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Assessment of microbial contamination of mobile phones among mothers in Raichur city, Karnataka: A cross- sectional study

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***Abstract*---**Studies have reported that multiple contaminated surfaces play an important part in spreading diseases including mobile phones. Cell phones act as a medium by which bacterial pathogens are transmitted- either from phone to phone or from the hand of user to mobile phone; resulting in exchange of microbial flora. This study was carried out to assess the amount of bacterial contamination among mobile phone users who are mothers and handle kids below 6 years of age. The aim of the present study was to assess the presence of different microbial species for contamination among mothers with children <6 years of age using different mobile phones in Raichur. A cross sectional study was carried out among 60 mothers in Raichur city of Karnataka. The sterile swab was used to collect samples and transferred to the laboratory for assessment. Among the 60 study subjects, all of them did not know that micro-organisms spread from

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their body parts to mobile phone. No one was advised by the doctor on ill effects of mobile phone usage during pregnancy and none cleaned their phones regularly with any chemical disinfectant. Half of the microbes identified was Coagulase negative species. More of anaerobic strains were observed in the study population. The result was consistent with the other studies reported on different populations across the world. The risk to the children and infants was very high. Cleaning practices by regular use of disinfectants was missing and hence vulnerability of cross infection/contamination was very high among the present study population.

***Keywords*---**India, mothers, children, mobile phones, microbes.

Introduction

The reservoir of any organism, which may be animate or inanimate objects, in the epidemiology of any bacterial disease is very important.(Hendley, Wenzel and Gwaltney, 1973)Studies have reported that multiple contaminated surfaces play an important part in spreading diseases.(Harry L. Greene, Wendy Levinson, Geoffrey A. Modest, 1996)Mobile phones are an integral part of modern societal life and are in the hands of billions of users worldwide every day. In the past decade the use of mobiles have gone up from 10 to 60% and is anticipated to reach 79% by 2025.(Stryjak J., 2019) Cell phones act as a medium by which bacterial pathogens are transmitted- either from phone to phone or from the hand of user to mobile phone; resulting in exchange of microbial flora.(Austin, Kristinsson and Anderson, 1999) Fomite-mediated transmission is a critical pathway to cause infectious disease spread.(Stephens *et al.*, 2019). Several studies have reported that transmissibility of transient microbial species depends mainly on the specific strain of the species as well as the quantity on the surface.(Marples and Towers, 1979; PATRICK, FINDON and MILLER, 1997)Studies have reported that approximately more than 150 bacterial species are contained in the human hand surface and the majority belong to the Proteobacteria, Firmicutes and Actinobacteria phyla.(Fierer *et al.*, 2008),(Findley *et al.*, 2013),(Zhao *et al.*, 2012),(Zhao *et al.*, 2019)An average cell phone device is 10 times dirtier than the toilet seat or bottom of a shoe.(Abrams, 2017)Anuradha et al. reported that there is very little awareness with regards to mobile phone contamination among both the urban as well as rural communities.(S.N *et al.*, 2016).

Infants and toddlers grab the mobile phones of parents; owing to the attractive glaring screens; resulting in greater risk of ingestion of dirt. This may in small numbers contribute to develop the immunity of the children; but it can also make the weaker ones; more susceptible to illnesses.(Beckstrom *et al.*, 2013)Antimicrobial drugs do kill pathogens, but its misuse or overuse may promote formation of newer multi-drug resistant strains.(Kalal and Nagaraj, 2016)Regular administration of antibiotics in childhood may alter the gut bacteria, metabolism, and the immune system; resulting in problems such as obesity, diabetes, asthma, allergies, autism and inflammatory bowel disease.(Dietert and Dietert, 2015)There are no studies reported on mobile phone

and risk of microbial transmission among the population in North Karnataka and reports from India are also seldom published. This study was therefore carried out to assess the amount of bacterial contamination among mobile phone users who are mothers and handle kids below 6 years of age. The aim of the present study was to assess the presence of different microbial species for contamination among mothers with children <6 years of age using different mobile phones in Raichur.

Materials and Method

Ethical clearance was obtained from the Ethics Committee of Navodaya Dental College and Hospital before the start of the study.

Sample size- 60

Sampling method

Convenience sampling.

Sample source

Those residing in the single geographical area of Raichur City based on inclusion criteria.

Inclusion criteria

- Mothers above 18 years of age with kids below 6 years
- Use of mobile phones on daily basis
- Ready to provide a written informed consent.

Methodology

A written informed consent was obtained from the participants after explaining the study to them at their home itself. Demographic data was obtained; information on number of phones; its frequency of use; age of child, habit of licking the phone; practise of disinfecting it with a chemical was also noted. Sterile swabs were wiped on screen by rolling technique and inserted into the container. All precaution measures like use of PPE kit was followed to ensure not to infect the swab from other sources. After collection the test swab were transferred to lab immediately for culture of microorganisms. The medium used for developing the culture was MacConkey's Blood agar. The samples were spread over the agar plate and it was incubated for 24 hours first. In case the bacterial colonies were not visible; it was incubated further for next 24- 48 hours under aerobic conditions for species like Staphylococcus and Streptococcus. Anaerobic incubator was used for culturing of species like E. Coli and Pseudomonas. All laboratory-based assessment was carried out by the Microbiologist on electron microscope for assessment of the type of species.

Results

Out of 60 mothers, 31(51.7%) used ordinary bar phone and 29(48.3%) used smart phones. 16 (26.7%) women used to spend less than hour per day with the phone whereas 38 (63.3%) were 1-2 hours. 5 (8.3%) were 3-4 hours, 1 (1.7%) more than 4 hours and all of the participants were using their phones while cooking. Among the 60 study subjects, all of them did not know that micro-organisms spread from their body parts to mobile phone. No one was advised by the doctor on ill effects of mobile phone usage during pregnancy and none cleaned their phones regularly with any chemical disinfectant. 46(76.7%) of them reported that their child/children fell ill frequently and overall 49(81.7%) children played with their mother's phones. Table 01 shows the type of microbes identified in the study population.

Table 1
Distribution of study subjects according to type of microorganisms on microbiological culture

Type of microorganisms	n	%
No growth	22	36.6
Candida species	1	1.7
Staphylococcus aureus	1	1.7
Non Pathogenic Organism (micrococcus)	6	10.0
Co-agulase negative staphylococcus species(CONS)	30	50.0
Total	60	100.0

There were no antibiotic resistant strains identified in the present samples.

Discussion

The total sample size in the present study was 60 adult females. Karabay et al (2007);(Karabay, Koçoglu and Tahtaci, 2007)had 122 health care professionals of which 39 were physicians and with 50 nurses and 22 residents and 11 interns. Famurewa and David(2009);(Famurewa and David, 2009)involved 150 samples from hospital premises; while Tekerekoglu et al (2011);(Tekerekoğlu *et al.*, 2011)involved 60 adults who were again health care professionals.All of the study subjects were using phones while cooking and none of them were cleaning their mobile phone with solution or disinfectant**;** 35(58.3%) of the mothers said their babies licked their phone**.** This was a potential source of contamination of the oral cavity of the child. Karabay et al (2007);(Karabay, Koçoglu and Tahtaci, 2007) reported that there were 4 E coli; 2 Pseudomonas aeruginosa; one Klebsiella pneumoniae; neither MRSA nor vancomycin-resistant Enterococci which were isolated from mobile phones in this study. Famurewa and David(2009);(Famurewa and David, 2009) isolated different organisms like Escherichia coli, (28.2%), Pseudomonas aeruginosa (22.6%), Klebsiella species (14.5%), Serratia species (13.7), Staphylococcus aureus (12.9%) and Proteus vulgaris (8.1%). Multiple antibiotic resistance was observed among the isolates in their study.

All the isolates were resistant to more than three antibiotics; we did not observe any resistant species in our study. Another study by Tekerekoglu et al (2011);(Tekerekoğlu *et al.*, 2011) reported that more multidrug pathogens in the mobile phones including methicillin-resistant Staphylococcus aureus, extended-spectrum β-lactamase-producing Escherichia coli, and Klebsiella, high-level aminoglycoside-resistant Enterococcus, and carabepenem-resistant Acinetobacter baumanii. The study findings suggested that mobile phones of patients, patients' companions, and visitors represent higher risk for nosocomial pathogen colonization than those of HCWs. Specific infection control measures may be required for this threat. Elmanama et al (2015);(Elmanama, Hassona and Marouf, 2015) reported in their study that there was 71.6% showed positive microbes; much higher than our findings. Staphylococcus aureus was the most predominant isolate (with 27%). Zakai et al (2016);(Zakai *et al.*, 2016) reported that 101 (96.2%) samples were contaminated with bacteria; which was more than the present study findings. Coagulase-negative staphylococci were the most abundant isolates (68%) in their study. Seventeen (16.2%) cell phones were found to harbor Staphylococcus aureus and Gram-positive bacilli were isolated from 20 (19%) samples. Viridans streptococci and Pantoea species were also isolated but at lower levels in their study; we did not get these strains in our samples. Bhumbla et al (2016);(Bhumbla *et al.*, 2016) reported 92% bacterial contamination with monomicrobial or polymicrobial growth; much higher than the present study findings. Bacteria which were isolated in their study were *Staphylococcus aureus*, *Micrococci*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa,* and *Citrobacter* spp. fungal growth included *Aspergillus niger*and *Candida albicans*. Martínez-Gonzales et al (2017);(N. E. Martínez-Gonzáles, F. Solorzano-Ibarra, E. Cabrera- Díaz, P. Gutiérrez-González, L. Martínez-Chávez, J. A. Pérez-Montaño, 2017) investigated the presence of Salmonella spp., Staphylococcus spp., Streptococcus spp., Enterococcus spp. and counts of microbial groups on the surface of undergraduate students' cell phones.

A total of 304 cell phones used by undergraduate students were sponge sampled to detect the presence of pathogenic bacteria and to enumerate yeasts and moulds, aerobic plate count, Enterobacteriaceae, coliforms and Escherichia coli. All sponge samples tested negative for the presence of the investigated pathogens. The study concluded that cell phones used by undergraduate students are a source of microbial groups in variable levels. Despite the fact that bacterial pathogens were not isolated from tested samples, usage habits and presence of E. coli suggest that cell phones could be a potential source of enteric pathogenic bacteria. Morubagal et al (2017);(Morubagal *et al.*, 2017) revealed that there is definite colonization of bacteria on mobile phones of the hospital workers. It is not only capable of transferring message but also disease-producing microbes. Al-Ghurabi (2017);(Al-Ghurabi *et al.*, 2017)reported that mobile phones can serve as a vector for cross transmission of community-acquired pathogenic organisms for human. Movahhed et al (2018);(Movahhed, Dehghani and Ghoddusi, 2018)also observed microbes in their computer samples. Fard et al (2018);(Hosseini Fard *et al.*, 2018) reported that out of 240 mobile phones that were cultured for microorganisms only 65.8% (n = 158) were culture-positive. The most commonly cultured organisms were Staphylococcus aureus, Escherichia coli, Enterococcus faecalis, and Pseudomonas. Gumanju et al (2019);(Gumanju *et al.*, 2019) reported

that out of 49 sample, Bacillus (20.4%) was the most predominant isolate, followed by Staphylococcus aureus (10.6%) and Pseudomonas (10.6%). Higher variety of bacterial isolates was found in the cell phones swabs from butcher followed by cook, farmer and panipuri vendor group. All Gram-positive and Gram-negative isolates were resistance to Cefoxitin (100%) except Micrococcus spp and Neisseria spp. Gram positive (18.2%) and Gram-negative (36.9%) isolates were multi drug resistant. All S. aureus and coagulase negative staphylococci were methicillin resistant. Chauhan et al (2018);(Chauhan *et al.*, 2018) on the other hand reported that S. aureus was the most prevalent constituting 88% of the total samples; which was higher than the present study findings. Other isolates that were identified were Pseudomonas aeruginosa, B. cereus and E.coli found in 8%, 80% and 4% of the mobile phone samples respectively.

Naaz et al (2019); reported that 30% of the study participants never cleaned their mobile phones; it was 100% in our study. The most common bacterial isolate from the hands were Staphylococcus aureus (44%) and coagulase negative Staphylococcus (CONS - 36%), while from cell phone swabs were similarly S. aureus (43%) and CONS (36%). The MRSA isolates from hands and cell phone in their study were 33% and 17% respectively. Gram- negative bacteria were isolated from 15% of the hand swabs and 7% of the mobile swabs respectively. Qadi et al (2021);(Qadi *et al.*, 2021) reported coagulase-negative staphylococci (CoNS; 67.3%), methicillin-sensitive Staphylococcus aureus (MSSA; 17.5%), Gram-positive bacilli (4.1%), methicillin-resistant Staphylococcus aureus (MRSA; 1.6%), and Gram-negative species (1.6%) were the most predominant bacterial isolates; which were almost similar to our findings. Ismail et al (2018);(Haruna Yahaya Ismail, Hauwa Abdullahi Bello, Abdullahi Adamu, 2018) reported that positive bacterial cultures were observed in 75.56% (n= 136) of the samples collected. The bacterial isolates were identified to be Staphylococcus epidermidis, Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Proteus sp., Klebsiella pneumoniae, and Micrococcus sp. with occurrence rate ranging between 26.47%, and 2.94%. Rest all concentrated on health care workers. Irrespective of that fact; still even health care workers carry these phones home. Working mothers are subjecting their kids to these infections. And hence the risk is higher. Therefore the blessing of mobile phone should not be a bane; instead it should be a boon for communication sans microbes. Its imperative to insist that more and more resistant strains of species and also aggressive anaerobic microbes are prevalent. Hence utmost care is essential. We have the habit of using mobile phones in kitchen, bathrooms, toilets, workplaces, public transport, and also on the dining tables and beds. So the chance of spreading infection is more and dangerously high. Therefore care to clean it is an essential part; for which people awareness and also better economically affordable chemical disinfectants should be available in the market.

Conclusion

The cross sectional study was carried out among 60 women who were mothers to children below 6 years of age. The study highlighted that more than half of mobile phones had at least one species of microbe. More of anaerobic strains were observed. The result was consistent with the other studies reported on different populations across the world. The risk to the children and infants was very high.

Cleaning practices by regular use of disinfectants was missing and hence vulnerability of cross infection/contamination was very high among the present study population. We recommend that the rate at which advertisements are showcased about the different types and forms of mobile phones, the knowledge about the bacterial contamination should be equally higher. Also freebies in the form of packets or coupons while buying or servicing phones should instead be replaced with tailor made disinfectants. More public awareness is essential; especially for mothers with very young kids. Mobiles are meant to communicate information and not bacteria should be the underlying motto.

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