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Assessment of Microbial Contaminations Associated with Steering Wheels and Palms of Commercial Drivers at the University of Cape Coast's Taxi Rank

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Authors' contributions

This work was carried out in collaboration among all authors. Author FAO conceived the study, collected the samples, did the laboratory analysis, analyzed and interpreted data and drafted the manuscript. Author HDN participated in the study design helped with the statistical graphs and assisted in the preparation of manuscript. Author AA assisted in editing the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The study aimed at enumerating, identifying and showing similarities and variation of microbial species found on the palms of drivers and steering wheels.
Methodology: Twenty-one (21) samples each from steering and palms were randomly collected into sterile bags and transported to the microbiology laboratory of the Department of Laboratory Technology for microbial analyses. Samples were cultured on Plate Count Agar (PCA), McConkey and Sabouraud Dextrose agar (SDA) for enumerations and identifications of total viable counts, bacteria and yeast and molds, respectively.
Results: Steering wheels had the highest microbial load (9.48 x10^5cfu/ml) whilst the palms of drivers had the lowest (8.88 x 10^5 cfu/ml) and that all 42 samples (100%) investigated were contaminated. A total of 163 bacteria of eight (8) different genera were obtained from both steering

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wheels and palms as well as sixty-two (62) fungi species made of five (5) different genera were also obtained. Bacterial isolates included *Staphylococcus aureus, Escherichia coli, Proteus* spp*, Bacillus* spp*, Klebsiella pneumonia, Pseudomonas aeroginosa, Citrobacter* spp *and Enterococcus faecalis*. For fungal genera, *Altenaria alternata, Aspergillus fumigatus, Aspergillus niger, Penicillium* spp*, Candida* spp were isolated*.* The steering wheels had higher bacterial and fungal contaminations than the palms of the drivers which showed no significant difference (P = 0.0832). This indicates that though there were numerical difference in contamination load, their effects were independent of each other.

Conclusion: This study confirms the contamination of fomites by microbes and the assertion that fomites are sources of transmission of many diseases.

Keywords: Fomites; microbial contamination; microbial load; bacteria isolates; fungi; diseases.

1. INTRODUCTION

Microorganisms are ubiquitous which constitute a major part of every ecosystem and live either freely or as parasites. They live as transient contaminants on hands where they constitute major health hazards in a community [1]. Microbes can survive on inanimate objects long enough, be transferred to hands from these contaminated surfaces and then onto people. Contaminated hands can transmit disease to oneself as well as others [2]. Surfaces such as doors, desks, currencies, keyboards, skin and many others exhibit unacceptable levels of bacterial contamination. Mostly, these areas were thought of to be completely sterile [3]. Results of a research conducted on Ghanaian currencies has exhibited similar trend in microbial contaminations [4]. In England, steering wheels have been reported to contain nine times more bacteria than public toilet seat [5]. In the United Kingdom, the steering wheels of emergency ambulances recorded 33.4% bacterial contamination of which *Staphylococcus epidermidis and Bacillus* sp. were isolated [6]. Drivers indulge in lots of activities with their hands including money collection, greeting, cleaning of filth but do not maintain hygienic practices. In Malaysia, microbes which are harmful lived in the hands of medical students who involved in unhygienic practices [2]. In 2012, door handles frequently used by patients in London hospital were studied and results showed a vast level of bacterial contamination. Microorganisms could contaminate the hands from any source of contact to carrier and then to a secondary surface [7]. Studies on surfaces such as mobile phones, currencies, doors have been published by Ghanaian researchers with less focus on steering wheels of commercial taxis and palms of drivers. Mobile phone surfaces have also been studied by Ghanaian researchers and these surfaces held substantial amounts of microbial load [8]. The constant handling of the steering wheels by different users exposes it to microbial contamination [9]. Since some of these microbes are pathogenic, there is the likelihood that most of the diseases caused in Ghana might be attributed to steering wheel surface contamination. Hence, there was a need to undertake this study to identify the type of microbes involved. This study identified and enumerated the bacteria, yeast, mold and fecal contaminants on steering wheels and palms of commercial drivers.

2. MATERIALS AND METHODS

The study was conducted at the University of Cape Coast's taxi rank in Cape Coast Metropolis, Central region, Ghana. The analysis of the samples was done at the Medical Laboratory of the University of Cape Coast's Laboratory Technology Department. Twenty-one (21) samples each from steering wheels and palms of the commercial drivers of the UCC taxi rank were randomly selected for the study. Sampling was done using cotton swab sticks on the steering surfaces and palms of drivers. The swabs were then placed in sterile polythene bags and transported to the laboratory of the department of Laboratory Technology, University of Cape Coast. Each swabbed sample was removed from the sterile polythene bag using sterile forceps and transferred into a bijou bottle containing 10ml of sterile peptone water. The bottle was vigorously shaken to homogenize the sample. The portion of the cotton on the swab stick was rinsed with sterile distilled water and cut into the universal bottle and the content was covered. The resulting sample was then incubated for 24-48 hours at 37^{o}C. Serial dilutions of samples were made from 10^{1} to 10^{10} using normal saline as diluent.

3. RESULTS AND DISCUSSION

A total of 42 swabbed samples comprising of 21 each from drivers' palms and steering wheels' surfaces were analysed and results were obtained for microbial enumeration and identification.

The results of microbial counts, percentage frequency of occurrences of bacterial and fungal isolates are presented in Table 1 and Figs 1, 2, 3 and 4.

Results of total viable counts represented in Table 1, showed that mean microbial load on the steering wheels were higher (9.48×10^5) than the palms of drivers (8.88×10^5) with p – value of 0.0832 which indicates no significant difference.

Table 1. Descriptive statistics of microbial counts (CFU/ ml) from steering wheels and palms of drivers of taxis

	Microbial count (CFU/ml)	
Descriptive statistics	**Wheels**	**Palms**
Number of samples	21	21
Minimum count	8.2×10^5	7.3×10^5
Maximum count	1.13×10^6	1.14×10^6
Mean count	9.48×10^5	8.88×10^5
Standard deviation	8.97×10^4	1.36×10^5
Standard error	1.96×10^4	2.75×10^4

p=0.0832, CFU=Colony Forming Unit

Table 2. Results of bacterial and fungal isolates on both steering wheels and palms

Steering wheels		Palms	
Bacterial Isolates	**Fungal Isolates**	**Bacterial Isolates**	**Fungal Isolates**
Staphylococcus aureus	*Alternaria alternata*	*Staphylococcus aureus*	*Aspergillus fumigatus*
Escherichia coli	*Aspergillus fumigatus*	*Escherichia coli*	*Aspergillus niger*
Proteus spp	*Aspergillus niger*	*Klebsiella pneumonia*	*Candida* spp
Bacillus spp	*Penicillium spp*	*Pseudomonas aeroginosa*	
Klebsiella pneumonia		*Enterococcus faecalis*	
Pseudomonas aeroginosa			
Citrobacter spp			

Note: Spp represents Species.

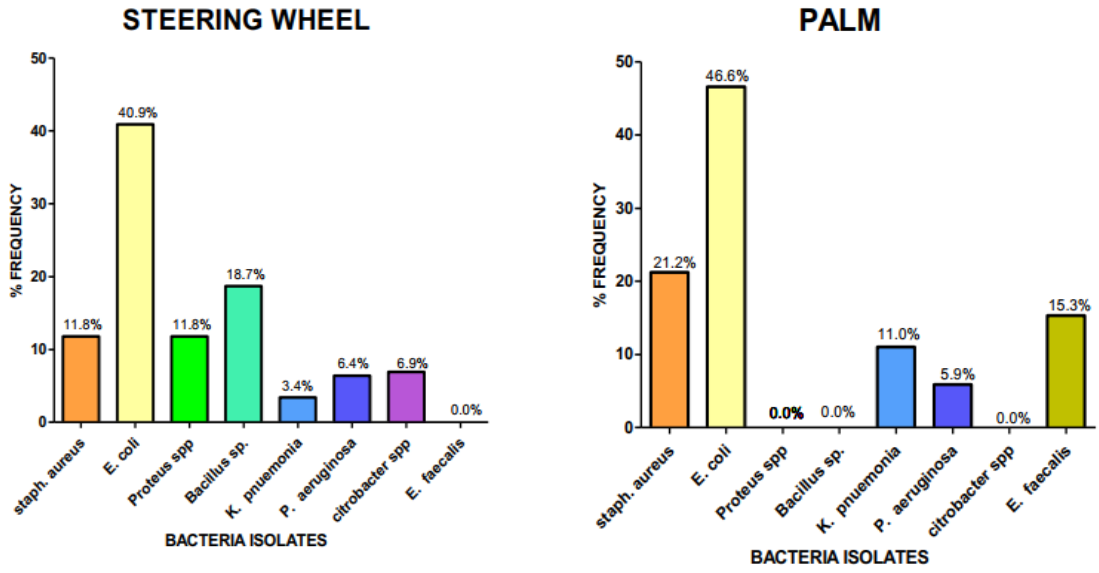

Fig. 1. Percentage occurrence of bacteria isolated from steering wheels of motor vehicle and palms of the drivers

The graphs above indicate the percentage occurrences of bacterial genera isolated from both the steering wheels and palms of drivers. *Escherichia coli* had the highest occurrence (40.9%) followed by *Bacillus* spp. (18.7%), *Staphylococcus aureus* and *Proteus* spp. (11.8%) as *K.pneumonia*, *P.aeroginosa* and *Citrobacter* spp. showed less than 10% occurrence. *E. faecalis* was absolutely absent from the steering wheels. *Escherichia coli* was dominant on the palms as well, with a percentage occurrence of 46.6%, followed by *Staph. aureus* (21.2%), *E. faecalis* (15.3%), *K. pneumonia* (11.0%) and *P. aeroginosa* (5.9%). Proteus spp., Bacillus spp., and Citrobacter spp. were totally absent on the palms of drivers.

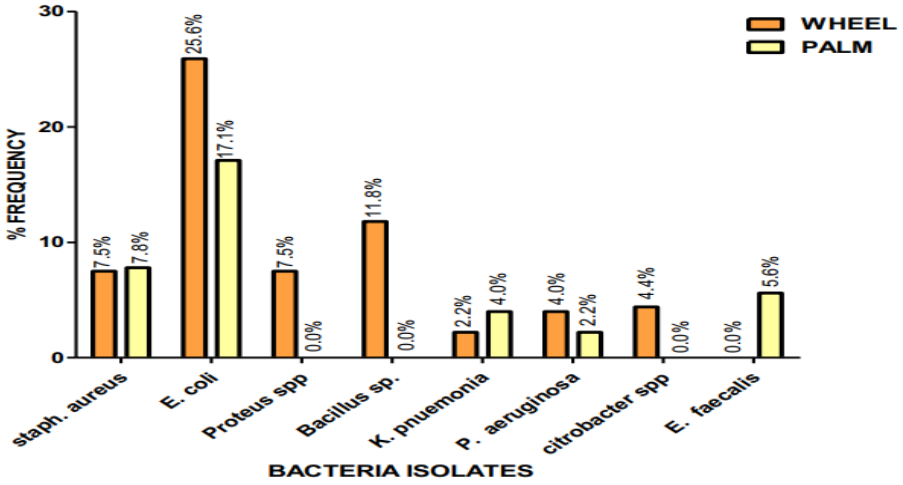

Fig. 2. Comparison of bacteria isolates form steering wheels of motor vehicles and palms of the vehicle drivers

The graph above compares the percentage occurrences of bacterial genera found on both steering wheels and palms of taxi drivers. It reveals that *E. coli* dominated on both surfaces though their percentage occurrences vary. *Staph. aureus, K. pneumonia* and *P. aeroginosa* were also identified on both palms of the drivers and the steering wheels. Some genera such as *Proteus spp, Bacillus spp, Citrobacter spp and E. faecalis* were at least found on either the steering wheel or palms of the drivers.

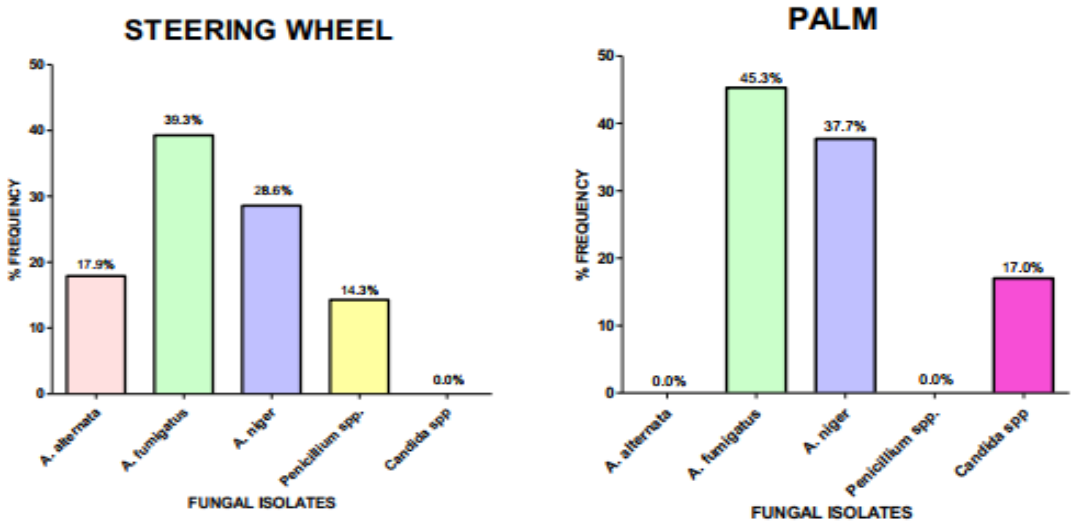

Fig. 3. Percentage occurrence of fungi isolated from steering wheels of motor vehicles and palms of the drivers

The graphs above indicate the percentage occurrences of fungal genera isolated from both the steering wheels and palms of drivers. *Aspergillus fumigatus* was the dominant genera with percentage occurrence of 39.3%, followed by *A. niger* (28.6%), *Alternaria alternata* (17.9%) and *Penicillium* spp. (14.3%) as *Candida* spp. was absolutely absent from the steering wheels. Again, *Aspergillus fumigatus* dominated with 45.3% occurrence on the palms of drivers, followed by *Aspergillus niger* (37.7%) and Candida spp. (17%). *Alternaria alternata* and *Penicillium* spp. were totally absent.

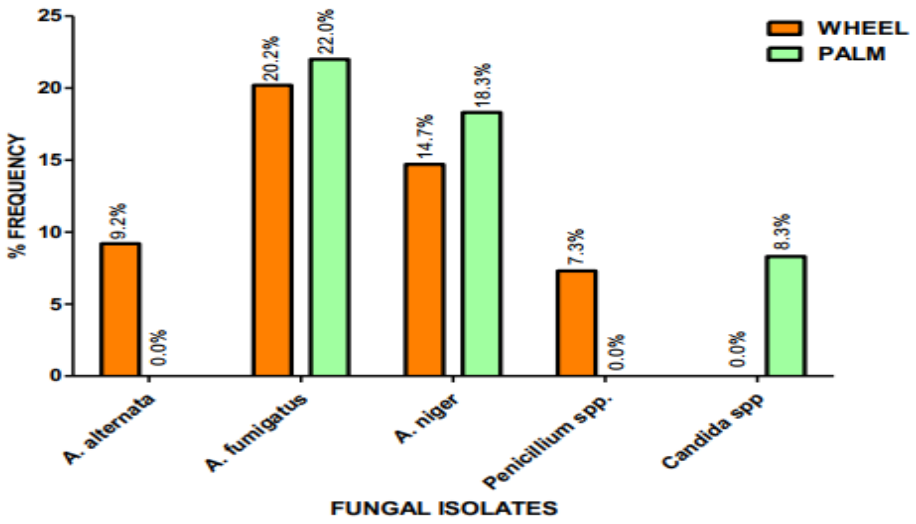

Fig. 4. Comparison of fungal isolates from steering wheels of motor vehicles and palms of drivers

The graph above compares the percentage occurrences of genera fungal found on both steering wheels and palms of taxi drivers. It shows that *Aspergillus fumigatus* dominated on both surfaces though their percentage occurrences vary followed by *Aspergillus niger*. Some genera such as *Alternaria alternata, Penicillium* spp, *Candida* spp, were at least found on either the steering wheel or palms of the drivers.

4. CONCLUSION

All sampled steering wheels and palms were highly contaminated with various types of bacteria and fungi. *Escherichia coli* pre-dominated the other bacterial isolates on both surfaces. *Aspergillus fumigatus* pre-dominated the fungal isolates. *Proteus* spp*, Bacillus* spp *and Citrobacter* spp were completely absent on the palms of drivers. *Altenaria alternata* and *Penicillium* spp were also not found on the palms. This suggest the potential of the steering wheels and palms as fomites which can result in community acquired diseases and infectious since most of microbial contaminants found were pathogenic in nature.

CONSENT

Consent was sought from drivers at the taxi rank and given before research was undertaken.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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