Bacterial Colonization of Students’ Bath Towels in a Tertiary Educational Centre in Owo, Nigeria

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ABSTRACT

Bath towels are designed to assimilate profuse amount of moisture and in the process may also absorb microorganisms that are present. These microorganisms remain viable and multiply within the moist towel to become vehicles for the transmission of infectious agents especially through contaminated hands to food, household items and the surrounding environment. The study was intended to know the level of bacterial colonization of bath towels of students in a tertiary educational institution in Owo, Ondo State. Students’ bath towels were swabbed with cotton wool-tipped swab sticks and teased into 5 mL sterile 0.85% sodium chloride. This was diluted ten-folds serially: $10^{-1}$, $10^{-2}$, $10^{-3}$... $10^{-10}$, and 0.1 mL each was inoculated onto standard bacteriological media. The cultures were incubated at 37°C overnight before reading. Bacterial counts increased significantly (p<0.05) from $3.4 \times 10^5$ in first week of laundry to $2.9 \times 10^9$ in towels laundered after three weeks of use. Staphylococcus aureus (74.3%) was the predominant isolate. Escherichia coli (20.2%) was the next frequently recovered microorganism. Other isolates were Klebsiella species (3.7%) and Pseudomonas aeruginosa (1.8%) was the least recovered organism. The isolates were most susceptible to pefloxacin, except Pseudomonas aeruginosa that had better susceptibility to gentamycin. The high level of bacterial colonization of bath towels with some of the regular microorganisms implicated in most human diseases brings to fore the urgent need for education on the basics of the bath towel hygiene.

Keywords: Bath towels, colonization, contamination, hands, infection.

INTRODUCTION

Towels are generally produced from cotton fibres that are characteristically designed for use in clammy environments in comparison to other varieties of textiles for every day purpose [1]. As a result of the efficaciousness for imbition of water and the diaphoretic potential, towels are often employed to rapidly remove copious moisture from the body and hands after washing and surfaces of inanimate objects. This correspondingly leads to the assimilation of microorganisms with films of water and their viability in the textiles become veritable channels for the transmission of infectious agents, including multidrug-resistant, MDR bacterial species [2-4]. The standard towel in the home or public arena has been recognized as being accountable for the transfer of pathogenic microorganisms in the home, healthcare institutions and within the community [5-6]. The realization that re-useable towels contribute to inadequate hand hygiene that is traceable to illnesses in developing countries is central to the drive for the elimination of the re-useable towel from restaurants and other public places [7] and replacement with hand dryers after hand washing [8]. Current literature indicates that antimicrobial impregnated textiles and redesign of the mopping towels are being considered for use in healthcare settings as a sustainable means to put under check the ever rising cases of hospital acquired infections, HAI’s world-wide [9-10]. The basic understanding of hygiene as it relates to re-useable towels is purely embedded in the relationship between a constantly clean environment and liberty from infectious agents [11]. The exclusion of infectious agents from all varieties of textiles is an essential component of good laundry practices, in addition to

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the removal of stains, grit and grease [12]. The desire to eliminate pathogenic microorganisms from all types of clothing and the displacement of hand towels with dryers attained a very high level of consciousness during the SARS-CoV-2 pandemic [13], and the part textiles could play in the spread of infectious materials were made prominent [14]. The study was initiated to evaluate the bacteriological cleanliness of bath towels of students in a tertiary educational institution in Owo, Nigeria.

MATERIALS AND METHODS

Population: This consisted of Achievers University students of both sexes living on campus who gave informed consent and ethical approval was obtained from the Ondo State Ministry of Health (Ref. No. OSHREC 04/09/2023/579) issued September 04, 2023.

Sample Collection: A sterile cotton wool-tipped swab stick was moistened with sterile distilled water, this was used to swab an area of the towel measuring 5 cm by 5 cm, and data on laundry frequency and care were collected.

Processing of Samples: Each sample was teased into 5.0 mL sterile normal saline and thereafter diluted ten-folds, 10−1, 10−2, 10−3...10−10. From each dilution was inoculated 0.1 mL onto well dried plates of nutrient agar (Oxoid CM 003), blood agar (Oxoid CM 005) and MacConkey agar (Oxoid CM 0037) plates. The plates were incubated at 37°C overnight and examined for growth. Colony forming units (cfu/cm²) were determined from the nutrient agar and blood agar plates that yielded between 3 and 30 colonies and the mean count was recorded. Characterization and identification of isolates was affected by applying the scheme described by [8] and sensitivity tests were done by the Kirby-Bauer disc diffusion technique.

RESULTS

The microbial load of students’ bath towels and frequency of laundry is presented in Table 1. The bacterial counts in the towels ranged from 3.4 x 10^4 cfu/cm² for towels that were washed weekly and 3.8 x 10^5-4.3 x 10^6 cfu/cm² with between 59% and 66% for both male and female students respectively washing their towels fortnightly. The number of students that washed their towel after 3 weeks of use were 35% of the males and 19% of females. The microbial counts were not significantly different (X^2 p>0.05) for both sexes. There were only two male students who indicated washing their towels once every month with a mean counting 2.9 x 10^4 cfu/cm³.

Table 1: Frequency and microbial load of students’ bath towels

<table>
<thead>
<tr>
<th>Interval (weeks)</th>
<th>Male (n = 100)</th>
<th>Female (n = 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of cases</td>
<td>Count cfu/cm³</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>3.4 x 10⁴</td>
</tr>
<tr>
<td>2</td>
<td>59</td>
<td>3.8 x 10⁴</td>
</tr>
<tr>
<td>3</td>
<td>35</td>
<td>5.7 x 10⁵</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2.9 x 10⁵</td>
</tr>
</tbody>
</table>

The sex distribution of pathogenic bacterial isolated from both sexes of students is presented in Table 2. Staphylococcus aureus was the most frequent microorganism isolated (74.3%) with more females’ towel colonization (42.7%) compared (31.0%) from the male students. Escherichia coli was the next commonest isolate with larger number of isolates 12.6% in males compared to 6.7% from females. Klebsiella species colonized more towels from male students while Pseudomonas aeruginosa was found in only in male students’ towels.

Table 2: Sex distribution of bacterial isolates from body towels of students (%)

<table>
<thead>
<tr>
<th>Isolate</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus aureus (n=76)</td>
<td>32 (31.0)</td>
<td>49 (42.7)</td>
</tr>
<tr>
<td>Escherichia coli (n=22)</td>
<td>13 (12.6)</td>
<td>9 (8.7)</td>
</tr>
<tr>
<td>Klebsiella species (n=3)</td>
<td>5 (1.9)</td>
<td>1 (1.0)</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa (n=2)</td>
<td>2 (1.9)</td>
<td>0 (0.0)</td>
</tr>
</tbody>
</table>

The susceptibility of the isolates to antibacterial agents is displayed in Table 3. The most valuable antibiotics against Staphylococcus aureus were pefloxacin (81.6%), azithromycin (72.5%) and gentamycin (64.5%). The susceptibility of Escherichia coli was highest with ofloxacin and pefloxacin while sensitivity profile was seen against Klebsiella species with pefloxacin and gentamycin. Pseudomonas aeruginosa isolates showed better susceptibility with gentamycin.

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The bacteriological examination of students’ bath towels showed that the towels were colonized by major pathogenic microorganisms that are regularly recorded in many human diseases with counts ranging from $3.4 \times 10^8$ to $2.9 \times 10^9$ cfu/cm$^2$. Similar observations have been reported in body towels [15]. Although, much lower bacterial loads have been recorded from other varieties of textiles in the healthcare environment [14]. The bacterial load in these body towels rose significantly (p<0.05) with longer intervals of laundry. This indicates that longer laundry internals while in-use correspondingly increases the microbial load. Thus, thus evokes such towels into fomites status and the consequent risk of being a vehicle for the transmission of infectious microorganisms from contaminated hands to food in the household and surrounding surfaces as other studies have revealed [5, 16-17]. Majority of students (89%) in the study population had no clear knowledge of the bath towel hygiene minimum standards - that bath towels should be dried completely after each use and must not be left in the bathroom or in a moist environment and laundered after every three to five uses, but these students had based laundry intervals on when the towel looked physically dirty or developed an unpleasant odor, at which point, the towel has become a fomite with enormous potential for the transference of infectious agents.11

Four genera of pathogenic microorganisms were isolated with Staphylococcus aureus (74.3%) being the predominant isolate. Staphylococcus aureus is a regular human colonizer that can be found in the anterior nares of as much as 60% in some populations and associated with a wide range of human infections that can vary from minor superficial to severe illnesses that could lead to fatality [18-21]. Transference of Staphylococcus aureus through contaminated hands from such towels to food may serve as antecedent to foodborne diarrheic illness that has been observed from other studies [7]. Escherichia coli (20.2%) was the next most frequently encountered microorganism and as a typical enteric bacterium, represents a sign of faecal contamination of the towels. Studies have revealed that the presence of intestinal bacteria in towels play a definite role in the contamination process in a household.10 Escherichia coli in the hands can be transferred to food and where this involves an entero pathogenic strain of Escherichia coli (EPEC) into infant formula, the initiation of a devastating form of infant diarrhea becomes inevitable [22-23]. The presence of Escherichia coli in bath towels particularly of female students is portentous of infection risk as one the primary microorganisms that is often incriminated in asymptomatic urinary tract infections in young non-pregnant and pregnant women [24-25]. The colonization of bath towels by Klebsiella species further buttresses the degree of unhealthiness of these towels. Klebsiella species generally colonize the intestinal tracts of humans, animals and bodies of natural waters and decaying organic matters. Many species are reputed for multidrug resistance. The presence of Klebsiella species in bath towels is a reflection of the poor sanitary conditions that may pose infection hazard especially from contaminated hands acting as channels for infection [26-28]. The ability of Klebsiella species to initiate human infections when introduced through a vulnerable site and, coupled with the observation that this microorganism is capable of posing a peculiar clinical difficulty due the ample endowments for intrinsic multidrug resistance [29-34] and most species are also implicated in both community acquired, CA and hospital acquired, HA urinary tract infections [35-39]. Although, Pseudomonas aeruginosa was the least in the proportion of isolation and was also recovered from towels used by male students that were not washed until after three weeks of use, shows that Pseudomonas aeruginosa will regularly colonize unsanitary bath towels. Pseudomonas aeruginosa is an important organism which is notoriously very resistant to many antimicrobial agents and a major agent in HAIs [38-41]. This makes such colonization of bath towels a prime source of infection risk [37-41].

CONCLUSION

Each of the isolated microorganism from the bath towels are some of the most frequent initiators of human infections globally that can be both opportunistic in the community infections and in the hospital environments. This study further accentuates the urgency to create greater awareness to members of the community on the essence of the bath towel hygiene and the guiding principles for a healthy bath towel.

Table 3: Antibacterial agent susceptibility tests of isolates

<table>
<thead>
<tr>
<th>Isolates</th>
<th>OFX</th>
<th>PEF</th>
<th>SPX</th>
<th>CN</th>
<th>CAZ</th>
<th>CTX</th>
<th>AZM</th>
<th>AMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus aureus</td>
<td>44.7</td>
<td>81.6</td>
<td>51.3</td>
<td>64.5</td>
<td>56.6</td>
<td>60.5</td>
<td>72.5</td>
<td>2.7</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>63.5</td>
<td>72.2</td>
<td>40.9</td>
<td>45.5</td>
<td>54.5</td>
<td>50.0</td>
<td>40.9</td>
<td>0.0</td>
</tr>
<tr>
<td>Klebsiella species</td>
<td>33.3</td>
<td>66.7</td>
<td>33.3</td>
<td>66.7</td>
<td>33.3</td>
<td>0.0</td>
<td>33.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>50.0</td>
<td>0.0</td>
<td>50.0</td>
<td>100</td>
<td>50.0</td>
<td>50.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

The bacterial isolate was tested against six different antibiotics, 50.0 µg each, at a concentration ranging from 0.0 to 2.0 µg/ml, respectively. These were ofloxacin (OFT), ceftriaxone (CTX), azithromycin (AZM), ampicillin (AMP), and others. The results were interpreted as per the disc diffusion method based on the diameter of the zone of inhibition. Each of the isolated microorganism were subjected to antibiotic susceptibilities tests using Kirby-Bauer disc diffusion test method. The bacterial isolates were obtained from the study participants at the time of demographic and clinical data collection. The presence of Escherichia coli in infant formula, the initiation of a devastating form of infant diarrhea becomes inevitable [22-23]. The presence of Escherichia coli in bath towels particularly of female students is portentous of infection risk as one the primary microorganisms that is often incriminated in asymptomatic urinary tract infections in young non-pregnant and pregnant women [24-25].
REFERENCES


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