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Research Article

Assessment of the Bacteriological Quality of Drinking Water in Parks in São Paulo-Brazil in Times of Drought

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Abstract: Urban parks are socially relevant in large cities, particularly for the low-income population. In the city of São Paulo, 12 million people have approximately 100 public parks available for leisure activities, sports, and recreation. The city is currently suffering from the most severe drought in 45 years, and the public water supply is regularly interrupted in the evening. Intermittent water supply coupled with a combination of integrity issues favors the risk of microbiological intrusion associated with enteric diseases. To establish the relevance of the issue under these conditions, an exploratory study was conducted to assess the quality of the water provided at water fountains at 15 randomly chosen parks. No bacteria of the *Pseudomonas* genus were detected. *Escherichia coli* was found in one of the samples. The concentration of heterotrophic bacteria ranged from <1 CFU/mL to 23 CFU/mL. *Aeromonas spp.* were present in 33 percent of the samples analyzed. The results show that drinking water quality has been compromised, although the maintenance of residual chlorine is apparently being effective in most cases, even with rationing. It is concluded that the improper conditions found at one of the fountains requires intervention, since network structural failures may be aggravated by pressure drop episodes. Future studies should be conducted under a multidisciplinary approach, to include a geographic sampling plan with risk analysis. Given the social importance of public parks, advances in water purification technologies applied at the point-of-use must be considered.
Keywords: drinking water, waterbrone diseases, green areas, dryness, environment, public health, water microbiology, urban parks

INTRODUCTION

The socioeconomic transformations that have taken place over the last decades in Brazil, accompanied by major changes in the population's demographic profile, have been increasingly pressing the government for more efficiency in services and in public resources use [1]. That has brought new challenges to management processes, no longer limited to basic education and health needs. Recent urban riots in the city of São Paulo showed the need for a revision of public policies in order to improve means of transport and access to affordable housing located adequately near sources of income [2]. Underlying this is the land speculation issue, that marginalizes the most impoverished people from the spatial viewpoint [3] and, at the same time, reducing public spaces intended for socializing and leisure in this city [4]. Offsets to the problem include the increase in the creation of public spaces in the form of parks and greenways in Brazilian urban areas [5].

The city of São Paulo covers an area of 1523 square kilometers, where approximately 12 million people live concentrated mostly in the urban area, i.e., a little more than half of the total area. In the metropolitan area, large works have brought about opportunities for spatial rearrangement, so that, today, the city of São Paulo has approximately 100 urban parks for recreation and leisure. However, appropriate solutions commit to consider not only the availability of the space itself, but also appropriate use conditions by providing security services and assuring public health, with the supply of restrooms and drinking fountains. A previous water quality investigation carried out at these sites and in domestic connections showed the presence of *Aeromonas spp* in 6 percent of the sampled sites [6]. The city is currently suffering the effects of the most severe drought of the past 45 years. Under rationing, water supply has been interrupted regularly at night. Intermittent water supply coupled with a combination of integrity issues favors the risk of microbiological intrusion [7] associated with enteric diseases [8].

OBJECTIVE

Evaluate the bacteriological quality of water supplied by drinking fountains at parks in São Paulo.

METHOD

This is an exploratory study in which water samples were collected from water fountains at 15 randomly chosen parks in São Paulo. Collections were made between July 20 and 21, 2014, pursuant to the Standard Methods [9]. Samples were collected in sterile vials and kept refrigerated for no more than 24 hours until analysis. The membrane filter technique was used to determine the presence of *Escherichia coli*, *Pseudomonas aeruginosa*, and *Aeromonas spp*. Heterotrophic bacteria were determined using the "Pour Plate" technique [9].

RESULTS

Bacteria of the *Pseudomonas genus* were absent from all samples. *Escherichia coli* was found in one of the 15 samples (6.7%) at a concentration of 1 CFU/100mL. Heterotrophic bacteria concentration ranged from <1 CFU/mL to 23 CFU/mL. *Aeromonas spp.* were present in 5 (33%) of the samples analyzed.

DISCUSSION

The demand for more public spaces in contact with nature is a growing worldwide phenomenon [10]. The social role played by these spaces inserted in the urban context is to provide the residents of metropolises the option of visiting natural areas with green landscapes and flora and fauna. Studies have shown that these sites, while encouraging the relationship with nature through the landscape, become effective resources to increase environmental awareness and improve quality of life [11]. Research done in Cairo showed that the use of urban parks and green areas favorably impacts the users' well-being and quality of life. In particular, the greater the human poverty, the greater the satisfaction [12]. Urban parks are also often associated with sports and recreation, activities that require water availability the most. Sampling in the USA, in 2009, showed that nearly half of respondents were using parks and playgrounds. Fifty-five percent of them reported accessing water fountains regularly [13]. Distribution system deficiencies compromise drinking water quality, are associated with gastrointestinal illnesses, and worsen in water outage episodes [14, 15].

In the studied case, 11 of the 15 sampled parks (73%) had some type of contamination. These results show, therefore, the compromised quality of these sources of drinking water. The Brazilian law forbids the presence of *E. coli* in water intended for human consumption, but it was noted in one of the samples analyzed. Heterotrophic bacteria determination is required to evaluate water fountain sanitary conditions. The results found here do not show issues with regard to this parameter, since the highest value noted was 23 CFU/mL. There are no legal restrictions in Brazil for the presence of *Pseudomonas aeruginosa* and *Aeromonas spp* in drinking water. Aeromonas are natural residents in wastewater and fresh surface water and are associated with the formation of biofilm on pipe walls. The connection between *Aeromonas* and enteric diseases, however, remains debatable [8].

These preliminary findings suggest that the maintenance of residual chlorine has been effective in most cases under rationing conditions. The improper condition found in one of the fountains requires intervention proposals, since network structural failures can be aggravated by pressure drop episodes [7].

Recreational fountain contamination at public parks is common not only by heterotrophic bacteria [16], but also by protozoa, accountable for severe epidemic episodes of gastrointestinal illness associated with the summer in the USA [17]. Drinking fountains, on the other hand, are supplied by public networks and normally have unsuspected conditions, favoring use by vulnerable populations such as children and the elderly. Ensuring quality using water purification technologies applied at the point-of-use is a promising option, but its current benefits are debatable [18] and technological development is still required [19]. Consequently, there should be a biological sampling plan at these sites, guided by a map and under a risk-based approach [20] in order to detect not only nonconformities, but also the best forms of physical intervention in the distribution system.

CONCLUSION AND FUTURE STUDIES

This pilot study supports the following primary conclusion: (1) Intermittent system operation has led to transitory intrusion events; (2) The limited presence of heterotrophic bacteria in most samples suggests that adding additional chlorine has been sufficient to limit, but not prevent, possible consequences of biofilm removal, and (3) residual disinfection is not enough for situations involving serious integrity problems at the water fountains.

Future studies should be conducted under a multidisciplinary approach in such a manner as to include a geographic sampling plan with risk analysis. Given the social importance of public parks, advances in water purification technologies applied at the point-of-use must be considered.

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