

Original Contribution

Environmental Health Education in Schools as Strategy for Rodent Control: An Experience in a Shantytown of Buenos Aires, Argentina

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Abstract: The general aim of this study was to assess the possibility of including elements of environmental health education within the curriculum of a school located in a shantytown of Buenos Aires city, Argentina. An environmental health education campaign was designed to introduce school-aged children to the problems posed by the lack of environmental sanitation, by using rodents as indicators of environmental disorder. The methodology implemented consisted of a lecture and two practical activities where the participating children were the evaluators of their neighborhood environment, recording the environmental factors that indicate direct or indirect presence of rodents and carrying out a survey about rodents among their neighbors. To assess the impact of the activities, an anonymous questionnaire was performed with the students before and after the campaign. The results showed that students were able to identify the man-made factors which favor the presence of rodents and were encouraged to propose strategies related to environmental sanitation to reduce rodent proliferation and the transmission of their parasites. This study demonstrated the feasibility of performing environmental health education campaigns in school-aged children by using practical activities to stimulate observation, participation, and comprehensive understanding of the problems posed by urban pests.

Keywords: environmental sanitation, health education, zoonosis, rodent control, shantytown

INTRODUCTION

Environmental changes and ecological disturbances have exerted, and can be expected to continue to exert, a marked influence on the emergence and proliferation of zoonotic parasitic diseases (Patz et al. 2000). One of the main processes of environmental disturbance is the rapid increase of urban settlements in developing countries. According to UN reports, more than half of the world

population lives in urban areas, with higher rates of urbanization occurring in less developed regions (United Nations 2012). This tendency is particularly observed in Latin America, where urban development is characterized by a strong fragmentation and by the consolidation of the so-called slums or shantytowns (Rodgers et al. 2011). These settings are inhabited by a very-low-income population that lives in precarious dwellings with an inadequate supply of basic urban services such as garbage removal, sanitation networks, electricity, telephones and plumbing (Fernández et al. 2007). In Buenos Aires city, 163,587 inhabitants (5.7% of the overall population) were

living in shantytowns in 2010 (Dirección General de Estadísticas y Censos 2010).

People living in poverty throughout the developing world are heavily burdened with a series of communicable diseases, particularly parasitic diseases, including lymphatic filariasis, soil-transmitted helminthiasis, schistosomiasis, onchocerciasis, leishmaniasis, Chagas disease, ectoparasitic skin infestations, and parasitic zoonoses (Ehrenberg and Ault 2005). These diseases are called neglected because they affect the poor, they are not subject to compulsory reporting in most countries, and are therefore not perceived as major public health burdens as compared with other diseases such as HIV/AIDS, tuberculosis, and malaria (Ehrenberg and Ault 2005).

Zoonotic diseases can be managed through the reduction of human exposure patterns. Different authors agree that achieving this requires reducing environmental pollution, improving hygiene practices of community members, and changing the behavior and attitudes towards social, cultural, and environmental risk factors (Asaolu and Ofoezie 2003; Díaz et al. 2009; Nguyen-Viet et al. 2009). The popular education model by Paulo Freire proposed several ways of action, emphasizing the importance of participatory action of the impoverished in their educational experience, to become critically conscious of why social problems exist and to become self-efficient to take social action in their communities (Freire 2000). Environmental health education involves a more ecosystemic and responsible view and aims to promote the conservation or creation of environments that foster health and the adoption of ways to relate environments that promote both human and ecosystem health (Sauvé and Godmaire 2004).

Synanthropic rodents play a significant role in human health, welfare, and economy due to their close association with humans (Stojcevic et al. 2004). Particularly, urban rats are recognized as reservoirs of different disease-causing agents with importance to public health (Acha and Szyfres 1992; Coto 1997). Rodent infestation is a problem in many cities worldwide. In shantytowns of Buenos Aires city, environmental and socioeconomic conditions favor the presence of different species of commensal rodents (Fernández et al. 2007; Cavia et al. 2009). These neighborhoods are characterized by poverty, precarious housing, overcrowding and inadequate sanitary practices that expose their inhabitants to a greater risk of parasitic diseases of zoonotic origin. In a parasitological study conducted in a shantytown of Buenos Aires city, it was found that 97.5% of the rats were parasitized with at least one helminth or

protozoan species, including *Hymenolepis nana* and *H. diminuta*, two cestodes with zoonotic importance (Hancke et al. 2011).

Education is the foundation of any rodent control program as it can provide the correct message, sustainable alternatives and affordable solutions to obtain a behavioral change in affected communities (Lambropoulos et al. 1999; Macpherson 2005; Fernández et al. 2007). Therefore, the general aim of this study was to assess the possibility of including elements of environmental health education within the school curriculum to contribute to the solution of the social needs of the most vulnerable groups. The specific aim was to introduce school-aged children from a shantytown of Buenos Aires city to the problems posed by the lack of environmental sanitation, by using rodents as indicators of environmental disorder. After, we asked students to carry out a practical activity where they were the evaluators of their neighborhood environment, seeking to stimulate their critical observation, participation and comprehensive understanding of the problems presented by environmental disorders.

MATERIALS AND METHODS

Study Area

This study was conducted in a school located in the periphery of a marginal urban district (34° 34' 50.89" S; 58° 23' 02.25" W) of Buenos Aires city. Students attending the school reside in this shantytown, which has a population of 26,492 inhabitants, half of which are immigrants from neighboring countries (Dirección General de Estadísticas y Censos 2009, 2010). About 35.7% of the dwellings lack direct access to drinking water, which indicates a significant proportion of households without sanitation and minimum levels of household welfare (Dirección General de Estadísticas y Censos 2009). In addition, the resident population is at a disadvantageous position compared with the inhabitants of residential neighborhoods regarding the maximum level of educational attainment, since 19% of the residents over 25 years of age have not completed elementary school (Dirección General de Estadísticas y Censos 2009).

Methodology

We evaluated the success of an environmental health education campaign by testing the knowledge of partici-

pants both before and after the intervention. We worked with students of both genders attending the last level of elementary school, whose ages ranged between 12 and 13 years old. A total of 56 students participated in the campaign and classes were held in the presence of the teacher in charge of the course. The health education campaign consisted of two interactive meetings with the students. During the first meeting, prior to the class, a brief, personal and anonymous questionnaire was given to the students to assess their knowledge related to environmental factors harmful to human health. This questionnaire consisted of five questions. In the first two questions, the students had to choose from a number of options (presence of garbage, standing water, unpainted walls, abandoned and unused objects in house or street, presence of animals, debris, the number of rooms in a house, tall grass, and anything they would add) those which are harmful to their own health and explain briefly why. The third and the fourth asked about the effect of the presence of rodents on people's health. The last question asked about how to act against the presence of rodents. Subsequently, we gave them a class about the importance of environmental care in the prevention of zoonotic diseases, emphasizing the role of rodents as hosts of different disease-causing agents. The topics included were: basic concepts about the biology of rodents; description of the environmental conditions that favor their presence and proliferation in an urban setting; the importance of rodents in disease transmission to humans; direct and indirect evidence for the presence of rodents in a house and peridomiliary area; and prevention and control methods. In addition, we described the parasite life cycles that include humans and rodents as hosts and pointed out the main environmental factors that favor their establishment. The methodology implemented in the class consisted of a lecture using illustrations and photographs.

The first meeting ended with the delivery of instructions for the students to carry out two practical activities in their neighborhood: recording the environmental factors that indicate direct or indirect presence of rodents and carrying out a brief survey about rodents among their neighbors. The class was organized in groups of five students, and each group had to work in a block (or area) of the neighborhood which had been previously defined. For the first practical activity, students had to use a preset list to record the presence of environmental factors associated with the activity of rodents (Fig. 1). For the second practical activity, students had to record the answers to a pre-fixed survey conducted among neighbors residing in the

area assigned to each group (Fig. 2). Students had a week to complete both practical activities and deliver the spreadsheets with the results to the teacher. We then collected the spreadsheets so as to analyze and organize them before the next meeting with the students.

The second meeting took place 15 days later and was divided into three parts. In the first part, the students described their experience during the implementation of the practical activity. In the second part, we showed the results of the environmental record and the surveys carried out by the students and discussed together the possible preventive measures that each neighbor might undertake to reduce the incidence of rodents and consequently, the zoonotic risk involved. In the third part of the class, we repeated the same questionnaire of the first meeting with the aim to compare the answers before and after the practical activity.

Statistical Analysis

The results of the two questionnaires conducted before and after the practical activity were analyzed. As the questionnaires were anonymous, the responses were averaged in both cases allowing us also to become independent of the number of questionnaires received, which fall from 56 to 51 in the final meeting. For the first two questions, we calculated the proportion of each of the selected options well related to the presence of rodents in both questionnaires (before and after). Then, we compared each of these proportions before and after the environmental health education campaign by tests of proportions (Zar 1996). Question 3 (*Are rats good, bad or do not affect people's health?*) was not relevant in terms of their responses, but was a link to the next, question 4, which asked *why do they think rats are good, bad or do not affect people's health?* The answers were classified into those which relate rats with disease transmission and those with another kind of explanation, like are disgusting or they bite, etc. After, Chi-square tests of independence were performed to study if the proportions of both groups of answers changed before and after the environmental health education campaign (Zar 1996). In a similar way, the answers to question 5 (*what can be done in your house and/or neighborhood to prevent rats?*) were classified in those which relate rodent control with environmental sanitation and those with the use of direct action methods (traps, poison). Chi-square tests of independence were performed to study the changes of the proportions of both groups of answers before and after the campaign (Zar 1996).

Environmental survey		site				
		1	2	3	4	
Members:	signs of presence of rodents	rats, mice (dead or alive)				
		footprints, droppings, gnawing marks				
		rat caves not covered and with no spider webs				
	shelters for rats	exposed sewer holes				
		weeds and tall grass				
		other large waste (wheels, tanks, branches, furniture, debris, etc.).				
		lumber stacked on the floor				
		abandoned appliances (refrigerators, stoves, washing machines, etc.).				
		abandoned cars				
	food for rats	standing water				
pet food						
exposed garbage						
exposed food						
Group N°	type of installation	wasteland				
		store				
		house				
Address						

Fig. 1. Checklist used by the students for the environmental survey

RESULTS

A total of 56 students participated in the first meeting and 51 in the second. During the first meeting, we described the environmental and health issues associated with the presence of rodents in urban environments and the zoonotic risk posed by their presence. The students participated enthusiastically telling their experiences in observing rodents in their neighborhood. Then, with the help of the teacher of the class, work teams were formed to carry out the practical activity (22 groups in total).

A total of 114 surveys and 71 environmental record sheets were delivered to us. Regarding the surveys, the students recorded that 93.9% of the respondents had seen rodents in the neighborhood and that 66.7% knew that rodents transmit diseases to humans. The environmental records showed that 43.7% of the sites observed by the students had exposed garbage and accumulated water in 25.4% of the cases, both signs of potential food sources for synanthropic rodents. In addition, in 47.9% of the envi-

ronmental records the students were able to identify a large number of potential refuges for rats, such as abandoned materials, debris, stacked woods, and unused items.

The comparison between the initial and final questionnaires showed that, after the health education class and the practical activity, a significantly larger proportion of students were able to identify the elements of the environment that could serve as shelter for rodents (test of proportions: $P < 0.05$) (Table 1). The accumulation of unused objects (abandoned material), the presence of debris, and overgrown grass were identified in class as situations of environmental disorder that favor the establishment of rat caves. In the question 1, students had to choose from a set of items which ones are harmful to health and why. Students justified the answers by correctly linking the options raised with the presence of rodents and/or the transmission of intestinal parasites during the second meeting. In this sense, while only 29% were able to relate the presence of garbage with the risk of disease transmission in the first meeting, 67% of them were able to do so in

Survey to the neighbors:

Respondent's age

Have you seen rats in your neighborhood? Yes No

Where?

standing water

sewer

debris

grass

garbage

others

Are rats dangerous for human health? Yes No

Why?

they bite

disgust me

transmit diseases

others

Fig. 2. Survey used by the students to gather information from neighbors

the second meeting (test of proportions: $P < 0.05$). The same trend was observed when recognizing the presence of debris as a potential shelter for rodents (9 vs. 55%) (test of proportions: $P < 0.05$). The number of students able to associate the health risk posed by the presence of standing water with the transmission of diseases was significantly higher in the second meeting than in the first (test of proportions: $P < 0.05$) (Table 1).

In addition, the students learned that rats are reservoirs of many diseases (leptospirosis, hanta virus, ecto and endoparasites, etc.). This was reflected in their answers to the question 4 about why rats are detrimental to public health. The answers that related commensal rodents with the

transmission of diseases increased significantly in the second meeting, reducing notably the alternative explanation of “disgust me” or “are a dirt” (χ^2 : 6.48, df 1; $P = 0.01$) (Table 2).

The last question of the survey attempted to assess the attitude of the students in relation to the presence of rodents. Regarding the question asked about the action to be taken in the neighborhood to prevent the problems that rats can generate to humans, it was noted that, before the health education campaign, most of the students thought that the use of traps and poisons were the most effective methods for rodent control, whereas after the campaign, a significantly larger number of students recognized that

Table 1. Participant Knowledge on Situational Factors Associated with Rodent Presence.

	Participants N (%)		P value
	1st survey (N = 56)	2nd survey (N = 51)	
Garbage	16 (28.6%)	34 (66.7%)	0.0001
Standing water	10 (17.9%)	24 (47.1%)	0.0017
Unpainted walls	3 (5.4%)	0 (0.0%)	0.2446
Abandoned material	14 (25.0%)	35 (68.6%)	<0.0001
Presence of animals	14 (25.0%)	8 (15.7%)	0.3384
Presence of debris	5 (8.9%)	28 (54.9%)	<0.0001
No rooms per house	1 (1.8%)	1 (2.0%)	1
Tall grass	17 (30.4%)	28 (54.9%)	0.0117
Others	4 (7.1%)	6 (11.8%)	0.5137

Table 2. Participant Questionnaire Responses to Questions Related to Rodent Problems.

Question 4	Why do you think rats are good, bad or do not affect people's health?		
Answers	Related with disease transmission	Other explanation (are disgusting, they bite, etc.)	Independence test
Before intervention (<i>N</i> = 56)	30 (53.4%)	18 (32.1%)	$\chi^2 = 6.48$
After intervention (<i>N</i> = 51)	37 (72.5%)	6 (11.8%)	<i>P</i> = 0.01

Question 5	What do you think can be done in your house or neighborhood to prevent rats?		
Answers	Related with environmental sanitation	Related with direct action methods (traps, poison)	Independence test
Before intervention (<i>N</i> = 56)	18 (32.1%)	33 (58.9%)	$\chi^2 = 5.51$
After intervention (<i>N</i> = 51)	24 (47.1%)	16 (31.4%)	<i>P</i> = 0.02

poor environmental conditions can generate suitable habitats for rodent proliferation (χ^2 : 5.51, *df* 1, *P* = 0.02) (Table 2).

DISCUSSION

The theoretical framework of this study was based on Paulo Freire's empowerment education model, which promotes citizens to become subjects rather than objects of social processes, ideally fostering desire to take social action against problems in their communities (Freire 2000). The main motivation of this work was to introduce school-aged children from a shantytown to the problems posed by the lack of environmental sanitation, by using rodents as indicators of environmental disorder and seeking to stimulate their participation and comprehensive understanding of the problem. Rats are a good model because their presence in urban environments is directly related to the presence of products derived from human activities and an inadequate anthropogenic waste disposal (Traweger et al. 2006).

The shantytowns of Buenos Aires city are the neighborhoods where their inhabitants are most exposed to a contact with rodents and to the zoonotic risk that this implies (Fernández et al. 2007; Cueto et al. 2008; Cavia et al. 2009; Hancke et al. 2011). Shantytowns of Latin America are not included in urban planning programs and the supply of basic services is insufficient (Fernández et al. 2007). Thus, to improve environmental quality, it is essential to focus efforts on individual and community actions. The incorporation of concepts related to environ-

mental improvement, and healthy hygiene practices is therefore indispensable to obtain a preventive attitude about the problem posed by the presence of rodents in such environments. Besides the fact that school-aged children are exposed to problems such as malnutrition, parasitic diseases, and other infectious diseases in areas of rapid urbanization, poor sanitation, and political and economic instability, schools are the propitious scenario to introduce health information into the community (OMS 1997).

According to Salleras (1994), schools, along with mass media and clinical care services, especially primary care, should be the main spheres to develop health education activities. Thus, schools should be an appropriate starting point to transfer information to the community about health behavior patterns leading to reduce the risk of endoparasitic infections transmitted by rodents. In this sense, the initial objectives of the health education classes were fulfilled, since they were able to make students aware of the consequences of environmental mismanagement in the transmission of zoonotic diseases. Students were able to identify rodents as indicators of the deficiency in environmental quality and the risks posed by their presence. In the questionnaire at the end of the campaign, students identified the man-made factors which favor the presence of rodents and were encouraged to propose strategies related to environmental sanitation to reduce rodent proliferation and the transmission of their parasites.

In agreement with Vivas and Guevara de Sequeda (2003), when the educational process is oriented to stimulate healthy attitudes and practices, the most appropriate strategies are those which allow interaction and dialog, as well as observation and experimentation. The implementation of a

practical activity gave satisfactory results for the purpose of the class. The age of the target population proved to be appropriate as they accepted this activity with curiosity and seriousness. The results of the surveys and environmental records made by the students coincide with studies made by us in the same area (unpublished data). We stimulated the active participation of the students, who demonstrated enthusiasm in identifying the environmental factors that promote the presence of rodents and who informed their neighbors about the health problem posed by rats.

Students were enthusiastic in telling their experiences in class and proposing solutions and control measures. Furthermore, the realization of the practical activity in their own neighborhood was important because it allowed them to identify for themselves the issues raised and did not receive the information in an abstract manner, as brochures or classes. However, behavioral changes are achieved over the long term and require communication strategies and social mobilization to promote and reinforce behaviors then accepted by members of the community (Sánchez et al. 2008). The time interval of 15 days between both meetings had advantages and disadvantages. On one hand, we framed our intervention in line with the curriculum of the class, and we made sure that no other external factor masked the effectiveness of our intervention, like local government rat eradication program or deworming campaigns. On the other hand, this time gap measures a short-term and not a long-term impact. To measure the extent of these types of interventions, long-term projects are necessary by repeating the experience in time and within integrated projects that include studies of rodent populations and their parasitic fauna. In addition, we believe it necessary to include this type of activity in other courses with students of other ages to extend and deepen the concepts of the environment–health relationship in the transmission of zoonotic diseases in urban environments.

The purpose of these kinds of projects is to get an improvement in environmental sanitation and consequently, a reduction in the number of rodents living in shantytowns. This study demonstrated the feasibility of performing health education campaigns in school-aged children by using practical activities to stimulate observation, participation, and comprehensive understanding of the problems posed by urban pests. With this aim, the education campaign was based on the importance of manipulating the elements of the environment for the prevention and control of diseases that arise from the interaction between the infectious agent, the host, and the environment. The results from the final questionnaires

have highlighted that students understood the importance of environmental management for the prevention of zoonotic diseases.

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