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PREVALENCE AND RISK FACTORS OF MOBILE PHONE BACTERIAL CONTAMINATION AMONG FACULTY HEALTH SCIENCES STUDENTS

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ABSTRACT

Background: Mobile phones are an indispensable tool in students' academic and daily lives, and their frequent use makes them a potential means of transmitting bacteria from users' hands.

Objectives: This study was conducted to identify bacteria present on touch screens of smartphones and to determine potential factors that may influence bacterial contamination of mobile phone surfaces with bacteria and the level of students' awareness of the role of immune blood cells against these bacterial agents of students of the faculty of Health Sciences in Al-Khums city.

Methods: The study was conducted at the faculty of Health Sciences from November 2024 . 200 swabs were collected from 200 mobile phones, and a questionnaire was distributed to all participants to collect data. Swab samples were taken from participants' phones and cultured to identify bacterial contamination in the college's medical laboratory. Samples were cultured on blood agar and incubated at 37°C for 24 hours. Bacterial isolates were identified using conventional bacterial species identification methods.

Results: Our results showed that the mobile phone contamination rate with microorganisms reached 95.7%, with 282 microbes isolated from 200 swabs. Staphylococcus epidermidis was the most common, accounting for 33.8%, followed by Streptococcus pneumoniae (20.3%), Streptococcus pyogenes (14.3%), Escherichia coli (10.3%) Staphylococcus aureus (10.3%). Pseudomonas aeruginosa (5.0%), fungi (1.1%), and Klebsiella (0.7%) were also found.

Conclusion: mobile phones can be heavily colonized by high quantities of pathogenic bacteria and thus potential sources of disease transmission requiring application of sound personal hygiene as preventive methods.

Keywords: Bacteria , Contamination, Mobile phone , Students

1. Introduction

Cell phones are common among undergraduate students, and can be used to communicate for social or academic purposes, according to the technological features of the device and Internet connection. Students related to health sciences majors use their cell phones while performing internships at hospitals or clinical laboratories, either to access information on their field of expertise, answer calls, text messages or take

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pictures during their practices. The use of this mobile communication technology in healthcare and higher education has increased and generated interest in evaluating their role as reservoir of pathogenic and opportunist bacteria, and as a source of contamination to our foods or ourselves. However, one of the most common concerns regarding heavy use of mobile devices is that they can act as a vehicle for transmitting pathogenic bacteria and other microorganisms [1].

Recent studies have revealed that mobile phones used by university students—especially those in medical and health-related fields—are frequently contaminated with pathogenic bacteria. A study at Basrah University found 137 bacterial isolates from 100 student phones, with *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Pseudomonas aeruginosa* being the most common. The findings emphasized that mobile phones can act as vectors for disease transmission and highlighted the need for hygiene protocols to prevent cross-contamination [2]. At Adekunle Ajasin University in Nigeria, researchers discovered bacterial growth on 50 out of 120 phones, with *Staphylococcus aureus* being the most prevalent. Notably, 80% of participants reported using their phones in toilets, suggesting poor hygiene practices. The study recommended frequent cleaning and personal hygiene to reduce bacterial load [3]. In Bangladesh, a cross-sectional study showed that smartphones used by students carried various microorganisms. Samples were cultured and incubated, confirming that mobile phones can serve as carriers for microbial transmission [4]. A study in Thailand among pharmacy students revealed that 98.11% of phones were contaminated, and 84.62% had dense bacterial colonies. The most common organisms were coagulase-negative staphylococci (CoNS), *Bacillus* species, and *Staphylococcus aureus*. The study stressed the importance of awareness and proper cleaning of personal medical instruments [5].

In Libya, research conducted at the University of Sirte found that 60.8% of student phones were contaminated, with 96% of the bacteria being Gram-positive. The dominant species included *Staphylococcus epidermidis*, *Staphylococcus aureus*, and *Streptococcus agalactiae*. The study concluded that mobile phones are significant vectors of infection in both community and healthcare settings, and recommended the use of disinfectants and hand hygiene to mitigate risks [6].

Mobile phones are recognized as potential carriers of various pathogens. Within academic environments, faculties and universities may serve as primary sources for the spread of these microorganisms.

The study aims to assess the prevalence of bacterial contamination on mobile phones used by Health Sciences students, identify the most common bacterial species involved, and raise awareness about proper phone hygiene. It also seeks to evaluate the extent of contamination within the Faculty of Health Sciences. Notably, this topic has not been previously investigated among students at Elmergib University.

2- Materials and Methodology:

The study was cross-sectional descriptive study

2.1 Research Material:

Blood agar, a nutrient-rich medium that supports the growth of diverse bacteria, was used in this study. This medium was obtained ready-made from Al-Khums Hospital and Al-Itqan Lab, and bacterial samples were cultured immediately after collection.

2.2 Research Tools:

The following tools were used in this study:

Sterile cotton swabs and sterile transport medium swabs: Used to collect samples from the surfaces of mobile phones, and the samples were cultured immediately after collection.



Blood agar medium: Used to culture the samples and identify bacterial species.

Heat source: Used to sterilize the work surface at the sample collection site before beginning the procedure.

Incubator: Used to incubate the culture media at 37°C for 24–48 hours.

Refrigerator: Used to store the culture media under appropriate conditions before use

2.3. Scope of the research:

This research examines the prevalence of bacterial contamination on mobile phones and its associated factors among students of the College of Health Sciences. The study scope is limited to students only, excluding faculty members and administrative staff, to ensure sample homogeneity in terms of mobile device usage and the educational environment.

2.4 Time and place of the research:

This study was conducted at the faculty of health sciences at Elmergib University in Al-Khums, where data collection and sample analysis were conducted within the college's laboratory in the Department of Medical Laboratories. Samples were collected during the period from November 2024 to January 2025, according to the methodological procedures approved by the academic department.

2.5 Research design:

This study was conducted to analyze the prevalence of bacteria on students' mobile phones in the College of Health Sciences, focusing on the factors contributing to bacterial contamination. Data were collected through questionnaires to assess students' habits such as handwashing, phone cleaning, and the duration of phone use. Bacterial samples were also taken from students' phones using sterile swabs and cultured on growth media to identify the types of bacteria presents. The results were analyzed using statistical methods to determine the relationship between usage patterns and the level of bacterial contamination on mobile phones.

2.6 Study population and sampling size:

The study was conducted on students in the faculty of Health Sciences. The number of participants was 200 students, divided into 51 males and 149 females, from various disciplines within the college. The sample was determined based on the following criteria:

Participants were randomly selected to ensure representation of all disciplines.

Participants' ages ranged between 18 and 25 years old.

The sample size was determined based on the statistical requirements of the study to ensure accurate and generalizable results.

2.7 Research procedure:

To ensure the accuracy of the results and avoid any cross-contamination, strict preventive measures were followed before collecting samples. The researcher sterilized his hands using a rapid alcohol-based sanitizer and wore powder-free medical gloves. Samples were collected from the surfaces of mobile phones using sterile cotton swabs and sterile transfer media. These swabs were passed over all parts of the phone, including the screen, sides, and back, using regular circular motions to ensure the collection of the largest possible number of bacteria. The collection process was conducted within the college's laboratory in the Department of Medical Laboratories, and the samples were inoculated directly onto blood agar, which helped maintain bacterial viability and ensure the reliability of the results.

2.8 Principle of the tests:



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The laboratory testing principle was based on culturing samples on blood agar, and then incubating them in an incubator at 37°C for 24 hours. After the incubation period, the media were examined for bacterial growth. Samples that did not show any visible growth were excluded. The results were read under the supervision of a microbiologist to ensure accurate observation and interpretation.

2.9. Data collection:

Data were collected from 200 male and female students in the College of Health Sciences using a questionnaire containing closed and open-ended questions. The questionnaire included information on the participant's name and age, as well as the students' mobile phone usage practices, their awareness of personal hygiene, and the impact of this on student health. The questionnaires were randomly distributed to ensure representation across all academic year groups.

3. Ethical clearance:

Ethical approval was obtained from the Faculty of Health Sciences Research Ethics Committee (HS: 13:2024) before data collection began. Participants were informed about the study's purpose and procedures, and an informed consent was obtained. Participants were also informed that participation was completely voluntary and that the data collected would be used for research purposes only. The site file is saved and only researchers can reach the data inside, also the data has been saved in another out databank which also protected and no sign in can be done only by the researchers. All biosafety requirements were followed during the study,

4. Statistics analysis:

All statistical analyses were performed using IBM SPSS Statistics version (SPSS Inc., Chicago, IL, USA), Excel Office, and Chi-Square Test, Categorical data were presented as numbers and percentages, and the prevalence of bacteria was calculated and presented as a percentage.

5. Results:

The data obtained by the researcher from the faculty of health sciences, was used, where she obtained a sample of 200 male and female students. By studying this sample statistically, the researcher reached the following:

5.1 Distribution of the research sample by gender:

In the research sample, the total number of cases reached 200 participants, where the number of male students reached 51, representing 25.5%, while the number of female students reached 149 female students, representing 74.5%, as shown in Figure 1.

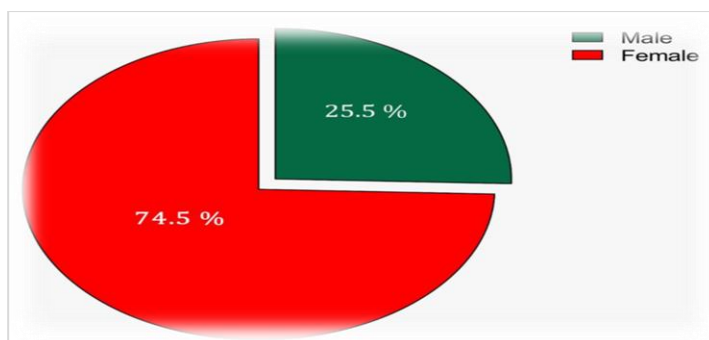


Figure 1: Distribution of the sample by gender



5.2 Distribution of the research sample according to the academic stage:

The number of first-year students was 38, representing 19% of the respondents, of whom 5% were males and 14% were females, the number of second-year students was 36, representing 18% of the respondents, of whom 4% were males and 14% were females, the number of third-year students was 65, representing 32.5% of the respondents, of whom 8.5% were males and 24% were females, while the number of fourth-year students was 61, representing 30.5% of the respondents, of whom 8% were males and 22.5% were females, as shown in Figure 2

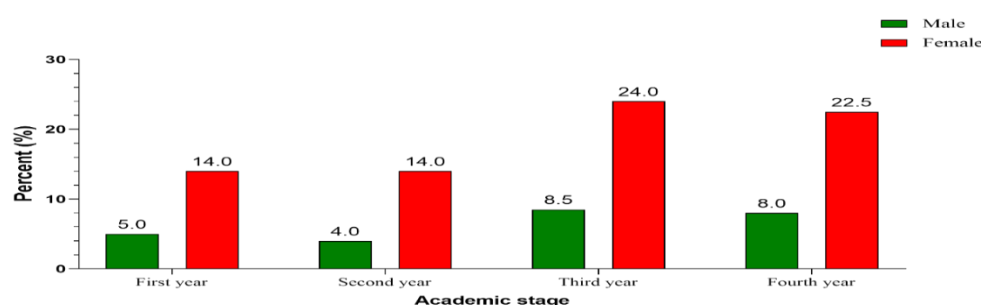


Figure 2: Distribution of the research sample according to Academic year and gender

5.3 Distribution of respondents' answers about the number of hours they spend using their phone daily:

When the study sample participants were asked about the number of hours they spend daily using their mobile phones: 14.5% of them answered (Less than 3 hours) which is the lowest percentage among the responses. The highest percentage (30%) was for those who reported using their phones for three to five hours daily. Additionally, 28% of them answered (6-8 Hours), while the remaining participants reported using their phones for More than 8 Hours, as shown in Figure 3

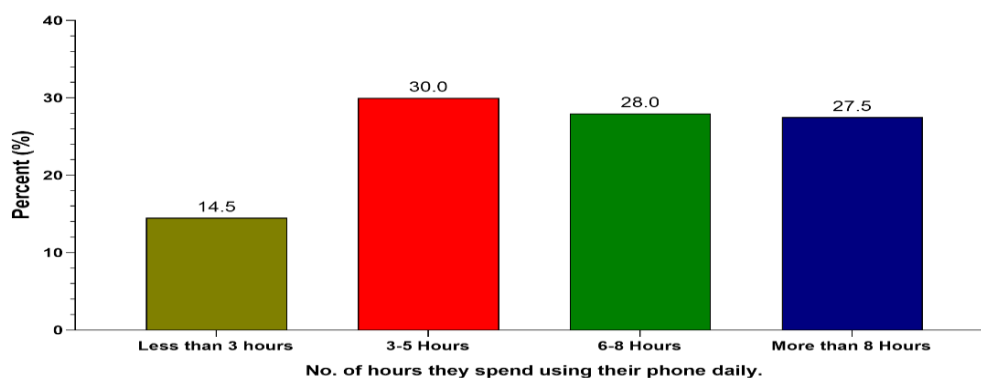


Figure 3: Distribution of respondents' answers about the number of hours they spend using their phone daily.



5.4 Distribution of respondents' answers about using mobile phones while eating and drinking:

When the students representing the research sample were asked about using their mobile phones while eating or drinking, 14% of them answered (Yes, Regularly), which is the lowest percentage, while 44% answered (Sometimes), which is the highest percentage. Additionally, 26.5% reported using their phones (Rarely), and the remaining percentage answered (No, Never), as shown in Figure 4.

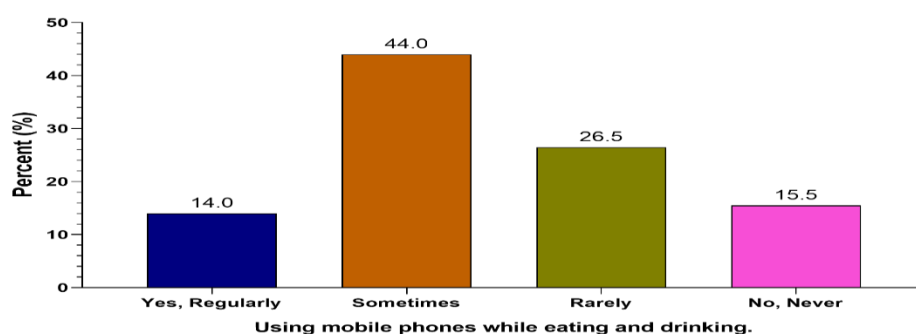


Figure 4: Distribution of respondents' answers about using mobile phones while eating and drinking

5.5 Distribution of respondents' answers about the times when the phone is used most:

When the students representing the research sample were asked about the times when the phone is used most: 2.5% indicated they use their phones most while commuting on public transportation. The majority, 61%, reported using their phones primarily at home, representing the highest percentage. Conversely, only 1% noted they use their phones most in college or university, the lowest percentage. The remaining participants selected "all of the above," as illustrated in Figure 5.

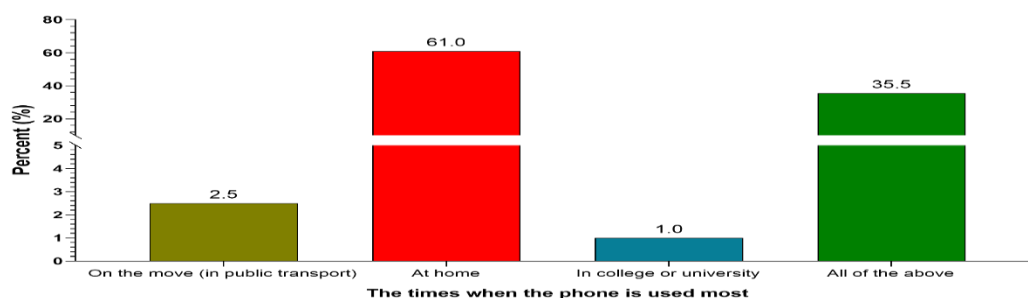


Figure 5: Distribution of respondents' answers about the times when the phone is used most

5.6 Distribution of respondents' answers about whether using a phone together with the family can affect personal hygiene:

When the students representing the research sample were asked whether using a phone jointly with family members could affect personal hygiene, only 13.5% responded "yes, significantly," representing the lowest percentage. The majority, 46.5%, answered "yes, to some extent," which is the highest percentage. The remaining participants indicated "no, it does not have much effect," as illustrated in Figure 6

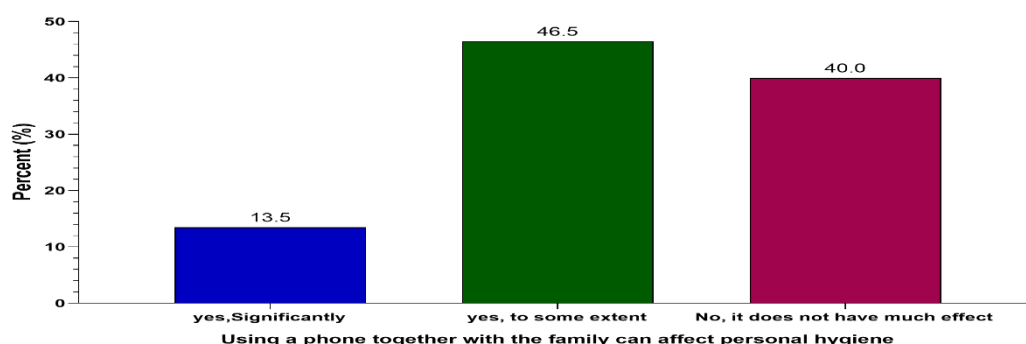


Figure 6: Distribution of respondents' answers about whether using a phone together with the family can affect personal hygiene

5.7 Distribution of respondents' answers regarding the fact that sharing:

When the students representing the research sample were asked whether sharing phones with family members can affect the health of children in the household, 47% of them answered (Yes, especially the little kids Yes) which represents the highest percentage, Meanwhile, 38.5% answered (yes, but to a limited extent), while the rest answered (No, I do not think it has an effect) which is the lowest percentage as illustrated in Figure 7

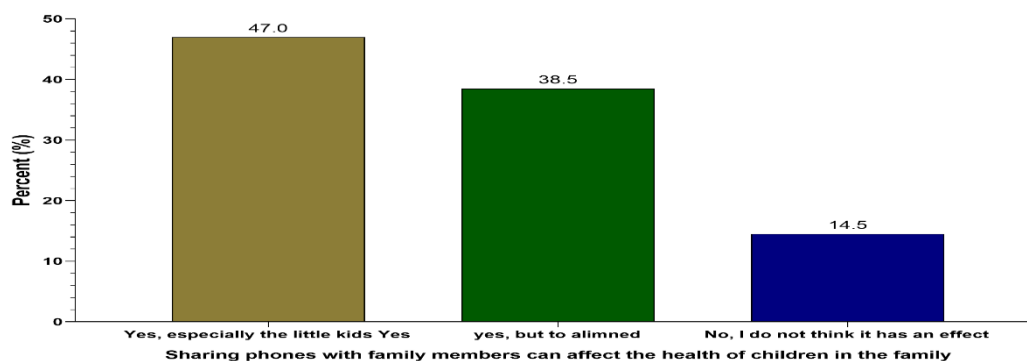


Figure 7: Distribution of respondents' answers regarding the fact that sharing phones with family members can affect the health of children in the family

5.8 Distribution of respondents' answers about sharing mobile phone with colleagues:

When the students representing the research sample were asked whether they share their mobile phones with colleagues, 55% of them answered (Yes) which is the lowest percentage, while the remaining participants answered (No) which represents the highest percentage, as illustrated in Figure 8.

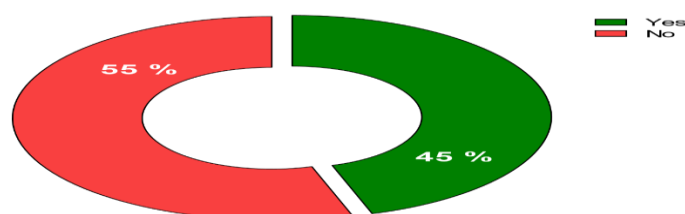


Figure 8: Distribution of respondents' answers about sharing mobile phone with colleagues

5.9 Distribution of respondents' answers about cleaning the mobile phone surface regularly:

When the students representing the research sample were asked about the frequency of cleaning their mobile phone surfaces, 31% of them answered (Yes, daily), 20.5% of them answered (Yes, weekly), 46% of them answered (Sometimes) which represents the highest percentage, while the rest answered (No, I never did that) which is the lowest percentage, as illustrated in Figure 9

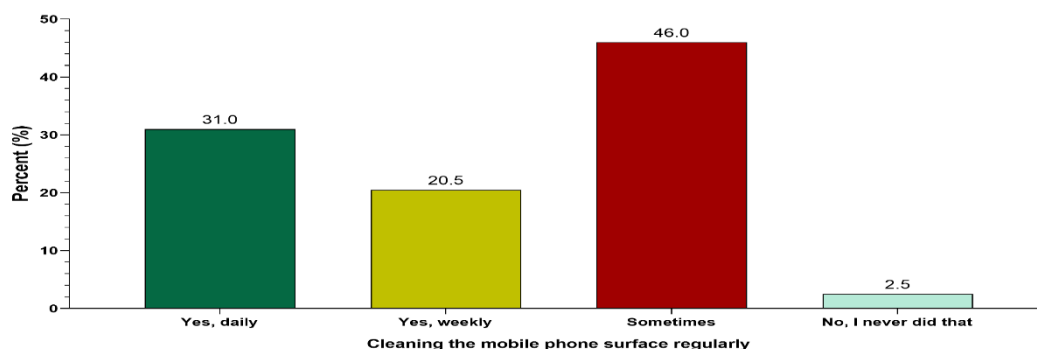


Figure 9: Distribution of respondents' answers about cleaning the mobile phone surface regularly

5.10 Distribution of respondents' answers about the methods:

When the students representing the research sample were asked about the methods they use to clean their phones, 45.5% of them answered (Sterile wipes), 52% of them answered (Peace of cloths) which represents the highest percentage. The remaining students indicated that they do not clean their phones, which constitutes the lowest percentage, as illustrated in Figure 10.

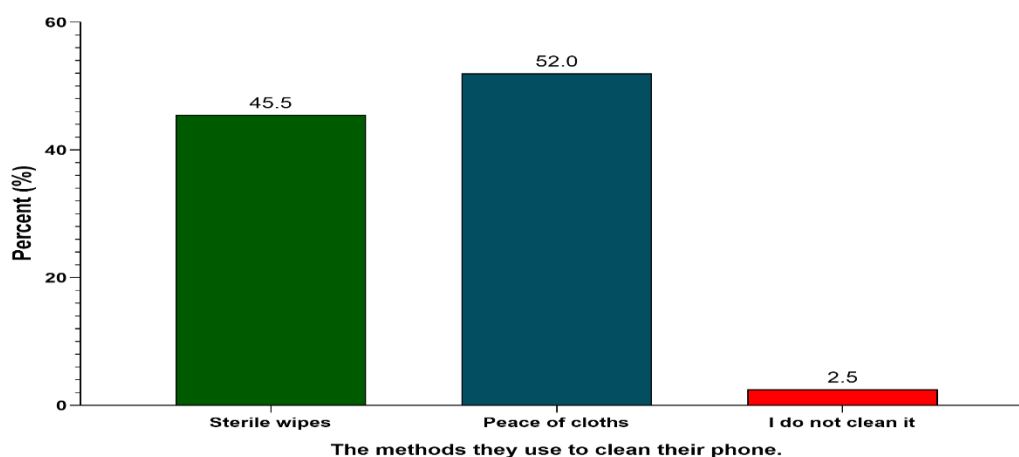


Figure 10: Distribution of respondents' answers about the methods they use to clean their phone.

5.11 Distribution of respondents' answers about hand cleaning before and after using a mobile phone:

When the students representing the research sample were asked How often they should clean their hands before and after using their mobile phones, 15.5% of them answered (Always), 36% of them answered (Mostly), 40% of them answered (Sometimes) which represents the highest percentage. The remaining students answered (No, never) which is the lowest percentage, as illustrated in Figure 11

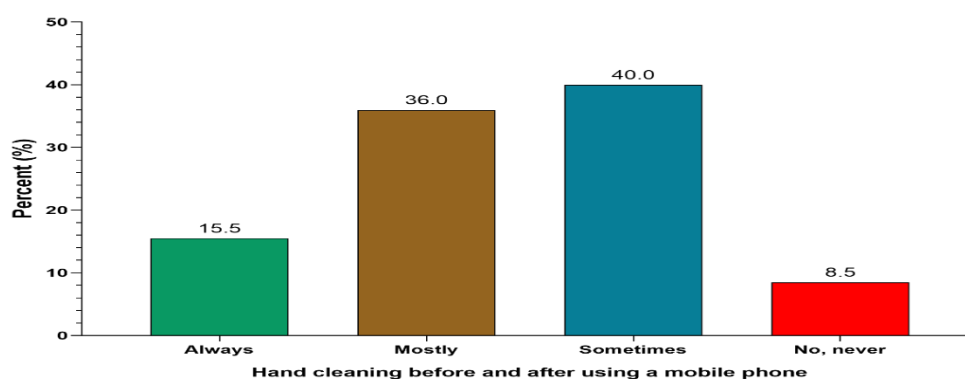


Figure 11: Distribution of respondents' answers about hand cleaning before and after using a mobile phone



5.12 Distribution of respondents' answers about avoiding sharing a phone with a family member with an infectious disease:

When the students representing the research sample were asked whether they avoid sharing their phone with a family member who has a contagious illness (such as influenza) ,57.5% of them answered (Yes) which is the highest percentage, while the rest answered (No) which represents the lowest percentage, as shown in Figure 12

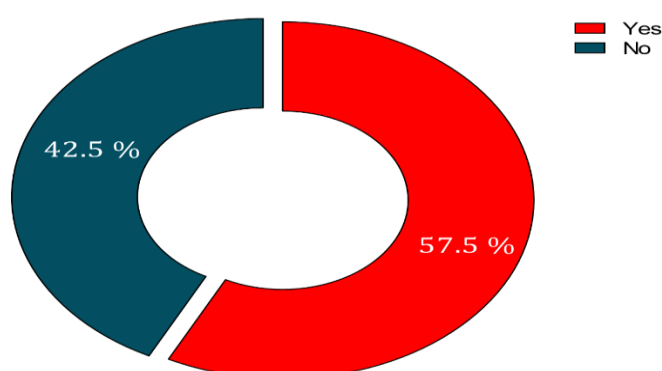


Figure12: Distribution of respondents' answers about avoiding sharing a phone with a family member with an infectious disease

5.13 Distribution of respondents' answers about mobile phone transmission of harmful bacteria:

When the students representing the research sample were asked whether they believe mobile phones can be a source of harmful bacteria transmission, 30% of them answered (Yes, Significantly), 40% of them answered (Yes, to a moderate degree) which is the highest percentage, 23% of them answered (Yes, but to a limited extent), while the rest answered (No, I do not think so) which represents the lowest percentage, as shown in Figure 13.

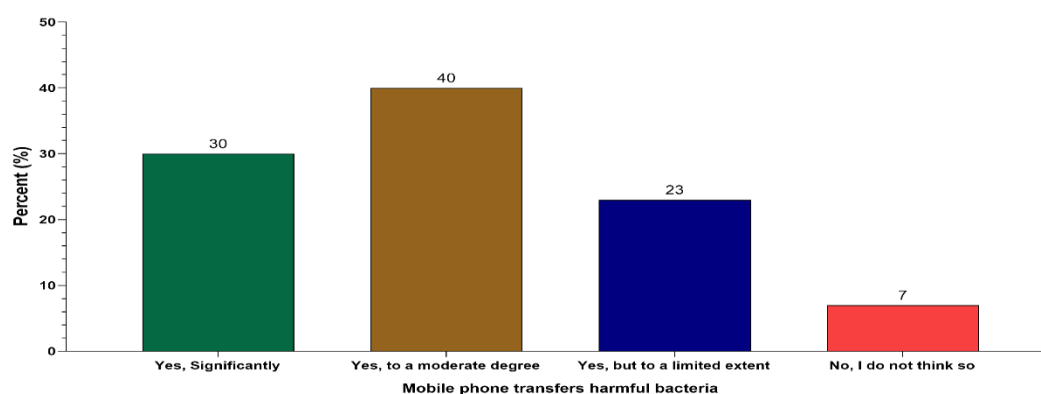


Figure 13: Distribution of respondents' answers about mobile phone transmission of harmful bacteria



5.14 Distribution of respondents' answers regarding prior knowledge of studies or research indicating the presence of harmful bacteria on mobile phones:

When the students representing the research sample were asked whether they had prior knowledge of studies or research indicating the presence of harmful bacteria on mobile phones, only 8.5% responded with (Yes, I know her well) which represents the lowest percentage, 59.5% of them answered (I heard about it in general) which is the highest percentage, while the rest 32% answered (No, I have not heard of that before), as shown in Figure 14.

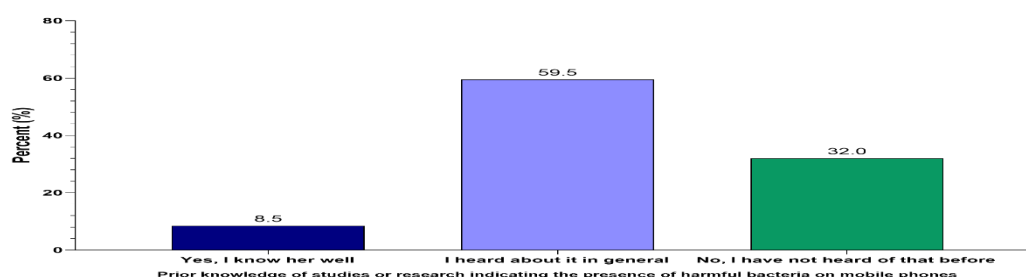


Figure 14: Distribution of respondents' answers regarding prior knowledge of studies or research indicating the presence of harmful bacteria on mobile phones

5.15 Relationship between academic stage and the transmission of harmful bacteria from mobile phones :

When students were asked about the transmission of harmful bacteria from mobile phones, 19% of the first-year students including 5%, answered (Yes, Significantly), 6% answered (yes, to a moderate degree), 5.5% answered (yes, but to a limited extent), while 2.5% of them answered (I don't think so). 18% of the second-year students, 32.5% of the third year students, while 30.5% of the fourth year students, as shown in figure 15, and we notice that there is no significant relationship between the academic stage and the transmission of harmful bacteria from mobile phones, where the correlation coefficient value was 0.011, indicating a very weak relationship, while the value of the Level of significance(P-value) was 0.881, which is greater than 5%, which confirms the absence of such a relationship.

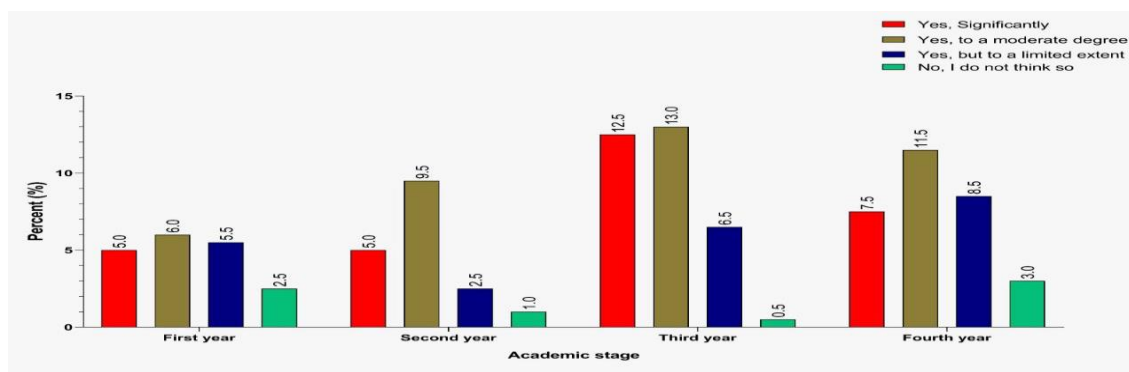




Figure 15: Relationship between academic stage and the transmission of harmful bacteria from mobile phones.

5.16 Relationship between academic stage and the prior knowledge of studies or research indicating the presence of harmful bacteria on mobile phones:

When students were asked about their prior knowledge of studies or research indicating the presence of harmful bacteria on mobile phones, 19% of the first-year students including 2.5% answered (Yes, I know her well), 10% answered (I heard about it in general), while 6.5% of them answered (I don't think so). Among other academic levels, 18% of the second-year students, 32.5% of the third-year students, and 30.5% of the fourth-year students, as shown in figure 16. However, the data indicates no significant relationship between academic year and prior knowledge of such studies, where the correlation coefficient value was 0.015, which is very weak, while the value of the level of significance (P-value) was 0.828, which is greater than 5%, confirming that the relationship is not statistically significant.

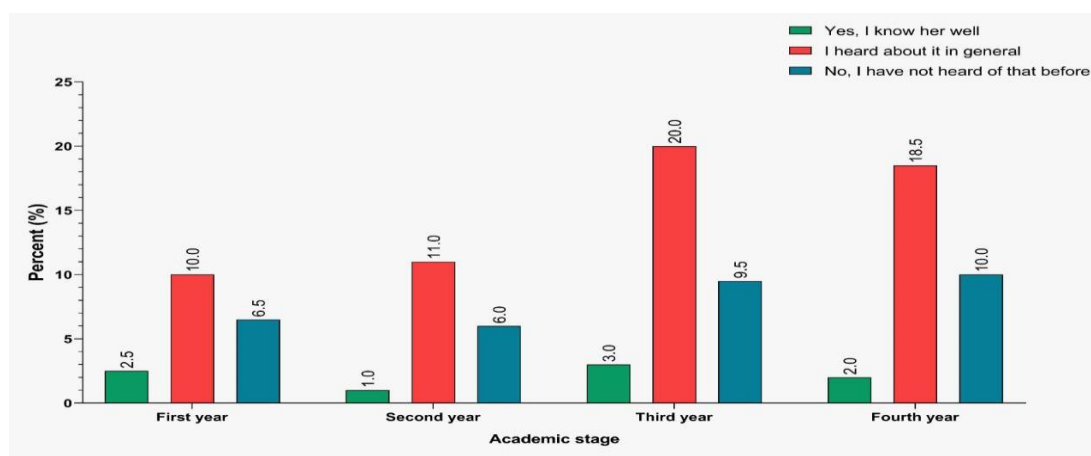


Figure 16: Relationship between academic stage and the prior knowledge of studies or research indicating the presence of harmful bacteria on mobile phones

5.17 Gender-Based Distribution of Microbes Presence:

This figure presents the distribution of bacterial species across male and female participants. The data illustrate potential gender-related variations in microbial prevalence.

Note: Samples showing no microbial growth were excluded from the main analysis, while fungal growth in mixed samples was ignored, focusing solely on bacterial growth. All samples were included in the results section to ensure accurate representation of the overall proportions.

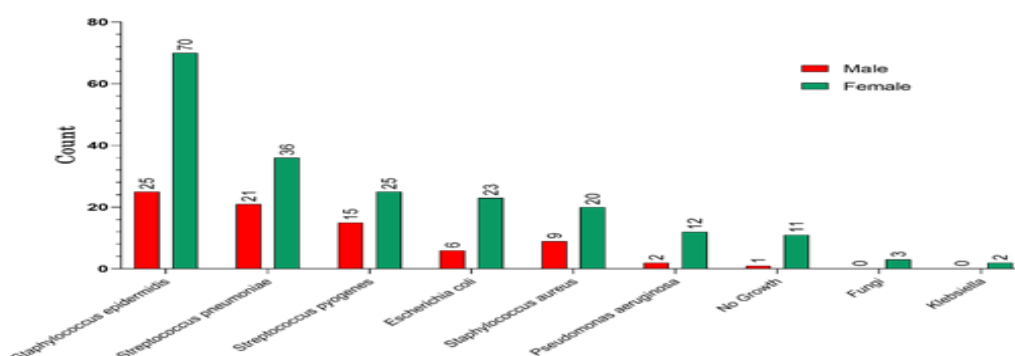


Figure 17: Gender-Based Distribution of Microorganisms Presence

5.18 Prevalence of Microorganisms in the Study Population:

The analysis of microorganism distribution within the study group revealed that *Staphylococcus epidermidis* was the most commonly detected bacterium, present in 33.8% of the samples, *Streptococcus pneumoniae* was found in 20.3%, followed by *Streptococcus pyogenes* in 14.2%. Both *Escherichia coli* and *Staphylococcus aureus* were identified in 10.3% of the samples, while *Pseudomonas aeruginosa* appeared in 5%. Additionally, 4.3% of the samples were excluded due to no bacterial growth, Fungal growth was excluded from 1.1%, and *Klebsiella* species were detected in only 0.7%. As illustrated in Figure 18, *Staphylococcus epidermidis* was the most prevalent bacterium, with other species occurring at comparatively lower rates.

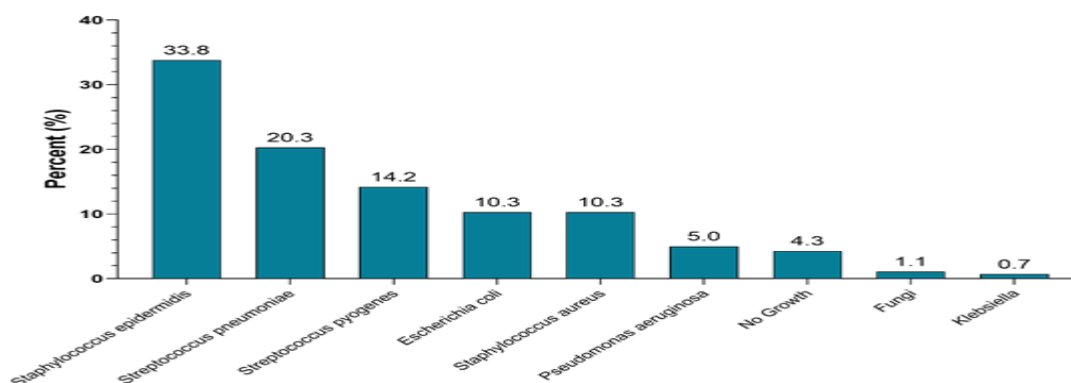


Figure 18: Prevalence of Microorganisms in the Study Population

5.19 Distribution of Microorganisms Presence Across Academic Years:

The distribution of bacterial species isolated from mobile phones of students in the College of Health Sciences was analysed based on academic year, ranging from first to fourth year. Out of a total of 200 isolates, 12 samples with no bacterial growth and 3 samples from which fungal growth was excluded, resulting in 188 valid samples for analysis. *Staphylococcus epidermidis* was the most frequently isolated bacterium, identified with percent of (33.8%), with the highest incidence observed among third-year (31.6%) and fourth-year students.



(30.5%). *Streptococcus pneumoniae* followed, detected in 20.3% of the samples, most commonly among third-year students (38.6%). *Streptococcus pyogenes* accounted for 14.2% of cases, also peaking in the third year. Both *Escherichia coli* and *Staphylococcus aureus* were found in 10.3%, distributed relatively evenly across all years, with a slight increase in the second year (34.5%). *Pseudomonas aeruginosa* appeared in 5.0% of cases, most frequently in the third year (42.9%). *Klebsiella* was the least common, isolated in only two cases (0.7%), both from fourth-year students. Overall, the third-year students had the highest proportion of bacterial isolates (31.7%), followed by fourth-year (28.1%), first-year (20.6%), and second-year students (19.6%), as detailed in Figure 19.

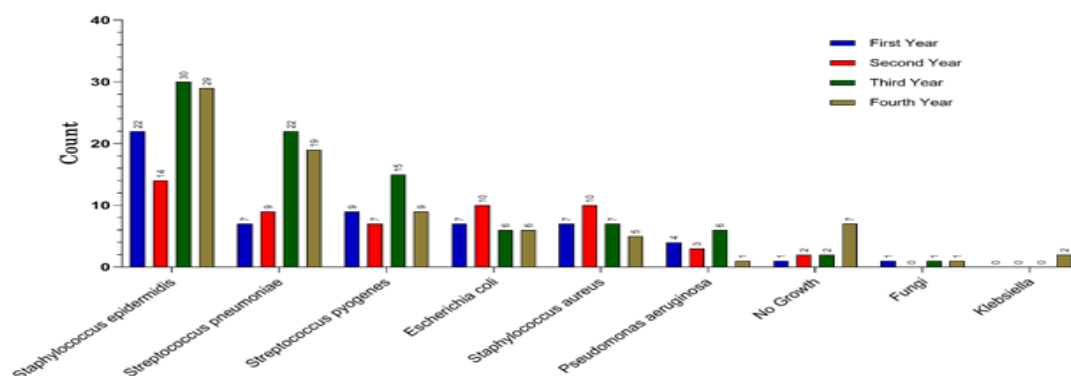


Figure 19: Distribution of Microorganisms Presence Across Academic Years

5.20 Distribution of Microorganisms Across Cleaning Methods and Chi-Square Test Results:

The figure below presents the distribution of microbes (both bacteria and fungi) isolated from mobile phones based on the cleaning method used—whether wiped with sterile wipes, cleaned with a cloth, or not cleaned at all. It also includes the results of the Pearson's Chi-Square test, which was conducted to assess whether there is a statistically significant relationship between the cleaning method and the type of microbe identified. The p-values indicate whether the observed differences among the groups are statistically significant, as illustrated in and Figure 20.

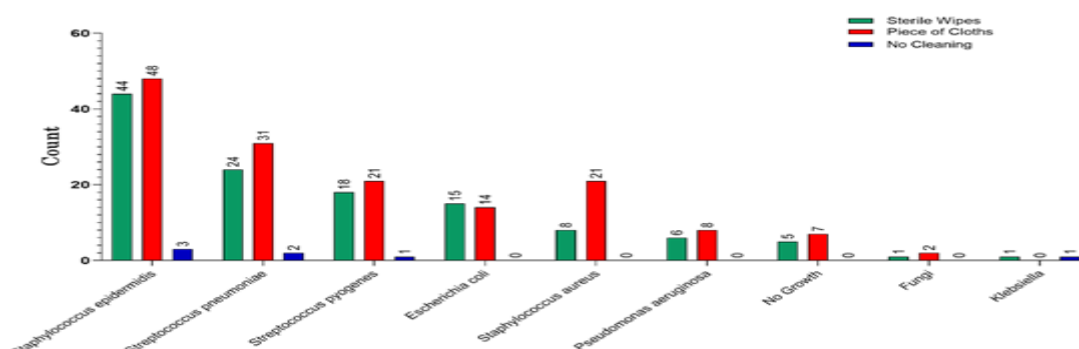


Figure 20: Distribution of Microorganisms Across Cleaning Methods and Chi-Square Test Results

6. Discussion:

The Pearson Chi-Square test results indicate no statistically significant association between cleaning methods and individual bacterial species (all p-values > 0.05). However, the overall Chi-Square test for all bacteria combined ($\chi^2 = 562$, $p < 0.001$) suggests a significant relationship between cleaning methods and bacterial presence.

Notably, the highest bacterial prevalence was observed in the "Piece of Cloths" cleaning method (54.1%), whereas sterile wipes had a slightly lower prevalence (43.4%), and no cleaning had the lowest bacterial detection (2.5%). This pattern suggests that the effectiveness of cleaning methods may vary, with piece of cloths potentially contributing to cross-contamination.

Certain bacteria, such as *Staphylococcus aureus* (72.4%) and *Pseudomonas aeruginosa* (57.1%), were predominantly found in the "Piece of Cloths" category, indicating that this cleaning method may be less effective in reducing bacterial load. *Escherichia coli* showed a nearly even distribution between "Sterile Wipes" (51.7%) and "Piece of Cloths" (48.3%), suggesting that both cleaning methods may have similar efficacy for this particular bacterium.

These results showed that the prevalence rate of microorganisms on students' mobile phones reached 95.7%. This rate is relatively close to the findings reported by Sribrapon et al. [5] in Thailand, where the prevalence was 98.11%. In contrast, the findings of Ya'aba et al. (2020) were lower, reporting a bacterial contamination rate of 56.3% among females and 43.7% among males [7].

These results suggest that mobile phones may serve as a favorable environment for the transmission and proliferation of bacterial pathogens, highlighting their potential role as a source of infection. When comparing the types of bacteria isolated, it was found that coagulase-negative Staphylococci were the most commonly isolated organisms in the study by Sribrapon et al. [5], accounting for 42.72%, compared to 33.8% in this study. Moreover, *Staphylococcus aureus* was detected at a rate of 20.39% in their study, while it was found at 10.3% in this study. Notably, *Escherichia coli* was not detected in the study by Sribrapon et al. [5], whereas it was identified in 10.3% of samples in this study.

These results are consistent with the findings of Sribrapon et al [5]. regarding the predominance of coagulase-negative Staphylococci; however, the detection of *Escherichia coli* in this study may reflect differences in sources of contamination or variations in personal hygiene practices among the studied populations.



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When comparing these results with those of Ya'aba et al., it was found that the contamination rate of mobile phones with Staphylococci was 47.1% among males and 55.6% among females, compared to 28.65% and 71.35%, respectively, in this study. Additionally, Escherichia coli was detected in 38.2% of males and 41.7% of females in their study, compared to 20.7% of males and 79.3% of females in this study. Regarding Klebsiella spp., their study reported rates of 35.3% in males and 38.9% in females, while in this study, Klebsiella spp. was not detected among males and was found in 100.0% of females. As for Salmonella spp., Ya'aba et al. reported a prevalence of 47.1% in males and 55.6% in females, whereas no Salmonella spp. was detected in this study [7].

In general, these results are in agreement with previous studies in identifying coagulase-negative Staphylococci as the most common isolated bacteria. However, this study is distinguished by the absence of Salmonella spp. and the presence of Escherichia coli, which may be attributed to differences in environmental factors, sample characteristics, or hygiene practices among students. [8].

7. Conclusion:

A cross-sectional study was conducted, the results of this study revealed a high rate of bacterial contamination on mobile phones among health sciences students, highlighting their potential role as hidden carriers of infection in university environments characterized by intense human interaction. A wide range of microorganisms was identified, with Staphylococcus epidermidis being the most prevalent, followed by Streptococcus pneumoniae, Streptococcus pyogenes, Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, and Klebsiella species and the students were known the role of immune blood cells against these bacterial agents

These findings suggest that mobile phones may represent a significant source of bacterial contamination, especially in the absence of adequate awareness regarding their potential to harbor pathogens. They also indicate that the transmission of infectious agents is not limited to healthcare settings but can also occur through everyday practices, emphasizing the need for greater attention to this issue within university life.

ETHICAL STATEMENT

Ethical approval was obtained from the Faculty of Health Sciences Research Ethics Committee.

AUTHORS' CONTRIBUTIONS

All authors contributed equally

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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