. Learning by experience in this context involved reflexive thinking about their own reality, asking the students to formulate hypotheses, test them and search for answers. In this approach, a person's present experience is seen as a function of the interaction with past experiences and ones present situation. As part of using the learning by experience approach, we made field visits to local streams and ponds with the students and teachers for the purpose of observing and explaining the relationship between visual water quality and occurrence of *Biomphalaria* snails. This provided students and teachers with an opportunity to apply their new classroom knowledge in observing physical and biotic elements of different water bodies in the community. In Boa União, a field trip to a small stream with visually clean water enabled students to observe its movement, color and turbidity, smell its clean odor and also observe *Biomphalaria* snails on plants. As a result, they experienced, for the first time, the cognitive and affective conflicts arising out of their attempts to reconcile the "new knowledge" and the "old knowledge" in their own conceptual framework. Music, poetry and drawings that focused on symbolologies and metaphors of water were also used as part of these demonstrations and instructions. Students were able to promote and direct a debate articulating art, common knowledge in the village and scientific knowledge. The empirical elements of the exercise, which permitted the visualization of previously subjective folk knowledge allowed the students to go from one level of knowledge to another.

Follow-up discussions in the classroom reinforced this learning experience and promoted critical examination of their previous knowledge. Following these field trips, samples of different types of water were examined at the school using a dissecting microscope, again stimulating critical thinking using the learning by experience approach. A science fair was organized at the end of the intervention trial and a plan for sanitation improvements was developed; both were presented to authorities of Boa União.

These activities, together with presenting exhibits and lessons on the transmission and prevention of schistosomiasis and the role of different types of water in transmission using existing education material, were carried out to strengthen the partnership with the schools and the communities.

4. Results of the Two Case Studies

The variable availability and use of different surface water sources with different qualities and turbidities in Boa União and Caju has conditioned both adults and children to seek out sources with optimal quality largely on the basis of visual assessment. This visual inspection includes the search for aquatic worms and any snail species, which children and adults alike associate with “xistose” (schistosomiasis), as shown by the snail surveys of one of the author (HK). Children learn early in life from their parents and other adults to use only clean waters and avoid turbulent, polluted, and putrid waters. Direct observations and discussions with teachers in Boa União indicated that women and girls preferred to use cleaner upstream sites at the edge of the village or beyond for laundering and for fetching water whenever the piped supply failed. Similarly, in a village near Boa União, a water contact study established that females washed clothes and utensils at distant upstream sites, outside the village, where the water was cleaner during the dry season. During the rains, when high silt loads in the stream make this site unattractive, the females went back to using the wells inside the village (Kloos et al., 1998). Younger children who had not yet adhered to the avoidance behavior of adults based on the clean/dirty water dichotomy and played in the polluted central and lower sections of the stream, were often reprimanded by their older siblings and parents.

A similar quest for clean water was observed in Caju, where 65% of the school children considered water necessary for transmission of schistosomiasis (Gazzinelli et al., 2006). Nearly a quarter of the individuals also mentioned the involvement of water in the transmission of leishmaniasis (Reis et al., 2006). This last response is borne out by epidemiological studies which show that sandfly vectors in South America are most abundant near water bodies and after rains (Salomon et al., 2002; De Lucas et al., 2003). In another village in the Jequitinhonha Valley (Virgem das Graças), adults and children commonly bathed at distant stream sites after work in the fields rather than at home, partly because of the apparently cleaner water away from the village (unpublished data).

Our findings in Boa União showed that prior to the health education sessions in the schools, a great number of words related to dirt and pollution were used by students to characterize the stream water of the community. Of 235 students, 161 (69 %) associated pollution, dirt, garbage and sewage with schistosomiasis transmission in the local streams. The results of the post-test administered after the educational sessions in the class room using the cognitive approach and emphasizing the natures, transmission and prevention of schistosomiasis showed that approximately half of the students who had associated transmission to dirty stream water in the pre-intervention tests still held that view during the post-tests. A similar proportion also did not perceive the disease as a relevant health problem (Gazzinelli et al., 2002).

We obtained similar results in the elementary school in Caju rural area in Jequitinhonha Municipality in Minas Gerais (Gazzinelli, 2006) when using the same approach. There, before

the education sessions, 44% of the students stated that schistosomiasis was transmitted through contact with contaminated soil, polluted water or garbage and after the sessions, almost the same number of the students (47%) held this view. These results indicate the difficulty for children to change their long held perceptions through an approach that focused on the scientific transmission model.

After completion of the various field and classroom instructions and exercises using both the social representation and learning by experience approaches, the students in both schools did not hesitate to consider clean water as potentially contaminated and substituted their old knowledge for the concept of visually clean water as a potential health threat. They thus accepted the notion that although visibly clean water is essential for human survival it may be impure, containing hidden and invisible elements. At the end of the training sessions, students were more confident about their ability to prevent schistosomiasis. The participating teachers gained knowledge about the transmission of schistosomiasis and methodological skills and expressed interest in upgrading their health education lessons to include diarrheal and other water-related diseases. Thus, in addition to informing how to construct knowledge, it was possible to stimulate teachers to act as multipliers of knowledge in collaboration with their students and colleagues.

5. Discussion

Our results suggest that a culturally more sensitive approach is needed that builds on prevailing local knowledge and symbolism associated with different types of water and their perceived role in schistosomiasis transmission. Such an approach offers opportunities to bridge the chasm between local and scientific knowledge. They also suggest that reconstructing and changing the indigenous imagery and symbolism centered on dirty water as the culprit in schistosomiasis to the concept of visually clean water transmission using instructional language, concepts and symbolism elementary school students can offer a promising means to affect this change. The double meaning of water – its symbolic nature and as an essential element for survival, also mentioned by Penna (2007), seems to have contributed to the school children's predominant response that dirty, polluted, rather than clean water, is the source of schistosomiasis transmission, although this aspect needs further study.

Bachelard (1999), in his book *Water and Dreams*, stated that in the process of imagining meaning and symbolism of water there are two forms of imagination: the formal and the material imagination. In formal imagination, the images are a copy of the real world. This type of imagination is the basis of the concept of “dirty water” as the only source of schistosomiasis transmission, as observed among school children during the educational interventions in both Boa União and Caju. The idea of “dirty water” was seen as an unquestionable association between dirt and parasite infection. In material imageries, on the other hand, the production of images goes beyond concrete forms and includes transformations and breaking with single images. Thus the way people understand a subject or observe facts is different from forms of imagination because here they can explore beyond the physical appearance of subjects. In examining water images and their relationships with schistosomiasis we operate interchangeably between the unique and the general, the superficial and the deep, which can generate multiple meanings for the role of water in the transmission of schistosomiasis. This imagination framework supports multiple images about water: cleanliness, purification, religion, pleasure, life, birth, transformation, cure, movements and many other images found in various cultures. These multiple images seem to be the basis that sustained the common thinking of the school children in our study. In this way they were giving a unitary meaning, pragmatic and simple, as revealed in the imagery of dirty water.

As stated above, the individuals' superficial and deep symbolologies related to water influenced the way they confronted and learned new information, indicating that innovative educational approaches can guide and evaluate the learning process from common to scientific knowledge. The results from Boa União and Caju schools indicate that imaginary organization in the symbolism of water is biased toward the development and persistence of concepts that are not compatible with the scientific facts of schistosomiasis transmission. These findings reemphasize the symbolic meaning of clean water described above and its function as a learning barrier to a better understanding of the infective nature of stream water.

Bachelard (1999) calls attention to features that may help to clarify the genesis of the individuals' perception of water quality previously described in Caju and Boa União by Gazzinelli et al. (2002, 2006) and Reis et al. (2006). As pointed by Bachelard (1999), clean water is often valued to the degree that nothing can change it. This symbolism explains in part the students' inability to readily understand that schistosomiasis can be transmitted through clean water, which they perceived to be devoid of impure elements. According to Sousa (2006), the concept of water purity and the pure/dirty water dichotomy can dominate the collective imaginary of water. Current flow of the schistosome-infested streams of those localities was not considered to be a factor in water quality. These various perceptions appear to have contributed to the difficulty of students recognizing the contamination of the streams in their communities as long as visually clean water is associated with purity, rebirth and renovation symbology.

On the other hand, even minimal impurity decreases the value of pure water, and impurity is often perceived as evil and is associated with disease and other bad things (Bachelard, 1999). This idea is related to our findings in Boa União and Caju, where schistosomiasis was strictly associated with dirty water.

These findings point out the need for educators to search for approaches that can free students from their preoccupation with general images and primary notions. Our results indicate that leading students to critically and analytically examine the properties and infectiousness of water can overcome these misconceptions. Common knowledge can be a starting point in a psychoanalytical process of recognizing and overcoming the initial misconceptions in which the educator explores the genesis of common knowledge and seeks to correct misinformation (Bachelard, 2002).

Most water images are part of folk culture that is deeply entrenched in rural communities worldwide. To be effective in promoting health, school teachers should be familiar with these and other elements of folk knowledge that reflect the day-to-day reality seen by the individual that permits him/her to cope successfully with their situation and environment. This in turn requires that educators examine the origin of such knowledge to understand its socioeconomic and cultural context and that students are encouraged to critically question and investigate popular knowledge and their perception of the environment. By examining the origin and basis of common knowledge, students were able to connect the various strands of knowledge and to defend a critical interpretation of the newly obtained scientific information. In this way health educators may create opportunities and an environment in which previous knowledge can be questioned cognitively and affectively.

6. Conclusion

The results of this review and our case studies indicate widespread misinformation about the relationship between water along a clean/dirty gradient and schistosomiasis transmission among students and apparently the general rural population in Brazil. The tenacity with which students in the two communities clung to the traditional perception of dirty water being more

infective than visually clean water appears to be rooted in old symbolism and concepts linking unclean water with disease and other harmful elements. These findings also point to the need for health educators to recognize the importance of students' common knowledge, considering that symbolism was adhered to among students as objective truth.

This study indicates that the use of the social representation and learning by experience approaches can provide insights into why and how actors develop their observation abilities and perceptions of local water sources and other elements in their environment. This information may therefore contribute to developing effective and acceptable health education programs in local schools. Further studies are required to evaluate the effectiveness of these approaches in other rural schools as well as in urban schools in Brazil. There may also be opportunities for exploring similar health education interventions using the same concepts and principles in different health care settings. Additional studies should include empirical measurement of water turbidity and color in relation to empirical indices of water infectivity among both infected and uninfected individuals as well as heavy and non-users of potentially infective waters may have considerable public health implications. Their results may help to better identify individuals and groups at high risk of schistosomiasis and reasons for non-use or selective use of different waters. Health education messages based on prevailing perceptions of surface waters and local environmental conditions may play a central role in sensitizing populations in endemic areas about the potential infectivity of apparently clean surface waters. Although this paper focuses on schistosomiasis, concepts and methods presented here may also be used for other water-related diseases, including acute diarrhea, hepatitis, cholera, and cryptosporidiosis, among others.

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