Bima Journal of Science and Technology, Vol. 8(3B) Oct, 2024 ISSN: 2536-6041

DOI: 10.56892/bima.v8i3B.1002

Hygienic Practices and Fungal Contamination: Evaluation of Commercial Tricyclists and Contact Surfaces of Tricycles within Gombe Metropolis

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ABSTRACT

Tricycles ("Keke napep") are a popular means of transportation in Gombe especially Gombe Metropolis, Nigeria, particularly for moderate-to-lower income earners. However, concerns exist regarding unknown hygienic practices as fungi frequently contaminate contact surfaces and therefore pose a significant threat to tricycle passengers hence, this study aimed to assess the knowledge, attitudes, and practices (KAP) regarding hygienic practices amongst tricycle users and level of tricycle fungal contamination within Gombe Metropolis. A cross-sectional survey was conducted involving random data collection from 250 tricyclists (collected in duplicate). Descriptive and inferential statistics and standard microbiological techniques were used to analyze the collected data and samples. Antifungal susceptibility testing (AST) was carried out using standard disc antibiotics. The findings revealed that most respondents demonstrated good knowledge of hygienic practices (65.2%), while a significant proportion (74.4%) observed poor hygiene practices in tricycles. Fungi isolates such as *Candida albicans* and *Aspergillus niger* were isolated from the study. *A. niger* and *C. albicans* exhibited sensitivity to fluconazole and ketoconazole but resistant to griseofulvin. These findings underscore the importance of maintaining good hygienic practices to mitigate the risk of disease contraction in tricycles, thus promoting public health and preventing the spread of diseases.

Keywords: Knowledge, Attitude, Practices, Tricycles, Occupational, Health safety and Commercial Drivers.

INTRODUCTION

Passenger knowledge and attitude towards hygiene measures in public transport systems form a critical cornerstone of public health, necessitating effective information dissemination strategies. Public health campaigns, grounded in scientific evidence and recommendations from health authorities, play a crucial role in raising awareness and shaping behavior. For example, the COVID-19 pandemic witnessed widespread dissemination of information on mask-wearing, handwashing, and sanitization through public service announcements, social media, and traditional media. This collective understanding significantly contributed to curbing disease transmission within transport systems (Smith *et al*., 2020).

Accessibility to information is paramount. Timely updates and clear guidance from health authorities empower passengers to make informed decisions regarding hygiene practices. Providing information in multiple languages and formats expands reach and ensures inclusivity. Public health education programs and workshops conducted within transport hubs can further enhance knowledge and address misconceptions about hygiene protocols (Johnson *et al*., 2019).

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Passengers' attitudes towards transport hygiene are multifaceted and susceptible to external influences. Perceptions of infection risk significantly impact individuals' behaviour. During disease outbreaks like SARS (2003) or COVID-19, heightened awareness of health risks often translates into more positive attitudes and compliance with hygiene guidelines (Johnson et al., 2019). Furthermore, individuals with positive attitudes are more likely to consistently adopt these practices, highlighting the importance of fostering a culture of collective hygiene within transport systems. Respect for fellow passengers and the understanding that good hygiene safeguards not only oneself but also the community, significantly influence individual behaviour. Embracing social responsibility motivates individuals to actively participate in and advocate for effective hygiene measures in shared spaces (Smith et al., 2020).

Bridging the gap between knowledge and consistent practice is crucial for successful disease prevention. Hand hygiene, a cornerstone practice, necessitates readily accessible handwashing facilities and hand sanitizers in transport hubs. While studies like Brown and Lee (2021) demonstrate high knowledge levels about hand hygiene, compliance can vary. Convenient and readily available facilities are essential for bridging this gap. Similarly, mask-wearing became a prominent practice during the pandemic. Clear signage, announcements, and enforcement by transport authorities play a vital role in ensuring compliance. Social distancing, while challenging in crowded settings, can be facilitated by passenger awareness and adherence to designated seating arrangements (Smith et al., 2020).

Transport authorities must also actively contribute to maintaining hygiene standards. Regular cleaning and sanitization protocols for vehicles, stations, and terminals are mandatory. Passengers can further contribute by disinfecting their personal spaces and promoting respiratory etiquette, such as covering coughs and sneezes, through personal actions and reminders displayed strategically (Smith-Johnson, 2022).

Fungi are ubiquitous and can spread from place to place through air, and water (Peters *et al*., 2018). The most frequent fungi that can be found in indoor air and surfaces of objects include *Candida albicans* and some species of *Aspergillus, Penicillium*, and *Cladosporium* (Hota, 2004). Therefore, the contact surfaces of tricycles within Gombe metropolis were investigated for fungal contamination and knowledge, attitude and practices of the tricycle drivers including the passengers were also evaluated as the aim of the study.

MATERIALS AND METHODS

Study Design

A descriptive cross-sectional study design was used in this study. This research design is appropriate because of its advantages in identifying attributes of a large population from a group of individuals. The design is suitable for the study of the awareness of tricycle operators.

Ethics Statement

The procedures for the study were in accord with the ethical standards of the Research Ethics Committee of Gombe State University. Ethical approval was obtained in favor of the conduct of the research, Participants' consents were also sought before the commencement of the study.

Study Participants

The participants in this study were tricycle operators and tricycle passengers in Gombe metropolis, Gombe. The subjects were residents of the Gombe metropolis and aged

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18–60 years. Considering the fact that it would be cumbersome to study the entire population due to time, cost and accessibility, a subset of the population; sample size was used so as to represent the whole population. Sample is viewed not as a whole in itself but as an approximation of the whole. In determining the sample size of this research, Taro Yamani's Statistical Formula were applied.

$$n = \frac{Z^2 pq}{d^2}$$

Where, n = sample size

Z = standard normal deviation responding to a 95% confidence interval level= 1.96 on the normal distribution table

p=prevalence of previous study

q = 1-p

d =degree of precision or margin error allowed at 95% confident limit, 5%=0.05

The translation of the formula is as follows:

$$n = \frac{1.96^2 \times 0.205\ (1 - 0.205)}{0.05^2}$$

$$n = \frac{3.8416 \times 0.205(0.795)}{0.0025}$$

$$n = \frac{3.8416 \times 0.162975}{0.0025}$$

$$n = \frac{0.6260}{0.0025}$$

$$n = 250.4$$

Hence, a sample size of 250 tricycles and tricycle passengers was utilized in this study.

Inclusion Criteria

All participants that operate and/or patronize tricycle business in Gombe metropolis and between the age (18 to 60 years) were included.

Exclusion Criteria

Tricycle operators that are not from the study area and those whose ages are between the age (18 to 60 years) but are not willing to participate.

Questionnaire Administration

A total of 250 sets of questionnaires comprising of close ended questions were administered to 250 tricycle passengers with the help of research assistant to provide their view on the awareness of tricycle users and isolation of fungal contamination from contact surfaces of the tricycles. The questionnaire was adopted from Abdulai *et al*. (2020) with modification. Other information on respondents such as demographic characteristics: age, gender, marital status, and level of education were also obtained from the respondents.

Data Analysis

All experimental data was analyzed and interpreted using descriptive statistics such as means, standard deviations, percentages, and frequencies. Independent sample t-test was used to analyze the differences between the population's male and female sociodemographic characteristics. All data analyses were performed using the SPSS statistical package (Version 22).

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Fungi Isolation

Hand contact surfaces of tricycles were swabbed with pre-moistened cotton-tipped swab sticks from different parts of the tricycle (right handle, left handle, driver's entrance, conductor entrance, and Kickstart lever). The swabs were immediately inoculated onto plates containing potato dextrose agar (PDA) and plates of PDA plus 50ug/ml of chloramphenicol and incubated at 28^{o}C for seven days (Okolo *et al*., 2020).

Fungi Identification

The incubated culture plates were observed daily and fungi isolates were subsequently identified by both macroscopic and microscopic features of each colony isolated. The fungi were identified based on the colony features and morphological characteristics of direct wet mount preparation with lactophenol cotton blue. Following the manufacturer's instruction, yeasts were identified using Brilliance Candida Agar (oxoid U.S.A). The germ tube test was used to confirm the *Candida albicans* isolated.

Antifungal Susceptibility Testing (AST)

The isolated fungi were subjected to antifungal susceptibility testing using the disk diffusion method (CLSI, 2017) to determine the antifungal susceptibility pattern of the isolates

RESULTS

Data obtained was analyzed and presented below using descriptive statistics such as means, percentages, and frequencies. Of the 250 questionnaires administered to the tricycle drivers, 235 (94%) were filled and returned while 6% of questionnaires were missing (Figure 1).

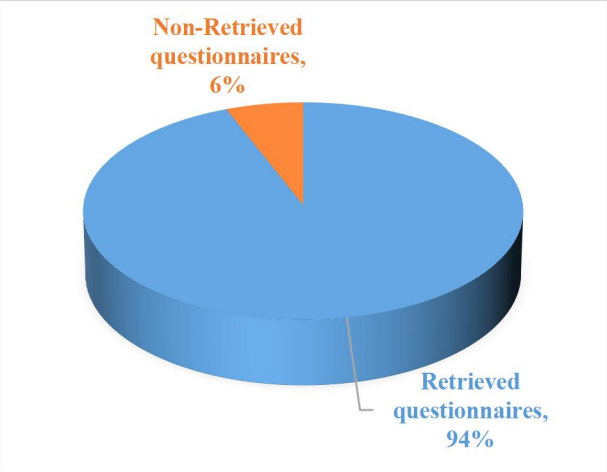

Figure 1: Total number of respondents.

Socio-demographic Characteristics of the Study Respondents

According to the data collected, all the 235 respondents (tricycle drivers) were males. The result of the age distribution of the tricycle passengers that participated in the survey is presented in (Figure 2) which revealed that respondents within the age range of 18 – 25 years recorded the lowest at 4(1.6.2%), whereas respondents within the age range of 26 – 35recorded the highest at108 (43.2%). The age distributions of the study population were in the following descending order (26 – 35 years) > (46 – 60 years)> (36 – 45 years) > (18 – 25 years).

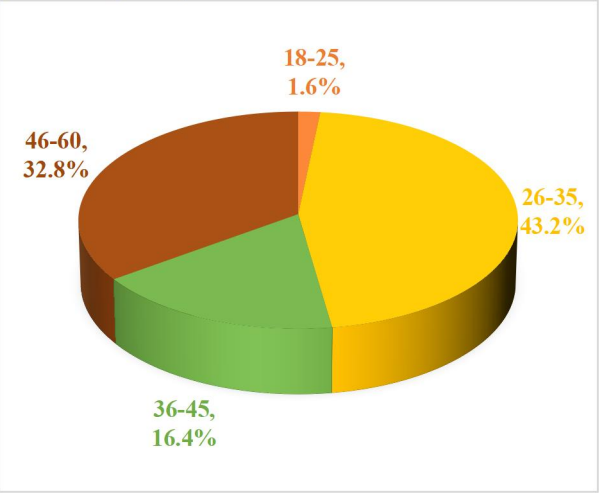

Figure 2: Age distribution of the respondents.

Bima Journal of Science and Technology, Vol. 8(3B) Oct, 2024 ISSN: 2536-6041

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The present result on the marital status of the respondents indicates that 116 (46.4%) of the respondents are married; 111 (44.4%) are single, and 8 (3.2%) are divorcee (Figure 3).

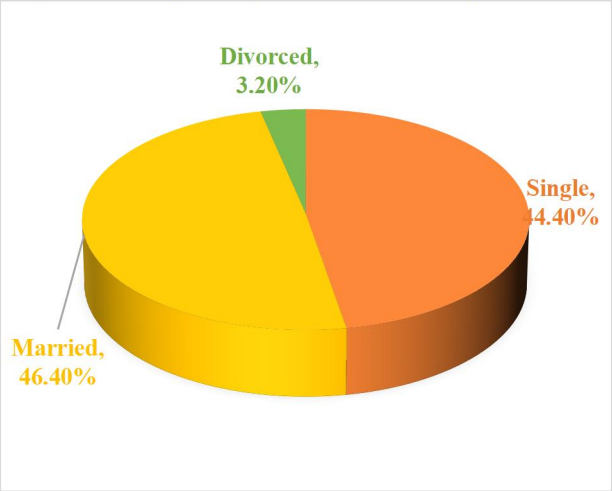

Figure 3: Marital status of the respondents.

The educational qualifications of the study respondents are shown in Figure .4. This result indicates that respondents with secondary school qualification recorded the highest percentage at103 (41.2%) 48 (21%), followed by those with no formal education representing83 (33.2%) and those with primary school certificates represent49 (19.6%). This shows that majority of the tricyclists are skilled.

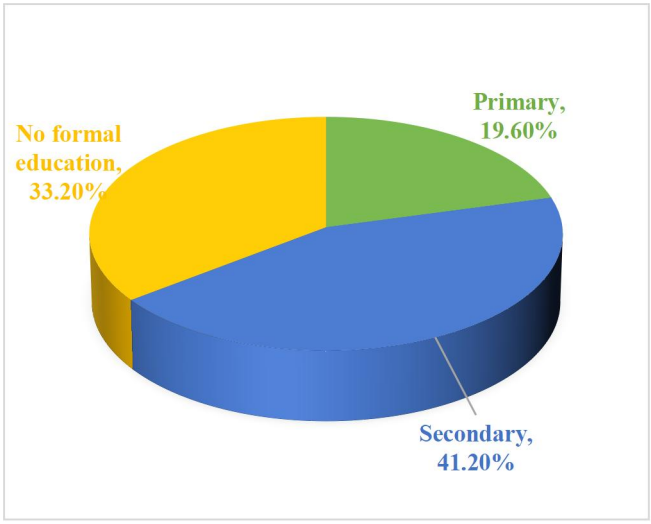

Figure 4: Educational qualification of the respondents.

Knowledge, Attitude and Practice (KAP) Among Commercial Tricycle Drivers

Table 1 showed the knowledge of hygiene among commercial tricycle drivers. From the results, it can be seen that the majority of the respondents (232; 92.8%) know the meaning the surface contamination, 186 (74.4%) are not sure that hand touching surfaces can be colonized by infectious microorganisms, 140 (56%) affirms that surface contamination can lead to infectious diseases, and 163 (65.2%) understand that surface contamination can be prevented by proper precautions.

Table 1: Knowledge of commercial tricyclists regarding hygienic practices.

	Yes	Not sure	No
Do you know the meaning of surface contamination?	232 (92.8%)	3 (1.2%)	-
Do you know that hand touching surfaces can be colonized by infectious microorganisms?	49 (19.6%)	186 (74.4%)	-
Do you know that surface contamination can lead to infectious disease?	140 (56%)	95 (38%)	-
Do you know that surface contamination can be prevented by proper precaution?	163 (65.2%)	72 (28.8%)	-

Attitude of Commercial Tricyclists Regarding Hygienic Practices

Table 2 Showed The Attitude Of Hygiene Among Commercial Tricycle drivers. From the results, it can be seen that the majority of the respondents (232; 92.8%) believe that regular washing of tricycle will help in preventing surface contamination, 186 (74.4%) are not sure that infectious diseases can spread through handshake and 226 (90.4%)

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believe that awareness can help prevent disease spread through surface contamination.

Table 2: Attitude of commercial tricyclists regarding hygienic practices.

	Yes	Not sure	No
Do you believe that regular washing of tricycle will help in preventing surface contamination?	232 (92.8%)	3 (1.2%)	-
Do you believe that infectious diseases can spread through handshake?	49 (19.6%)	186 (74.4%)	-
Do you believe that awareness can help prevent disease spread through surface contamination?	226 (90.4%)	24 (9.6%)	-

Practice of Commercial Tricyclists Regarding Hygienic Practices

Table 3 showed the practice of hygiene among commercial tricycle drivers. From the results, it can be seen that all the respondents (235; 100%) use hand sanitizer and use detergent in washing their tricycle, while 177 (70.8%) are not sure. They seldom wash your tricycle after dropping a sick passenger. From the results obtained, it can be inferred that majority of the commercial tricycle drivers had an average knowledge, attitude and practice on fungal contamination and contact surfaces.

Table 3: Practice of commercial tricyclists in assessment of hygienic practices.

	Yes	Not sure	No
Do you use hand sanitizer?	235 (100%)	-	-
Do you wash your tricycle after dropping a sick passenger?	58 (23.2%)	177 (70.8%)	-
Do you use detergent in washing the tricycle?	235 (100%)	-	-

The microscopic and macroscopic features of the isolates revealed cream yellow with a smooth texture and slightly black colour with smooth-walled surfaces and hairs-like structure in terms of colour/texture for the two isolated organisms, while the microscopic characteristics include hyphae formation, discrete spouse or colonies like structure, the mass of hyphae, possession of spore and presence of sporangiophore and sporangium and the organisms isolated include *C. albicans* and *A. niger* as presented in Table 4.

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Table 4: Microscopic and Macroscopic Features of Fungi Isolates.

Colour/Texture	Microscopy	Fungi
Cream yellowish with a smooth texture	Formation of hyphae Desecrate spouse or colonies like structure	*C. albican*
Slightly black color, smooth walled surfaces, heirs-like structure	Mass of hyphae Possession of spore, Sporagiophore present and sparangium	*A. niger*

The frequency of occurrence of the fungi isolated from the contact surfaces of tricycles were presented in Table 5 below.

Table 5: Frequency of Occurrence of Fungi Isolated from Contact Surfaces.

Isolated fungi	Frequency	Percentage (%)
C. albicans	166	39.7
A. niger	252	60.3
Total	**418**	**100**

Table 6: Prevalence of Isolated Fungi Based on Contact Surfaces.

Fungi Isolates	Right handle			Left handle			Driver entrance			Conductor entrance			Kickstart lever			Overall Total
	Single	Mixed	Total	Single	Mixed	Total	Single	Mixed	Total	Single	Mixed	Total	Single	Mixed	Total	
C. albicans	8 (18.2%)	36 (81.8%)	44 (100%)	12 (36.4%)	21 (63.6%)	33 (100%)	9 (28.1%)	23 (71.9%)	32 (100%)	14 (34.1%)	27 (65.9%)	41 (100%)	4 (25%)	12 (75%)	16 (100%)	166 (30.9%)
A. niger	44 (36.7%)	76 (63.3%)	120 (100%)	31 (39.2%)	48 (60.8%)	79 (100%)	14 (18.4%)	62 (81.6%)	76 (100%)	21 (37.5%)	35 (62.5%)	56 (100%)	18 (43.9%)	23 (56.1%)	41 (100%)	252 (46.8%)
Total	52 (31.7%)	112 (68.3%)	164 (100%)	43 (38.4%)	69 (61.6%)	112 (100%)	23 (21.3%)	85 (78.7%)	108 (100%)	35 (36.1%)	62 (63.9%)	97 (100%)	22 (38.6%)	35 (61.4%)	57 (100%)	538 !00%)

Table 7: Antifungal Sensitivity Test.

Fungi Isolates	Antifungals (µg/mL)		
	Fluco (200µg/m)	Keto (200µg/m)	Griso (500µg/m)
Candida albicans	18	21	16
Aspergillus niger	22	18	21

Key: µg/mL = microgram/mililitre, Fluco= Fluconazole, Keto= Ketoconazole, Griso= Griseofulvin.

DISCUSSION

The findings of the present study showed the age distributions of tricycle users. The ages of the tricycle users were in the order, of 18 – 25 years > 26 – 35 years > 36 – 45 years > 46 – 60 years. The tricycle passengers within the age range of 26 – 35 years were the highest at 108(43.2%) whereas, respondents within the age range of 18 – 25 years were the least at 4 (1.6%). The majority of the tricycle users in the study had an average level of education and exposure. The results showed that there is significant ($p<0.05$) association between the knowledge and attitude of tricycle users on hygienic practices. In support of this finding, Bloomfield (2007) found that higher levels of knowledge about hygiene are positively associated with improved hygienic practices. In addition, Redmond and Griffith (2003) have shown a positive correlation between education and the practice of hand hygiene. Similarly, Curtis *et al* (2000) observed that a positive attitude toward hygiene could act as a motivator for adopting and maintaining good hygienic practices. According to Aiello (2010), consistent and correct hygiene practices are essential in preventing the spread of diseases. Similar study revealed that

DOI: 10.56892/bima.v8i3B.1002

individuals with higher levels of education were more likely to engage in good hygienic practices such as handwashing and using a clean towel after bathing (Alshehri *et al*., 2021).

The findings of this study revealed that sociodemographic characteristics (gender, age, marital status and educational qualification) significantly ($p<0.05$) affect the knowledge, attitude, and practice (KAP) of hygienic practices among tricycle users. KAP of hygienic practices among tricycle users can be complex and may vary depending on the specific cultural and socioeconomic context (Tiwari *et al*., 2020). The findings showed that majority of the respondents had good knowledge regarding hygienic practices (65.2%). However, majority of the study respondents (74.4%) observed poor hygienic practices in tricycles. Similar to the present study, the findings of Rahman et al. (2016) revealed that average tricyclists tend to have slightly better knowledge of hygiene practices due to their exposure to various health messages over time.

The results obtained from the study include *C. albicans* and *A. niger* fungi isolates. This showed that contact surfaces of tricycles are easily contaminated by the above pathogenic fungi, and this is in line with the report of Okolo et al., 2020. The prevalence of isolated fungi based on contact surfaces was presented in Table 6. From the Table, it was clearly shown that both right and left handles had the highest fungi contamination which were 120%, 164%, 79% and 112% for both *C. albicans* and *A. niger* respectively. This was followed by both tricyclists and conductor's entrances with 76%, 108%, 56% and 97% for *C. albicans* and *A. niger* respectively. While kickstart lever recorded the least fungi contamination with 41% and 57% for both *C. albicans* and *A. niger* respectively. These findings indicated the possibility of mycoses contraction through keke napep as a means of transportation due to the isolation of pathogenic fungi (*C. albicans* and *A. niger*). The result obtained is in agreement with the report of Okolo et al., 2020.

Table 5 showed the frequency of occurrence of fungi isolated from contact surface of tricycles within Gombe Metropolis. It is observed that *A. niger* had the highest frequency of occurrence with 252 (60.3%) while *C. albicans* had the lowest frequency of occurrence with 166 (39.7%). However, this result obtained from the study is in contrast with that of Okolo et al., 2020.

The isolated fungi were subjected to antifungal susceptibility testing (Table 7) of three different antifungal agents (fluconazole, Ketoconazole and Griseofulvin) and the findings revealed that both the isolates were susceptible to both fluconazole and ketoconazole but resistant to griseofulvin. This susceptibility pattern would help in the mycoses treatment.

CONCLUSION

The study evaluated a concerning prevalence of fungi contaminants on contact surfaces of tricycles and hygienic practices of the tricyclists within the Gombe metropolis, despite the high level of knowledge regarding hygienic practices among tricycle users a significant proportion (74.4%) observed poor hygiene practices in tricycles. The identified fungi isolates and their antimicrobial sensitivity profiles provide valuable insights into potential strategies for mitigating contamination and enhancing public health in urban transportation settings.

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