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Original Article

Prevalence of Bacterial Flora Associated with Earphones Used Among Students of University of Tripoli, Libya

Hamida El Magrahi*, Abir Ben Ashur, Asma Elkammoshi, Malak Elgani, Wafe Zriba

Department of Medical Laboratories Sciences, Faculty of Medical Technology, The University of Tripoli, Tripoli, Libya.

Corresponding Email: hamidasadkali@gmail.com

ABSTRACT

Background: The majority of students today are more fascinated by new technology. The most trending digital appliance among students is headphones. The use of earphones has become more and more popular among students this can easily be a vector of possible pathogens that can give rise to serious disease. Objective: This study was conducted to determine the bacterial contamination on earphones and external ear of students and to assess the awareness amongst the students of the importance of cleaning earphones. **Methods:** The study was performed at University of Tripoli from June to September 2020. A total of 50 swabs were collected from student's ear canal and earphone. The samples were cultured according to the standard microbiological procedures. Isolates were identified by conventional identification methods. The questionnaire was submitted to all participants to collect information on the extent of usage of earphones. **Results**: The results showed that the most isolated organisms were gram-positive bacteria which were found in 48(96%) ear canal, and 46(92%) earphones of the students.; Gram-negative was detected in 2(4%) and 4(8%) of the ear canal, and earphone, respectively. Staphylococcus aureus, Staphylococcus epidermidis was the most frequently identified microorganisms. **Conclusion**: This study showed that earphones are potential carriers for the spread of many pathogens. Frequent and constant use of earphones increases the bacterial growth in the ear and sharing of earphones that may be able to produce serious disease. It is advised to maintain earphones clean and not to share.

Keywords: Associated bacteria; Earphones; Ear Infections, Students.

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INTRODUCTION

Nowadays, earphones have become one of the most important professional and social life accessories [1]. There is a drastic increase in the use of earphones especially among teenagers and has become widespread in sharing among college students [2]. Earphones are a technology used by young people but all today use them without acknowledging the associated health risks [3]. Many studied have been mentioned that the use of earphones, is a potential reason for aural hygiene problems and infection in

the ear canal [4]. There were several reports on earphones where there was a strong connection between usage of earphones and the occurrence of otitis externa especially among the undergraduate students who have a high rate of share among them [5]. Almost every surface of adult human skin is covered with several microflorae and sometimes exposed to pathogenic microbes [6]. Frequent use of these earphones significantly increases the bacterial flora in the ear. This is because when earphones are used constantly, they increase the temperature and humidity of the ear canal. This becomes an ideal environment for the bacteria to grow. [7].

Wearing earphones that not cleaned properly and regularly may act as a reservoir of microorganism's colonies that can be transmitted into the ear canal [8]. Furthermore, sharing earphones with others can disperse bacteria between people. Besides, certain earphones are coated with rubber or soft sponges that accumulate several microbes. These microbes enter the ear canal when they are used [9], The human ear canal has a self-cleaning properties structure as the cerumen coat migrates laterally and sloughs externally [10]. Using earphones in to excessive cleansing of the canal predisposes lead to infection in 2 ways. First, the act of removing cerumen, even using one's fingernail, maybe traumatic, as it can abrade the canal skin and allow the introduction of bacteria. Secondly, the removal of cerumen leads to the disruption of this protective barrier [11]. The external auditory canal normally has many common commensals bacterial flora of the ear, that residents are predominantly non-pathogenic and mostly aerobic, including Staphylococci species and the Corynebacterium species the third were Streptococci species and Pseudomonas aeruginosa. Together, they account for more than 90% of the normal flora in the external auditory canal [12].

These mobile earphones that are shared by students often become carriers and may serve as vectors and spread microorganisms and lead to otitis externa [13]. A cross-sectional study was carried out to isolate and identify associated bacteria from earphones and external ear of students at University of Tripoli and to determine the value of earphone cleaning knowledge among students.

METHOD

Study design and patient setting

This is a prospective study was conducted at University of Tripoli, Faculty of Medical Technology, from June to September 2020, and was approved by the Research Ethics Committee. A total of 50 students who use earphones were randomly selected (n=50) samples were taken from the ear external canals of healthy students and others (n=50) were from their used earphones.

A questionnaire was used for data collection. this questionnaire gave details about: How long of duration does one use earphones in a day? Do you share your earphone with someone else? The rest of the questions were on awareness of earphones use.

On the other hand, Samples were collected using sterile cotton swabs after that swaps were soaked in 2ml normal saline in a sterile plain container vortexed well to ensure all micro-organisms diffuse in normal saline, and 100µl of each sample was immediately spread on prepared nutrient agar plates and aseptically sub cultured onto differential media Blood agar. This enriched medium was used to support the growth of pathogens that require additional nutrients.

Besides selective and differential media Mannitol salt agar was used to differentiates Staphylococci spp. At the laboratory, the plates were incubated at

37°C for 48 hours and observed for growth and colonial description of the isolates.

The bacterial isolates were examined for colonial identification, according to the standard microbiological methods. Characteristics Morphological description of colonies, Gram staining, and biochemical reactions was performed to identify the isolated bacteria; Such as catalase test, coagulase test, oxidase test, and Bile - esculin test [14].

Statistical analysis

The pre-structured questionnaire with multiple choice questions was used to collect data from the participants after taking their consent. An analysis was done by using Excel and SPSS software. (Armonk, NY: IBM Corp).

RESULTS

Table (1) shows the duration of daily usage of earphones, amongst the 50 students who were a part of the study, 35 (70%) use earphones for more than three hours per day 3-4 hours. Out of the remaining percentage of students, 10 (20%) using over earphones for 1-2 hours and 5(10%) using for 5- 6 hours. Table 2 illustrates the bad habits associated with respondents with a usage of earphones. During the study, it was discovered that 36 (72%) were unaware of the sharing of unclean earphones with family. Around 4 (8%) of the respondents were also not aware to share their unclean earphones with other students. While 10 (20%) students never shared their earphones with anyone.

The present study demonstrated that 32% of the students didn't sanitize their earphones. Meanwhile, about half 50% of the students didn't clean the inside their earphone, similarly, 50% of the students said there are not let the earphone to be dry completely before the store or wear them. over half 58% of the students didn't keep their earphones in a pocket or bag when not in use, while 88% of the students didn't change a rubber cover, every two months.

Table1: Shows daily hours spent by respondents on devices with earphone

Daily hours spent on earphone.	Percentage of respondents
1-2 hours	10 (20%)
3-4 hours	35 (70%)
5-6 hours	5 (10%)

Table 2: Shows some bad habits associated with respondents with a usage of earphones

Parameters	Response	Number	percentage
Do you share your earphone with someone else?	Family	36	72%
	Best friend	4	8%
	Personally	10	20%
	Yes	**No**	P value
Do you sanitize your earphone?	10(20%)	16(32%)	0.000
Do you clean the inside your earphone?	13(26%)	25(50%)	0.000
Do you let the earphone dry completely before you store, or wear them?	14(28%)	25(50%)	0.000
Do you keep your earphone in a pocket or bag, when not in use?	8(16%)	29(58%)	0.000
Do you change a rubber cover, every two months?	2(4%)	44(88%)	0.000

The results also showed that Gram-positive bacteria are the most common bacteria isolated from the ear canal of healthy students and their earphones with 48(96%), 46(92%) respectively. The rest of the isolates were from negative bacteria gram group that were detected in 2(4%) and 4(8%) of ears canal, and earphones, as shown in Table 3.

Amongst the bacterial isolates, *Staphylococci aureus* had the highest occurrence with 21(42%) from the ears canal, and in 19(38%) of earphones followed by *Staphylococci epidermidis* 19(38%) ears canal, and in 17(34%) earphones. *Enterococci faecalis* was found at 2(4%) ears canal, and with 3(6%) in students' earphones. Whereas the last isolated species recorded with the lowest percentage were *Streptococci pyogens, Corynebacterium spp, Pseudomonas aeruginosa*. However, the isolated organisms can become pathogenic if the conditions become congenial.

Table 3: Distribution of isolates bacteria according to types and species.

Type of isolates	**Ear canal n = 50 (%)**	**Earphone n = 50 (%)**
Gram positive	48(96%)	46(92%)
Gram negative	2(4%)	4(8%)
Species of isolates		
Staphylococci aureus	21(42%)	19(38%)
Staphylococci epidermis	19(38%)	17(34%)
Enterococci faecalis	2(4%)	3(6%)
Streptococci pyogens	2(4%)	3(6%)
Corynebacterium spp	4(8%)	4(8%)
Pseudomonas aeruginosa	2(4%)	4(8%)

DISCUSSION

In this study, several microorganisms were isolated, some were real pathogens and others were normal flora and commensal at the skin. These pathogens may become disease-prone when they have the opportunity to do so. *Staphylococcus aureus, Staphylococcus epidermidis*, and others Table 3 were the main bacterial isolates frequently associated with earphones. These organisms may have found their way to the earphone through the skin and from hand to hand contact. These organisms are the normal microflora that resides on the skin which was mentioned earlier [15].

This study shows no differences in positive bacterial cultures between the earphone and ear canal for all participants. Gram-positive was the most common organisms of earphone at 46(92%) and in the ear canal with 48(96%), followed by Gram-negative 2(4%) in the ear canal, 4(8%) at earphone. That might be due to unaware of students of not to share earphones and forget cleaning their earphones which can harbor different types of microbes.

A variety of studies referred to that earphone use was investigated as a possible cause of aural hygiene problems and ear canal infections [16,17,18]. In recent years, the use of earphones by students has increased. As its continuous use will increase the temperature and humidity of the canal, and provide a vector for the introduction of organisms into the skin of the canal, it may have been a possible predisposing factor for an external ear infection and establish the potential for skin abrasion [19].

Another study which was conducted to determine the association of using earphones with bacterial growth showed that 68% of samples from earphones had growth [1] In comparison with the studies mentioned above, our study showed a high percentage of bacterial growth (100%). In the present study, the high prevalence rate of the isolates was *Staphylococcus* with 21(42%) from ears canal, and in 19(38%) of earphones, this finding corresponds well with the other similar studies with the stethoscope [16] and the airline headset [17] where *Staphylococcus* (63% and 55% respectively) was the most widespread isolate.

Staphylococcus aureus was the bulk of the isolates, which consider the most frequently a normal skin flora, that may well be a pathogen if the condition is congenial. Lower quality or misuse can lead to abrasion and a rupture of the skin that can be an infection portal. In the study, we also found that the positive relationship between bacterial growth and frequency and duration of use by earphones was also shown in both ear and earphones, which is significantly higher in bacterial growth. An important conclusion of this study is the incidence of greater colonization with continuous and frequent usage of earphones.

CONCLUSION

In this study, the occurrence of bacterial flora is high when people prefer to share or not clean earphones regularly. In conclusion, frequent and constant use of earphones increases bacterial growth in the ear, particularly if there is an abrasion in the outer ear. Contaminated earphone is capable of transmitting bacteria that can cause serious illness. Therefore, it is strongly advised that earphones should be properly sanitized with antiseptics before and after each use to help reduce the incidence of disinfectants.

Recommendation

Education campaigns of hygienic practices are highly recommended for university students to increase their awareness about bacterial contamination of earphones and devices. Routine cleaning of headphones may be effective in reducing bacterial contamination. In the future, earphones could be produced with protective material against bacterial contamination.

Declaration of interests.

We declare no competing interests.

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