

Basic sanitary conditions in Iporanga, São Paulo State, Brazil

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Keywords

Sanitary profiles. Basic sanitation. Water pollution. Domestic effluents. Solid wastes. Health knowledge, attitudes, practice.

Abstract

Objective

To assess the pollution of water bodies by domestic sewage and to evaluate the basic sanitation conditions of residences and the knowledge of the local population concerning intestinal parasitic diseases and the hazards they present to public health.

Methods

Thirteen water samples were collected from each of four sites in different water bodies of the Bairro da Serra region, in Iporanga, São Paulo State. Rates of total and fecal coliforms were measured and median values were presented so as to show domestic sewage contamination in the area. Questionnaires were administered to 50% of local households in order to obtain information on water supply and disposal of domestic sewage and solid waste, and to evaluate knowledge of the transmission, health hazards, and prevention of intestinal parasitic diseases among the local population.

Results

The Betari river showed microbiological indexes indicative of pollution by domestic sewage. Higher levels were verified both upstream and downstream from the Bairro da Serra. Median values were even higher in two of the river's tributary streams, indicating strong pollution by domestic sewage and lack of conformity with current legislation. In 91% of the households investigated, sewage disposal was done by means of septic tanks, most of which were rudimentary and contributed to the contamination of the environment. The knowledge of 62% of interviewed subjects concerning the transmission of helminthic diseases was considered as poor.

Conclusions

Our results indicate a risk of proliferation of intestinal parasitoses and of other water-transmitted diseases, an issue which is aggravated by increases in population caused by the region's vocation for ecotourism.

INTRODUCTION

Intestinal parasitic diseases are an important public health problem in developing countries. It has been demonstrated that this problem is directly related to poor basic sanitation and to the consequent degradation of the environment. Schooling and sanitary knowledge within the affected population are also relevant factors. The resolution of this problem has been prevented by the high costs involved in

improving basic sanitation, as well as by the lack of educational programs capable of achieving community mobilization, which is fundamental for changing habits and beliefs that contribute to the mechanisms of disease transmission, and often play a role in social underdevelopment.^{5,6,10,14,16}

The present work was aimed at verifying domestic sewage contamination in a river and two of its affluent streams, evaluating basic sanitation conditions, and

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measuring local residents' knowledge of intestinal parasitic diseases. This will allow us to make inferences concerning the exposure of residents and tourists to these diseases.

METHODS

The Ribeira Valley, in the southern region of São Paulo State, Southeastern Brazil, includes substantial areas of preserved Atlantic Forest, and accounts for 10% of São Paulo State territory.

The municipality of Iporanga is located in the Alto Ribeira Valley, 360 km away from state capital São Paulo, at latitude 24°S and longitude 48° W, on a branch of the Paranapiacaba mountain chain, part of the Brazilian coastal mountain system.⁹

The Ribeira Valley is the poorest and least urbanized area in the State. Socioeconomic indicators are unfavorable, and a large share of the population works in agriculture and extraction.⁷

The municipality of Iporanga has 4,562 inhabitants and an area of 1,160.20 km². Part of its territory is located within the Alto Ribeira State Tourist Park (PETAR).⁸ This state preservation unit also includes part of Apiaí, a neighboring municipality, as well as the nearby *Bairro da Serra* neighborhood (Figure).

An affluent of the Ribeira de Iguape River, named Betarí River, runs through this neighborhood, close to two of the preservation unit's headquarters. Due to its natural attractions – which include caves, clear water creeks, and waterfalls – the *Bairro da Serra* is under the influence of tourist visitation.

There are several inns and camps in this area, in addition to other tourism-related services. These novel economic activities are an important source of income for the local residents, and are an economic alternative for the local population.

The *Bairro da Serra* neighborhood comprises approximately 110 residences and has about 600 inhabitants. It was originally a rural settling, and its first inhabitants lived on agriculture, palm heart (*Euterpe edulis*) and timber extraction, and mining, activities which are currently in decline. An exception to this is a cluster of residences alongside the SP-125 highway, with an urban-like configuration. This nucleus has electricity, public and private telephones, a school, and a few commercial establishments.¹³

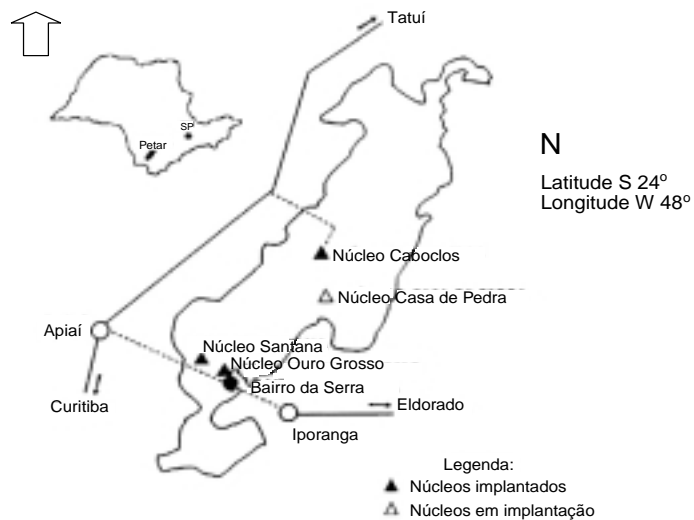


Figure - Bairro da Serra and surroundings, Iporanga, São Paulo (Brazil).

The poverty of the Ribeira Valley region is also seen in terms of basic sanitation, especially in the rural areas. In the *Bairro da Serra*, ditches for pluvial drainage have residues and odors typical of domestic sewage, indicating the precariousness of sanitary sewage. Part of the sewage generated in these locations flows, untreated, to small streams which lead to the Betarí river, a local tourist attraction and a site of leisure, especially for children living in the area.

Water samples were collected in order to determine the levels of total coliforms and of fecal coliforms at sites considered to be under the influence of domestic sewage. Interviews were conducted with residents at their homes in order to obtain data on basic sanitation conditions and on the population's knowledge of intestinal parasitic diseases.

Four sites were selected for the collection of water samples. The first site was in the Betarí river, upstream from the *Bairro da Serra*, where the minimal water output is 4 m³/s.* The second and third sites were the Seco and Monjolo streams, branches of the Betarí river that run through the more populous areas of the *Bairro da Serra*. These are small streams flowing from springs, which during the draught season are practically without current. The fourth collection site was also in the Betarí river, downstream from the *Bairro da Serra* and from the confluence with the Gaúcho stream, another small branch that runs through the neighborhood.

Thirteen samples were collected on a monthly basis, from February 2002 to February 2003. One hundred milliliter samples were collected from the upper portion of the water bodies in polyethylene flasks sterilized for

*Information obtained from the Department of Water and Electricity of Registro, São Paulo State, in January 2001.

at 120°C for 15 minutes, containing 0.1 ml of thiosulphate 18% and 0.3 ml of EDTA 15%. Samples were stored at 2 to 8°C in polystyrene boxes and sent to an environmental microbiology laboratory for analysis. Analysis was performed using the multiple-tube method, through determination of most likely number (MLN/100 ml) of bacteria of the total coliform and fecal coliform groups. This technique consists in different volumes and dilutions of inoculated water samples in lactose-rich medium in series of five tubes, incubated at 35°C for 24 hours for later verification of gas production and subsequent quantitative estimation.¹

Interviews were conducted in June/July 2002. An adapted form of the questionnaire developed by Gióia⁶ (1996) was employed. Fifty-five households were included, some of which were located in the regions of greater household density, others which were located in lesser populated areas. The questionnaire comprised questions concerning water origin and treatment, trash and sewage disposal, and parasitic diseases (transmission of intestinal parasites, opinion about intestinal parasites, and knowledge of prophylactic measures). Considering that our study design required the inclusion 50% of the total households in the Bairro, we chose to select half of the sample from each side of the river, with equal spatial distribution across the neighborhood, in order to increase result reliability. The questionnaire was administered to the head of the family in each of the households visited. Field observations and research in the Iporanga Municipal Sanitary Surveillance System were also carried out.

Answers given to the questions about helminthic diseases were evaluated and classified as coherent, fair, or poor, according to the following criteria:

- The answer to the question concerning the transmission of intestinal parasites was considered as coherent, fair, or poor according to the mention of three or more, two, or only one potential form of contamination by these parasites, respectively;
- The answer to the question which qualified the subject's opinion regarding intestinal parasites was evaluated as follows: coherent – answers that showed an awareness of the seriousness of the issue at hand; fair – answers that included at least one hazardous parasite; and poor – answers that failed to show an understanding of the fact that intestinal parasitoses are diseases, rather than something common to most people;
- The answer to the question about knowledge of prophylactic measures was considered as coherent, fair, or poor according to the mention of three or more, two, or only one form of preventing contamination.

Answers were computed as categorical variables based on descriptive analyses, and percentiles were calculated. The Betarí river divides the Bairro da Serra into two parts, which differ in terms of infrastructure. The SP-125 highway and the Betarí river run parallel to each other. The river flows from Apiaí to Iporanga. Heading in this direction, the highway and the area of greater household density are located on the right bank. This area is supplied with water by Sabesp, the São Paulo State Basic Sanitation Company. On the left bank are the more scattered households, which do not have water supply due to a conflict between the Municipality and the Park with respect to the ownership of the area. Therefore, when evaluating results, it is important to consider the distribution of households between the left and right river banks.

RESULTS

We wish to emphasize that the aim of the present study is to show results indicative of environmental contamination by domestic sewage, and not of the behavioral parameters of the river and its branches, as would be the case in a traditional limnologic study.

The Table shows the median of the thirteen sample collections from each site. The use of the median attenuates the discrepancies generated by populational fluctuations due to tourism and by environmental interference. The Ribeira Valley region has high pluvial rates, which are related to the dilution of the pollutant concentrations in water bodies. Therefore, spreading the samples across the entire period, and using the median value for data presentation allows us to minimize the discrepancies related to seasonal variations in the water flow of the bodies studied.

Regarding the microbiological parameters employed, 'total coliforms' include microorganisms that indicate the occurrence of organic depuration, thus also being associated with domestic sewage. Fecal coliforms, on the other hand, are directly associated with pollution by domestic sewage, since these bacteria originate in the digestive tract of warm-blooded animals.²

According to statute 20/86 of the National Council for the Environment, in order to be adequate for domestic water supply, protection of aquatic communities, recreational activities involving direct contact, and other usage appropriate to its water body category, the Betarí river and its tributary streams must have levels up to 1,000 fecal coliforms per 100 ml or 5,000 total coliforms per 100 ml.³ The Table shows that the collection site upstream from the Bairro da Serra presents levels that may be associated with sewage

Table - Median values for total and fecal coliforms in the Betarí river and tributary streams. Bairro da Serra and surroundings, Iporanga, São Paulo State, Brazil. February 2002 to February 2003.

Sampling site	Total coliforms (mln/100ml)	Fecal coliforms (mln/100ml)
Betarí River, upstream from the Bairro da Serra	500.0	130.0
Seco Stream	24,000.0	7,000.0
Monjolo Stream	70,000.0	30,000.0
Betarí River, downstream from the Bairro and the Gaúcho Stream	900.0	220.0

coming from nearby residences, as well as with the location of the Santana Headquarters, which receives a large influx of tourists during certain periods.

The Seco and Monjolo streams show high levels of pollution, according to the legal standards. This is a consequence of the inadequate distribution of domestic sewage in the Bairro da Serra (Table).

According to the questionnaires, 69% of the households included in the survey had access to piped water. Water in the remaining households was obtained from springs or directly from the caves frequently visited by tourists and researchers. Of these, 22% filtered water before use, 15% boiled it, and 62% did not employ any type of water treatment.

Sabesp does not provide sanitation to residences located on the left bank. Of the households on that side of the river, 92% used spring water, and the remainder used water from caves. The water supplied to residences with access to piped water complied with the quality criteria established by the Ministry of Health.

Regarding sewage disposal, 91% of the households included in the study released their sewage into septic tanks, probably in a very rudimentary fashion. Of the remaining households, 4% dispose of sewage on the ground or street, and 5% directly into the river or stream. The precariousness of the septic tanks used reflects itself on the pollution of the streams.

The issue of final garbage disposal is being dealt with more appropriately. Until 2002, all the garbage collected in the municipality was sent to a dump on the bank of a tributary of the Ribeira de Iguape river, close to the center of Iporanga. In 2002 a municipal sanitary disposal unit was implemented. Our results show that garbage collection takes place regularly in the Bairro da Serra; 83% of households dispose of solid waste in plastic bags for collection, 2% in drums, also for collection, 13% burn or bury their garbage, and 2% reported using organic residues for compost and leaving the remainder for garbage collection. However, the municipal truck collects garbage only from the right bank of the river. Left-bank residents have to transport their waste to the other side of the river, which has an effect on the numbers for this area: 61% of household

waste is placed in plastic bags; 31% is burnt somewhere near the house, and 8% is buried without any prior treatment.

Concerning the transmission of intestinal parasitic diseases, only 5% of subjects had opinions considered as coherent; 33% of opinions were considered as fair, and 62% as poor. Regarding subjects' opinions about parasites, 5% had opinions considered as coherent, 27% as fair, and 68% as poor. As to prevention, 7% of subjects showed coherent knowledge, 29% fair knowledge, and 64% poor knowledge.

DISCUSSION

In light of the microbiological data presented above, it is possible to draw certain conclusions regarding the pollution of the Betarí river by domestic sewage generated in the Bairro da Serra.

The precariousness in terms of basic sanitation, the pollution of water bodies, the lack of sanitary knowledge among the population, and the prevalence of intestinal parasitoses is a consequence of the regional context into which the area is inserted.

Historically speaking, bibliographical records of the sanitation in the Ribeira Valley show that, in 1971, conditions in this respect were precarious: 82% of the population did not have access to piped water and 95% to the sewage network. At the time, it was reported that much of the valley's population did not wear shoes and drank polluted water, thus constituting "easy prey for three to seven different types of helminths". High rates of infant mortality were also reported, a problem notoriously linked to sanitary conditions^{9,11}

Hogan et al⁷ (2000) carried out a survey of demographic and sanitary conditions in the Ribeira Valley, based on data from national censuses (conducted by IBGE, the Brazilian Institute for Geography and Statistics). This study showed that, in spite of the advancements in sanitary sewage disposal, in 1991 the Ribeira Valley was still one of the most precarious regions in the state of São Paulo in terms of basic sanitation.⁷

The 2000 IBGE census shows that, 53% of all residences in Iporanga have access to piped water and

40% have bathrooms or toilets connected to the main sewage network.⁸

A study conducted in the municipality of Assis, São Paulo State, shows a correlation between basic sanitary conditions and the prevalence of intestinal parasitic diseases. The authors verified the rates of water/sewage connection in the different areas studied, and found a direct relationship in these areas with positive outcomes for intestinal parasites in stool tests performed in the population.¹⁰

An ethno-epidemiological description of an indigenous population of the state of São Paulo showed that polyparasitism is the rule among the subjects analyzed, being related mainly to the sources and treatment of drinking water.⁵

However, a socioeconomic threshold is assumed to exist, below which sanitation measures are not sufficiently prophylactic. Such infections may also occur in the domestic environment, where sanitary education, notions of hygiene, and cultural aspects are relevant to the elimination of these diseases.¹⁴

A study investigating the prevalence of intestinal parasitoses among the population of São José da Bela Vista, state of São Paulo, showed that, of 1,032 stool tests, 44.4% had positive outcomes, and that these were associated with low family income and large family size, precarious personal and household hygiene conditions, and poor knowledge concerning the prevention protozoan and helminthic diseases.¹⁶ Hence, population knowledge is one of the factors which may lead to a reduction of the prevalence of intestinal parasitic diseases. Gioia (1995) conducted a parasitological survey at the Intervalles Farm and surroundings – the preservation unit immediately adjacent to PETAR. This area is very similar, in terms of soil, climate, and human occupation patterns, to the Bairro da Serra in Iporanga. Stool tests were performed on samples from 393 subjects (almost the entire local population), and 72.5% of these harbored parasites or commensals, with an average 2.3 different species per subject. Such rates were associated with precarious knowledge and sanitation.⁶

Even though the helminths reported in the aforementioned studies were mostly geohelminths, which do not directly require water in order to reach an infective state, the precariousness of sewage disposal contributes to the perpetuation of the transmission mechanisms of such parasites. However, the measurement of levels of pathogen cysts and eggs in water samples was abandoned due to the current legislation, which favors the use of bacteria from the coliform group, acknowledging this parameter as an indicator of the conditions

of water bodies with respect to pollution and contamination by domestic sewage.

Another statistic relevant to the subject of parasitic diseases is related to schistosomiasis. According to data from SUCEN (São Paulo State Superintendence for the Control of Endemic Diseases, 2001), more than 200,000 cases of the disease were notified in the state of São Paulo in the ten years preceding the survey. Most of these cases were classified as 'imported', only 10% being autochthonous. The Ribeira Valley is one of the main areas of transmission. However, for the water bodies which were the subject of the present study, field observations and queries to health agencies did not indicate the presence of planorbids of the *Biomphalaria* genus – the intermediate hosts of *Schistosoma mansoni*, the etiological agent of the disease.¹⁵

As mentioned, the Bairro da Serra is inserted into a region with longstanding problems, historically precarious due to failures in socioeconomic development, and with few changes in terms of the occurrence of such well-known problems as intestinal parasitic diseases. The influx of tourists, which increases local population, especially during holidays, aggravates environmental conditions and exposes tourists to endemic diseases.

Czeresnia & Ribeiro,⁴ emphasize the importance of space to epidemiology. Space not only allows for the circulation of pathogenic agents, but also promotes the encounter of sources of contamination and populations in a condition of risk due to economic, cultural and social factors. In this context, the tourist can be considered as a potential introductory agent for non-endemic diseases, due to his or her condition as a biological reservoir for pathogens that, upon arrival, may be favored by the precariousness of the local scenario. As an example, Silva¹² points out that the Eltor cholera biotype, disseminated as a pandemic since 1961, has established itself endemically in several countries, including Brazil. This fact is suggestive of the importance of spatial factors in the endemic behavior of diseases.

As to the solution of the problem, the implementation of a basic sanitation structure in the area has been arrested. There is a project for a joint venture between the Municipal Government and Sabesp, in which the former would be in charge of building the collection network, and the latter of building a sewage treatment facility. However, the feasibility of such a project is barred by the matter of economic viability, a crucial element for its implementation by the sanitation company.

Still, the resumption and conclusion of activities aimed at the removal, treatment, and disposal of domestic sewage would be the most important measures

for reverting such a situation and its hazards to Public Health. These measures, which may be associated with a sanitary education program, would be aimed at informing and at changing certain habits of the local population.

Changes which took place in terms of the generation of income, engaging local residents in the tourism industry, increase the general awareness of the population. Silveira¹³ (2001) reports that, among these changes, there is an increasing concern regarding the garbage and sewage network issues. These demands are fostered by the perception of recent environmental issues in the Bairro, such as the pol-

lution of streams and the increase in waste production.

In conclusion, we have verified that the perpetuation of the transmission cycles of intestinal parasitic diseases is greatly favored by the conditions preponderant in the area, which include waterborne transmission, among others. The presence of such conditions renders the local population, especially children, at risk of contracting infectious diseases, which are highly prevalent among Bairro da Serra residents. This is not an easy problem to solve. Clinical care and medication are not sufficient, since environmental contamination and population habits tend to favor the occurrence of further systematic infections.

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