ASSESSMENT OF MICROBIOLOGICAL QUALITY AND SANITARY STATUS OF SWIMMING POOLS IN IBADAN, NIGERIA
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Abstract
The prevalence of recreational water illnesses contracted through the use of swimming pools is a public health concern worldwide. In many developing countries, there is a dearth of information on the microbiological quality and hence the sanitary status of swimming pools. Five swimming pools selected for the study in Ibadan were stratified by facility type into: Hotel/Guest House Facilities(HGHF), Recreational Facilities(RF) and Student Facility(SF). Water samples were collected from each facility and analysed to ascertain their physico-chemical and microbiological quality. Results showed that the mean turbidity of the pools were above the WHO guideline. Also, the mean pH values of samples from RF and SF facilities were above permissible limit. The mean coliform count of water samples from the selected swimming pools were above the WHO Guideline limit, thus signifying contamination. *Escherichia coli* and *Staphylococcus aureus* were isolated from RF, HGHF and SF while *Pseudomonas aeruginosa* was also isolated from the HGHF and RF. Only one facility was observed to have clear water such that the pool bottom could be seen clearly from the deck; availability of constant water supply was often a problem at the students’ facility. The study recommends improvement in personal hygiene of swimmers, adequate disinfection of the pools and enforcement of standards by government.

Keywords: Ibadan, microbial quality, sanitary status, swimming pool,

Introduction
Swimming is recognized as one of the most beneficial forms of exercise yet, recreational waters such as swimming pools present risks to health (World Health Organisation, 2003). The prevalence of recreational water illnesses contracted through the use of swimming pools is a global public health concern. The fact that swimming is gradually gaining popularity especially among the young people in Nigeria cannot be disputed. Swimming as an essential skill has been introduced into the curriculum of many schools in Nigeria. Also swimming has become a prerequisite for employment in certain sectors like aviation, marine, oil drilling and prospecting. More and more people are learning to swim because of the health benefits associated with swimming hence it becomes imperative to ensure that public swimming pools are well maintained and properly disinfected.

If the swimming pool is not properly maintained, it becomes contaminated and can lead to the spread of infectious diseases. In many cases, the risk of illness or infection has been linked to faecal contamination of the water. According to CDC (2001), faecal contamination may be as a result of Accidental Faecal Release (AFR) by swimmers or the presence of residual faecal material on swimmers’ bodies. Infected swimmers can directly contaminate the pool and surfaces of objects or materials at a facility with pathogens (notably viruses or fungi), thus leading to skin infections in other swimmers who come in contact with the contaminated water or surfaces. “Opportunistic pathogens” (notably bacteria) can also be shed from users and transmitted via surfaces and contaminated water (WHO, 2006). Also, poor personal hygiene by swimming pool users can further contaminate the pool water thus exposing swimmers to recreational water illnesses such as skin, ear, respiratory, eye and wound infections and
diarrhoea. In many developing countries including Nigeria, there is a dearth of information on the microbiological quality and hence the sanitary status of swimming pools. This study therefore assessed the microbiological quality and sanitary conditions of swimming pools in Ibadan, Nigeria.

Methods
The study was carried out in Ibadan, the capital of Oyo state Nigeria. Ibadan city is located at 7° 23'0"N, 3° 56' 0" E in the south western Nigeria. The climate is characterized by a rainy season from March to October, while dry season stretches from November to February. The study was a laboratory based descriptive cross-sectional study. Ten swimming pools in existence within Ibadan metropolis at the time of study were stratified by facility type into three viz: Hotel/Guest House Facilities (HGHF), Recreational Facilities (RF) and Student Facility (SF). Three swimming pools from seven HGHF Facilities and one swimming pool from two RF Facilities were randomly selected by balloting; while the only swimming pool used as a Student Facility (SF) was purposively selected. Water samples were collected from each of the five swimming pools into sterile bottles containing 0.1ml of 3% sodium thiosulphate solution at 11am and 4pm on Saturdays and Tuesdays for a period of four weeks. A total of 80 samples were collected for microbial analysis. As much as possible, samples were collected during periods of peak use when swimmers were in the water. Samples were stored in ice box after collection and analysed for bacteria (total coliforms, *Escherichia coli*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*) and fungi (*Aspergillus*, *Fusarium*, *Penicillium*, *Mucor* and *Rhizopus*) using standard methods within six hours of collection in the laboratory. In addition, the sanitary status of the pools was assessed by observation with the aid of an observation checklist. Ethical issues were well taken care of. Data obtained was analyzed using descriptive statistics, Chi-square test and ANOVA. The level of significance was set at 5%.

Results
Table 1 shows the microbiological characteristics of swimming pools in the three facility categories. None of the facilities met the WHO standard of coliform <1cfu/100ml. For the fungal counts, all the mean values were less than 200cfu/ml, even though there were some individual samples with values greater than 200 as shown in the range values. *Escherichia coli* and *Staphylococcus aureus* were isolated from the RF, HGHF and SF while *Pseudomonas aeruginosa* was also isolated from the HGHF and RF facilities. Figures 1and 2 show the percentage occurrence of bacterial and fungal indicators in the three swimming pool categories. The mean microbiological counts in water samples were compared across the three swimming pool categories using ANOVA (Table 2). There were no significant differences between the mean coliform counts (p >0.05) across the three categories. Figure 3 shows the mean coliform count of water samples from the three swimming pool categories.

![FIGURE 1: Percentage occurrence of bacteria indicators in the three swimming pool categories](image-url)
Table 1: Microbiological characteristics of Swimming Pools

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Recreational</th>
<th>Hotel/Guest house</th>
<th>Student</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Range</td>
<td>Mean</td>
</tr>
<tr>
<td>Coliform count (Cfu/100ml)</td>
<td>13.3 ± 8.7</td>
<td>5-25</td>
<td>8.3 ± 9.3</td>
</tr>
<tr>
<td>HPC (Cfu/ml)</td>
<td>8.3 ± 1.9</td>
<td>7-11</td>
<td>169.5 ± 71.7</td>
</tr>
<tr>
<td>Fungal count (Cfu/ml)</td>
<td>2 ± 0</td>
<td></td>
<td>2.3 ± 1.0</td>
</tr>
</tbody>
</table>

Table 2: Comparison of mean microbiological quality of the three swimming pool categories

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Recreational</th>
<th>Hotel/Guest house</th>
<th>Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPC (Cfu/ml)</td>
<td>8.3 ± 1.9</td>
<td>169.5 ± 71.7</td>
<td>74.5 ± 119</td>
</tr>
<tr>
<td>Cfu/ml</td>
<td>1.9 ± 71.7</td>
<td>± 119</td>
<td>4.1 ± 5</td>
</tr>
<tr>
<td>Fungal count (Cfu/ml)</td>
<td>2 ± 0.0</td>
<td>2.3 ± 1.8</td>
<td>1.8 ± 0.1</td>
</tr>
<tr>
<td></td>
<td>1.0 ± 2.1</td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

The observation checklist provided information on the general state of swimming pools and its sanitary conveniences, the presence and functionality of equipment used for swimming pool maintenance. All the swimming pools were rectangular in shape with varying degrees of algal growth. Most of the pools were turbid and odourless. However only one swimming pool from the hotel/guest house facility had clear water such that the pool bottom could be seen clearly from the deck. All the selected swimming
pools had clean surroundings. Few had refuse bins placed at strategic positions.

All the swimming pools had toilets, showers and change rooms but constant supply of water was often a problem at the swimming pool located in the student premises. All the swimming pools had functional vacuuming machines but only a few had functional filters. Pool skimmers and drains were present but not functional in most of the swimming pools.

**Discussion and Conclusions**

**Discussion**

Data from the study revealed that coliforms were present in all three categories of swimming pools. The mean coliform count of water samples from the selected swimming pools were above the WHO Guideline limit of <1cfu/100ml, thus signifying contamination. The presence of significant numbers of coliforms in swimming pool water indicates either deficiencies in the treatment of the swimming pool or inadequate protection of the source of untreated water (Borchardt and Walton, 1971). In a similar study in Nigeria, Itah et al, (2004) also isolated coliforms in swimming pools in Calabar. The mean heterotrophic plate count values of the three categories of swimming pools were all below the WHO standards of <200/ml. However the hotel/guest house facilities exceeded WHO limit in the first week (265cfu/ml) while the student facility exceeded the limit in the third week (253cfu/ml). This could be due to increased bather load during those weeks resulting in greater levels of contamination and thus requiring higher levels of disinfection.

The three selected bacterial indicators (Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa) were isolated from the student and hotel/guest house facilities. *E coli* and *Staph aureus* were the only bacterial indicators isolated from the recreational facility. The presence of *Pseudomonas aeruginosa* and *Staphylococcus aureus* indicate non-faecal contamination. These findings are supported by Robinton and Mood (1966) who found that *S. aureus* was shed by bathers under all conditions of swimming, and the bacterial can be found in surface films in pool water.

The warm moist environments on decks, drains, benches and floors around the pools are ideal for the growth of *Pseudomonas aeruginosa*. According to WHO (2006), it is likely that swimmers pick up the organism on their hands and feet and transfer them to the water. The results of this work are supported by the findings of Moore et al (2002) who isolated *Pseudomonas aeruginosa* from 38% of swimming pools examined in Northern Ireland.

The presence of *Escherichia coli* in the three categories of swimming pools indicate faecal contamination because *E coli* is exclusively faecal in origin (Okafor, 1985) and this corresponds with the findings of Itah et al,(2004) who also isolated *Escherichia coli* from swimming pools in the South Eastern states of Nigeria (Akwa Ibom and Cross River). The presence of *E coli* in water is a strong indication of recent faecal pollution because of the extra enteral behavioral pattern of this organism (Itah et al, 1996). The isolation of these indicator bacteria from the swimming pools indicates the possible presence of enteric pathogenic bacteria. This constitutes a public health hazard because some swimmers accidentally swallow pool water while swimming. Ingestion of such contaminated waters could lead to outbreaks of disease such as diarrhoea, cholera, typhoid fever and gastroenteritis.

Fungal isolates from the swimming pools include species of *Aspergillus, Penicillium, Fusarium, Mucor and Rhizopus*. Some species of *Aspergillus* and *Penicillium* may cause opportunistic infections in man. This is in consonance with the findings of Maghzay et al (1989) and Nanbakhsh et al (2004) who also isolated these species of fungi from public swimming pools in Egypt and Iran. *Fusarium* is known for occular infections in humans and
animals (Prescott et al, 2002). These organisms may have been introduced into the swimming pools by infected bathers. Another reason for the presence of these fungi is the fact that there were no facilities for foot disinfection before swimming so swimmers do not disinfect their feet before swimming.

There were no functioning filters in some swimming pools in the three swimming pool categories and this was evident because most of the swimming pools had turbid water and the bottom drains could not be clearly seen from the deck. Constant water supply was equally a problem in many swimming pools especially in the student facility and this could discourage swimmers from pre-swim showering and the use of toilet facilities at pool side.

Conclusions
The study has revealed the ineffectiveness of pool water disinfection in Ibadan due to the fact that coliforms, *E coli* and other pathogenic bacterial and fungal indicators were isolated from the three categories of swimming pools. It could therefore be concluded that the sanitary status of the selected pools was below international standards. The study recommends improvement in personal hygiene of the swimmers, adequate disinfection of the pools and enforcement of national/international guidelines by government.

References


**Disclosures**

Authors have nothing to disclose