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REGULAR ARTICLE

MICROORGANISMS ASSOCIATED WITH COMMERCIAL MOTORCYCLE HELMETS IN LAGOS METROPOLIS

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ABSTRACT

Microorganisms associated with commercial motorcycle helmets were investigated in the commercial city of Lagos, Nigeria. 300 motorcycle helmets were randomly collected from different commercial motor cyclists in two densely populated areas of Lagos: Yaba College of Technology (YABATECH) and Lagos University Teaching Hospital (LUTH) main gates respectively. Two sterile swabs moistened with sterile water were rotated over the inner surface of each helmet and cultured on MacConkey Agar and Nutrient Agar for bacterial growth and Sabouraud Dextrose Agar for fungi growth. The plates for bacteria growth were incubated aerobically at 37 ºC for 48 h, while plates for fungi at 28 ºC for 2 weeks. Biochemical tests were used to identify bacteria; while, cultural characteristics were used for fungi identification. The microorganisms consistently common to the samples investigated in the two locations were similar and included (with respective frequency of occurrence for both location): *Staphylococcus aureus* (80%; 7%), *Pseudomonas aeruginosa* (75%; 12%), *Staphylococcus epidermis* (60%; 8%), *Enterobacter aerogenes* (52%; 27%), *Escherichia coli* (40%; 13%), *Bacillus* spp (37%; 10%), *Aspergillus* spp (82%; 7%), *Candida*

spp (55%; 22%), *Rhizopus* spp (40%; 27%), *and Penicilium* spp (35%; 12%). The motorcycle helmets collected at YABATECH had higher microbial colonization than LUTH irrespective of the isolates. This trend was similar for bacterial and fungi. Results showed that helmets could serve as vehicles for transmission of pathogens. Good hygiene practice (GHP) and regular cleaning of motor cycle helmets with sterilants is strongly advocated in order to reduce the incidence of microbial transmission and its associated infection.

Keywords: motorcycle helmet, hygiene, pathogenic organisms, fungi, bacteria

INTRODUCTION

Transportation is vital to every human community. One means of transportation in most part of the world is the motorcycle. Lagos State is the smallest state in Nigeria, with an area of 356,861 hectares of which 75, 755 hectares are wetlands and a projected population of 15 million (**Olugbenga, 2011**). Motorcycles (also known as "okada") are a popular means of transportation especially for short distance. Its frequent use and patronage is very high because it is faster, convenient and can easily maneuver through the regular traffic jam and get to any destination provided there is road (**Banjo *et al*., 2011**). The Nigerian crash helmet law came into force 1st January, 2009 (**BBC News, 2009**) and has made it compulsory for both the motorcycle rider and passenger to wear a helmet. Motorcycle helmets (MCHs) are capable of protecting motorcyclists from serious head/brain injuries in the event of an accident (**Liu, 2003**). However, motorcycle helmet could constitute a health hazard to the users. Constant handling and use of MCHs by different individuals could create a prime breeding ground for many microorganisms such as bacteria and mildews (**Roth and Femer, 1998**), and a possible transmission of pathogenic microorganisms as well as communicable diseases among users.

The human skin is constantly in contact with environmental microorganisms and become readily colonized by certain microbial species. The adult human skin supports about 10^{12} cfu/ml bacteria (**Mackowiak, 1982**). The normal microbiota of the skin include among others, coagulase negative *Staphylococcus, diptheroides, Staphylococcus aureus, streptococcus* (various species), *Bacillus* spp, *Mallassessia furfur, Candida* spp and occasionally, *Mycobacterium* spp are found on the skin (**Roth and Jenner, 1998**). However, this normal microbiota can produce disease condition if introduced into foreign locations or compromised hosts (**Ekrakene and Igekele, 2007**).

Other studies have focused on the vulnerability of riders, passengers and pedestrians (**Solagberu *et al*, 2009**), as well as factors affecting helmet use (**Skalkidou *et al.*, 1999**), frequency of helmet use (**Mumtaz *et al.*, 2007**) and enforcement of helmet laws (**Branas and Knudson, 2001; McSwain, 1990; Sosin, 1990**); while others have explored the reactions of motorcyclists (**Krantz, 1985**). The colonization of potentially pathogenic organisms on various objects, such as stethoscopes, bronchoscopes, pagers, ballpoint, pens, patient hospital charts, computer keyboards and mobile phones has been reported as a potential vehicle for transmission of pathogenic organisms and important source of infections (**Singh *et al.*, 1998 and 2002; Schultz *et al.*, 2003; Marinella, 1998 and Jeske *et al.*, 2007**). There is paucity of information on the potential hazard associated with the common use of motorcycle helmets by different people. Such information would reveal the public health implication of this practice and is vital to the advocacy of GHP among the people.

Hence, this study was undertaken to determine the microorganisms associated with commercial motorcycle helmets and its public health significance in Lagos State, Nigeria.

MATERIALS AND METHODS

A total of Six hundred (300 hundred from each location) randomly collected motor cycle helmets from two locations: Yaba College of Technology (YABATECH) main gate and Lagos University Teaching Hospital (LUTH) main gate, were used in this study. Microbial samples were collected from the motorcycle helmets using three sterile swabs according to the method described by **Gholamreza *et al.* (2009).** Three sterile swabs moistened with sterile water were rotated over the inner surface of the MCHs. The first swab was immediately streaked onto Nutrient agar (NA) plates and MacConkey (MAC) agar plates. The second swab was streaked on Sabouraud Dextrose agar (SDA). The third swab was incubated overnight at 37°C and pour plates were prepared from ten-fold dilutions on NA and MAC agar for aerobic counts. NA and MAC agar plates were incubated aerobically at 37°C for 48 h while SDA plates were incubated at 28°C and cultures examined every 48 h for evidence of growth. Distinct colonies were subcultured on NA until pure cultures were obtained. Pure cultures were held on slant and stored in the refrigerator at 4 °C until ready for use. Bacteria isolates were identified based on morphological characteristics (using Gram staining and viewing under the light microscope (x 100)) and a series of biochemical tests: Coagulase slide test, Catalase test, Indole production, Citrate utilization test, Oxidase test and Methyl red test. Fungal mycelium was teased out in a drop of lactophenol cotton blue on a

grease-free microscope slide as described by **Samson and Van Reenen-Hoekstra (1988)** and examined microscopically. Fungi were identified on the basis of cultural and morphological characteristics as reported by **Samson *et al.* (1984).**

RESULTS AND DISCUSSION

The various bacterial isolates obtained from MCHs from both locations of the study is shown in Table 1. Bacterial isolated include *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Staphylococcus epidermis*, *Enterobacter aerogenes*, *Escherichia coli* and *Bacillus subtilis.* In addition to bacteria, fungi isolates were found in MCHS from both locations as presented in table 2. The fungal isolates include three species of *Aspergillus: A. niger, A. flavus* and *A. fumigatus; Penicilium* spp*, Rhizopus* spp and *Candida* spp. Table 3 and table 4 shows the total aerobic count on Nutrient agar of YABATECH main gate and LUTH main gate sample respectively. These show that all the samples had significant growth on Nutrient Agar.

Table 1 Cultural characteristics, biochemical profile and identification of bacteria isolates from MCHs in LUTH and YABATECH

Cultural characteristic	Biochemical test						Probable organism
	CA	CI	CO	OX	IND	MR	
Circular, opaque, smooth, flat, undulate, white	+	+	-	-	+	+	*Bacilus subtilis*
Circular, opaque, smooth, shiny, flat, undulate, yellow pigment	+	-	+	-	-	+	*Staphylococcus aureus*
Circular, opaque, smooth, flat, undulate, pink	+	-	-	-	-	+	*Staphylococcus epidermidis*
Circular, translucent, low convex, smooth, lobate, undulate, greenish, diffusible and pigmented	+	+	-	+	-	-	*Pseudomonas aeruginosa*
Circular, convex, smooth, undulate, lobate, with entire margin, pink	+	-	-	-	+	+	*Escherichia coli*
Circular, transparent, smooth, flat, lobate, umbonate, yellow	-	+	-	-	-	-	*Enterobacter aerogenes*

CA = Citrate utilization, CO = Coagulase test, CA = Catalase test, IND = Indole production, MR = Methyl red test, OX = Oxidase test, + = Positive, - = Negative

Table 2 Cultural and morphological features of fungal isolates obtained from MCHs in LUTH and YABATECH

Cultural characteristic	Probable organism
Circular, transparent, rough, raised, lobate, filamentous, black	*Aspergillus niger*
Circular, transparent, rough, raised, undulate, pink	*Aspergillus fumigatus*
Circular, opaque, smooth, flat, umbonate, filamentous, yellow – green	*Aspergillus flavus*
Circular, transparent, flat, filamentous, rough, cottony, lobate, rough, brownish, cottony	*Rhizopus* spp
Circular, transparent, smooth, raised, white	*Penicillium* spp
Circular, transparent, undulate, lobate, flat, whitish pigment	*Candida* spp

Table 3 Total aerobic count on Nutrient Agar of YABATECH main gate sample

Sample	Dilution factor		
	10^5	10^3	10^2
1	100×10^5	250×10^3	300×10^2
2	80×10^5	150×10^3	200×10^2
3	100×10^5	150×10^3	200×10^2
4	100×10^5	300×10^3	TNC
5	200×10^5	TNC	TNC
6	200×10^5	320×10^3	TNC
7	120×10^5	150×10^3	180×10^2
8	150×10^5	200×10^3	300×10^2
9	100×10^5	250×10^3	TNC
10	200×10^5	230×10^3	TNC

NB: 10 samples were randomly selected and used for the total aerobic count (cfu/ml Bacteria). TNC:Too numberous count.

Table 4 Total aerobic count on Nutrient Agar of LUTH main gate sample

Sample	Dilution factor		
	10^5	10^3	10^2
1	10×10^5	15×10^3	25×10^2
2	40×10^5	70×10^3	150×10^2
3	26×10^5	60×10^3	180×10^2
4	20×10^5	50×10^3	80×10^2
5	22×10^5	30×10^3	52×10^2
6	19×10^5	35×10^3	64×10^2
7	35×10^5	65×10^3	150×10^2
8	15×10^5	40×10^3	70×10^2
9	35×10^5	55×10^3	65×10^2
10	36×10^5	60×10^3	95×10^2

NB: 10 samples were randomly selected and used for the total aerobic count (cfu.ml^{-1} Bacteria).

The frequencies of occurrence of the bacterial and fungal isolates are indicated in figures 1 and 2 respectively. Figure 1 generally indicates that higher numbers of bacteria was isolated from YABATECH than LUTH. Furthermore the figures indicate that *Staphylococcus aureus* had higher frequency of occurrence followed by *Pseudomonas aeruginosa* in YABATECH location. However, *Staphylococcus aureus* occured least frequently among the different bacteria species isolated from LUTH. *Bacillus subtilis* had the least frequency of occurrence for both locations. In figure 2, the frequency of occurrence of fungi isolates from both locations of the study are shown. Generally, higher numbers of the fungal isolates were isolated from MCHs from YABATECH than LUTH. *Aspergillus niger* had the least frequency of occurrence of all the fungal isolates in LUTH location. However, it had the most frequency of occurrence in YABATECH location. Of all the fungal isolates from LUTH, *Rhizopus* spp had the highest frequency of occurrence. *Penicilllum* spp had the lowest frequency of occurrence in YABATECH.

Microbes are the agents of disease; and a conscious effort at minimizing the transfer of such pathogenic agents through good hygiene practice (GHP) is imperative in order to maintain good health. This investigation brings to light the possible health hazard associated with the use or sharing of MCHs among motor cycle users, not just in the study area, but the world over. This study which comprised 300 randomly sampled MCHs in two locations shows that an array of microorganisms is associated with MCHs in Lagos metropolis. These microorganisms included (with the respective frequency of occurrence for both location) *Staphylococcus aureus* (80% and 7%), *Pseudomonas aeruginosa* (75% and 12%),

Staphylococcus epidermidis (60% and 8%), *Enterobacter aerogenes* (52% and 27%), *Escherichia coli* (40% and 13%), *Bacillus* spp (37% and 10%), *Aspergillus* spp (82% and 7%), *Candida* spp (55% and 22%), *Rhizopus* spp (40% and 27%), *and Penicilium* spp (35% and 12%). These organisms were all present in both locations and probably found their way into the helmets through the agency of skin and hair contact as well as hand to hand transmission.

It is important to note that most of the organisms implicated in this study are pathogenic. This has a lot of health implications (**Roth and Jenner, 1998**). *Staphylococcus aureus* is known to cause boils, abscesses, wound infections, toxic shock syndrome, pneumonia and other disease (**Brook *et al.*, 2007; Yusha'u *et al.*, 2010; Willey *et al.*, 2011**). On the other hand, *Staphylococcus epidernidis* is a common skin resident responsible for endocarditis and infections of patients with lowered resistance. Its presence indicates that the use and/or sharing of MCHs can lead to transmission of serious skin infections. The presence of *Enterobacter aerogenes* and *E. coli* indicate possible faecal contamination of the MCHs. The implication of this is that the handling of MCHs could be a potential source of food poisoning when infected hands are used in eating and food preparation without proper hygiene of hand washing (**Yusha'u *et al.*, 2010**). *Pseudomonas aeruginosa* infects people with low immune resistance such as cystic fibrosis patients. It also invades burns and causes urinary tract infection (**Willey *et al.*, 2011**).

Fungal organisms identified in this study equally have health implications like the bacterial counterpart. Most of the fungal isolates are inhabitants of soil and air (**Joanne *et al*, 2008**). *Aspergillus fumigatus* is ubiquitous in the environment. It is known to trigger allergic response and has been implicated in the increased incidence of severe asthma, sinutis and pulmonary aspergillosis (**Willey *et al.*, 2011**). *Aspergillus* spp were also implicated in a similar work carried out by **Yusha'u *et al.*, (2010)** on mobile phones. *Candida* spp also identified in this study are known pathogens that cause candidiasis (**Brook *et al.*, 2007; Yusha'u *et al*., 2010; Willey *et al.*, 2011**). However, they are a part of the normal microbiota within the gastrointestinal tract, respiratory tract, vaginal area (**Willey *et al.*, 2011**). *Rhizopus* spp are capable of producing toxins, which can lead to food poisoning (**Yusha'u *et al.*, 2010; Ekrakene and Igeleke, 2007**).

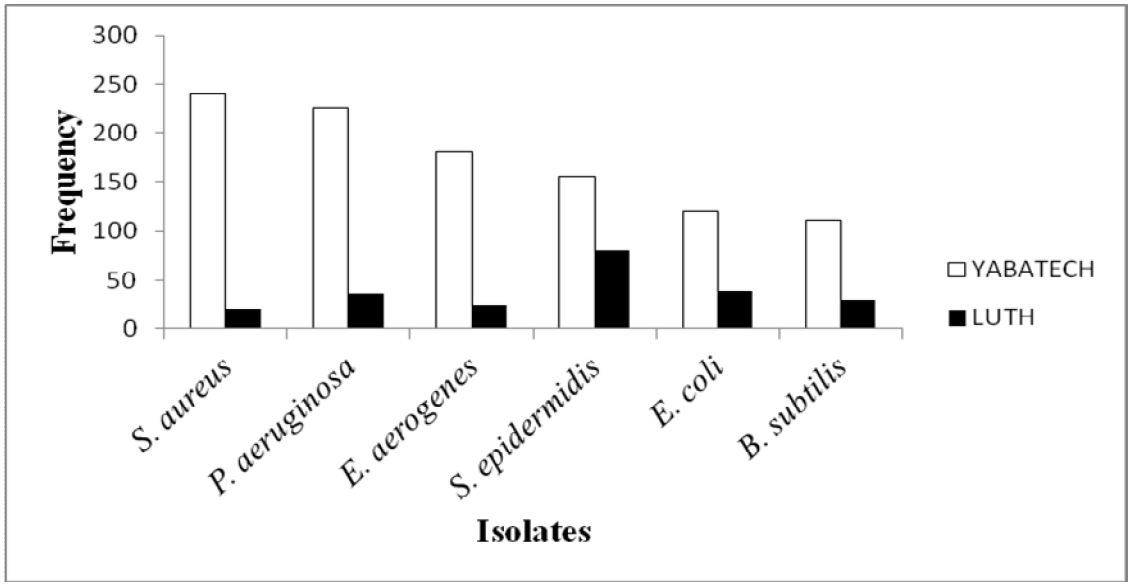

Figure 1 Frequency of occurrence of bacterial isolates in MCHs from YABATECH and LUTH

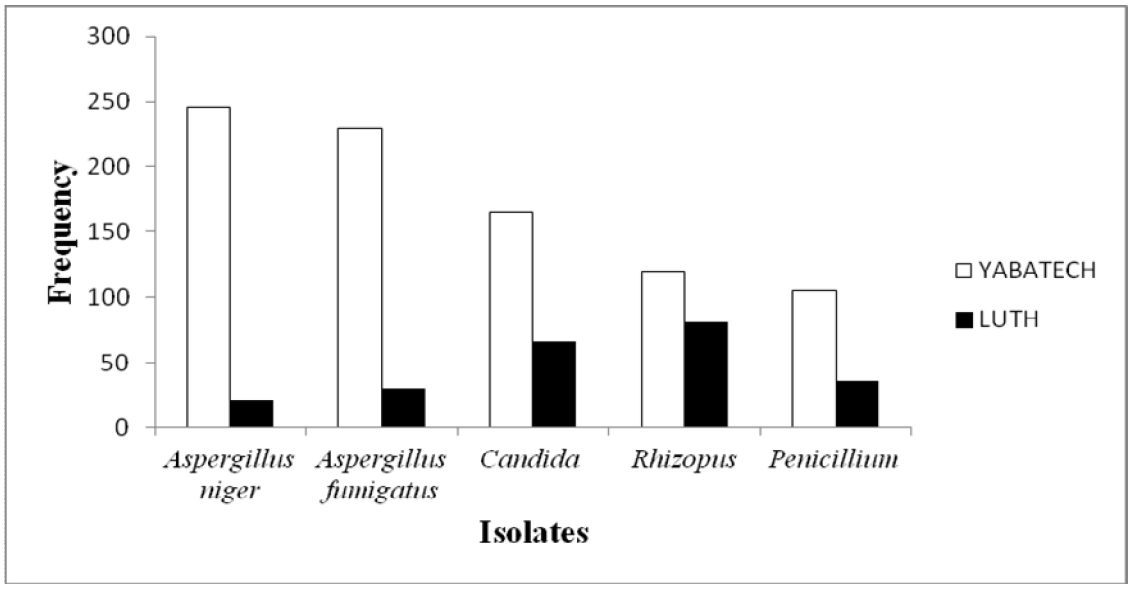

Figure 2 Frequency of occurrence of fungal isolates in MCHs from YABATECH and LUTH

CONCLUSION

This study has revealed that motorcycle helmets could serve as a vehicle for transmission of microorganisms with serious health implications. We therefore recommended that Good hygiene practice (GHP) be adhered to during and after handing of motorcycle

helmet, and as well, that regular cleaning of motor cycle helmets with sterilants be carried out in order to reduce the incidence of microbial transmission and its associated infection.

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REFERENCES

BARAN, R. 2003. Pathogen carriage in health care workers wearing nail cosmetic. In *Abstracts of the fifth meeting of the European Nail Society*, *Dermatology Online Journal,* vol. 9, 2003, no. 1, 17 D. available online from: http://dermatology.cdlib.org/91/abstracts/nail/17D.html

BANJO, T. – NWAZE, E. – AJA, G. N. D. 2011. Perceptions and attitudinal disposition of commercial motorcycle passengers towards helmet use in a Nigerian metropolitan suburb. In *Acta SATECH,* vol. 4, 2011, no. 1, p 74 – 80.

BBC NEWS. 2009. Nigerian motorcyclists dodge helmet laws by wearing vegetables. BBC News, January 6, 2009. Available from http://www.huffingtonpost.com/2009/01/06/nigerian-motorcyclists-do_n_155756.html.

BRANAS, C. C. – Knudson M. M. 2001. Helmet laws and motorcycle rider death rates. In *Accident analysis and prevention*, vol. 33, 2001, no. 5, 641-648.

BROOKS, G. F. – BUTEL, S. J. –MOSES, S. A. 2007. In: JAWETZ – MELNICK – ADELBERG'S (Eds) Medical Microbiology. International edition, Lange Medical Books/McGraw-Hill Medical Publishing Division, USA, p. 147-150.

EKRAKENE, T. – IGELEKE, C. L. 2007. Micro-organism Associated with public mobile phone along Benin, Sapele Expressway. In *Journals of Applied Science Researches,* vol. 3, 2007, no. 12, p. 2009-2012.

GHOLAMEREZA, S. –NOOSHIN, T. – ALI, M. – TOURAJ-REZA, M. – EHSAN, S. 2009. Bacterial contamination and resistance to commonly used Antimicrobials of Health care workers' mobile phones in teaching Hospitals, Kerman, Iran. In *American Journal of Applied sciences,* vol. 6, 2009, no. 5, p. 806- 810.

HAZEN, A. – EHIRI, J. E. 2006. Road traffic injuries: Hidden epidemic in less developed countries. In *Journal of the National Medical Association,* vol. 98, 2006, no. 1, p. 73-82.

JESKE, H.C. – TIEFENTHALER, W. – HOHLRIEDER, M. – HINTERBERGER, G. – BENZER, A. 2007. Bacterial contamination of anethetists' hands by personal mobile phone and fixed phone use in the operating theatre. In *Anaesthesia*, vol. 62, 2007, p. 904-906.

KRANTZ, K. P. 1985. Head and neck injuries to motorcycle and moped riders with special regard to the effect of protective helmets. In *Injury,* vol. 16, 1985, p. 253–258.

Liu B. – Ivers, R. – Norton, R. – Blows, S. – Lo, S. K. 2003. Helmets for preventing injury in motorcycle riders. In *Cochrane Database of Systematic Reviews*, vol. 4, 2003, no.: CD004333. DOI: 10.1002/14651858.CD004333.pub2.

MACKOWIAK, P. A. 1982. The normal microbial flora. In *New England Journal of Medicine*, vol. 307, 1982, p. 83.

MARINELLA, M. A. 1998. The stethoscope and potential nosocomial infection. In *Infection Control and Hospital Epidemiology*, vol. 19, 1998, p. 477-478.

MCSWAIN, N. E. – BELLES, A. 1990. Motorcycle helmets - medical costs and the law. In *Journal of Trauma*, vol. 30, 1990, no. 10, p. 1189-97.

MUMTAZ, B. – KHAN, M. H. – KHAN, M. W. – AHMED, M. – MAHMOOD, A. 2007. Frequency of helmet use among motorcycle riders in Rawalpindi. In *Professional Medical Journal,* vol. 14, 2007, no. 4, p.663-668.

OLUGBENGA, I. A. – ADEJUMO, O. T. 2011. Urban Agriculture in metropolitan Lagos: an inventory of potential land and water resources. In *Journal of Geography and regional planning*, vol. 4, January 2011, no. 1, p. 9-19.

ROTH, R. – JENNER, W. 1998. Microbial Ecology of the skin. In *Annual Review of microbiology*, vol. 42, 1998, no. 1, p. 42 - 43.

SAMSON, R. A. – HOEKSTRA, E. S. – VAN OORSCHOT, C. A. N. 1984. Introduction to foodborne fungi. 2nd edition. Centraalbureau Voor Schimmelcultures, Institute of the Royal Netherlands, Academy Arts Science, Baarn, Delft, 1984, p. 248.

SAMSON, R. A. – VAN REENEN-HOEKSTRA, E. S. 1988. Introduction to Foodborne Fungi. 3rd Edition. Centraalbureau voor Schimmelcultures (CBS), Institute of the Royal Netherlands Academy of Arts and Sciences, Baarn, Delft, 1988, p. 299.

SCHULTZ, M. – GILL, J. – ZUBAIRI, S. – HUBER, R. – GORDIN, F. 2003. Bacterial contamination of computer keyboards in a teaching hospital. In *Infection Control of Hospital Epidemiology,* vol. 23, 2003, p. 274-276.

SINGH, V. – AGGARWAL, V. – BANSAL, S. – GARG, S. P. – CHOWDHARY, N. 1998. Telephone mouthpiece as a possible source of hospital infection. In *Journal of the Association of Physicians of India*, vol. 46, 1998, p. 372-373.

SKALKIDOU, A. – PETRIDOU, E. – PAPADOPOULOS, F. C. – DESSYPRIS, N. – TRICHOPOULOS, D. 1999. Factors affecting motorcycle helmet use in the population of Greater Athens, Greece. In *Injury Prevention,* vol. 5, 1999, p. 264-267.

SOLAGBERU, B. A. – OFOEGBU, C. K. P. – NASIR, A. A. – OGUNDIPE, O. K. – ADEKANYE, A. O. – ABDUR- RAHMAN, L. O. 2006. Motorcycle Injuries in a developing country and vulnerability of riders, passengers, and pedestrians. In *Injury Prevention,* vol. 12, 2006, p. 266-268.

SOSIN, D. M. – SACKS, J. J. – HOLMGREEN, P. 1990. Head injury-associated deaths from motorcycle crashes. In *Journal of the American Medical Association*, vol. 264, 1990, p. 2395–2399.

WILLEY, J. M. – SHERWOOD, L. M. – WOOLVERTON, C. J. 2011. Prescotts Microbiology (8th edition). McGraw hill, New York, 2011, p. 969 – 971.

YUSHA'U, M. – BELLO, M. – SULE, H. 2010. Isolation of bacteria and fungi from personal and public mobile cellphones: A case study of Bayero University, Kano (Old Campus). In *International Journal of Biomedical and Health Sciences*, vol. 6, 2010, no. 1, p. 97- 102.