The Bioscientist Journal Vol. 14 (2): 57 – 63, May 2026
Journal of the Faculty of Biosciences, Nnamdi Azikiwe University, Awka, Nigeria
Available online at http://www.bioscientistjournal.com
DOI 10.54117/the_bioscientist.v14i2.217



OPEN ACCESS

Full Length Research Article

Knowledge of Disease Transmission, Disinfection Practices and Fungal Contamination of Tools among Barbers in Awka, Anambra State, Nigeria.

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***Article History**: Received: 10th December, 2025 Accepted: 31 May, 2026*

Abstract
Barbershops inherently pose significant public health risks through the use of sharp instruments and direct skin contact. This study assessed the knowledge of disease transmission among barbers, evaluated disinfection practices, and determined the level of fungal contamination of barbing tools in Awka, Anambra State, Nigeria. A cross-sectional study employing stratified random sampling was conducted among 30 professional barbers across three strata of Awka metropolis. Semi-structured questionnaires were used to assess awareness and hygiene practices, while 120 swab samples were collected from clippers, combs, brushes and scissors before and after disinfection for mycological analysis using standard mycological procedures. Results showed that although 53.3% of barbers were aware that diseases could be transmitted through barbering tools, only 23.3% disinfected tools after each customer. Hygiene practices were inconsistent; while 46.7% barbers disinfect clippers before and after use, 53.3% cleaned accessories only once daily. All sampled tools (100%) were contaminated with fungi before disinfection while 42.5% remained contaminated after disinfection, despite the use of petrol, methylated spirit, heat, and combined heat-chemical method. The reduction in contamination after disinfection was statistically significant (McNemar's test, $p < 0.001$). *Aspergillus niger* (44.0%) was the predominant isolate, followed by *Penicillium* spp. (23.9%) and *Candida albicans* (19.3%). Brushes exhibited the highest post-disinfection contamination rate (60.0%), while clippers showed the lowest (30.0%). Highest number of fungal isolates (42.5%) was recorded within Ifite stratum, while Amaenyi stratum was least at 26.6%. No significant association was observed between fungal species and tool type ($p = 0.802$), nor between prevalence across study strata ($p = 0.907$). The

study concludes that despite moderate awareness, a critical knowledge-practice gap exists among barbers in Awka, and highlights the persistence of fungal contamination despite routine disinfection practices.
Keywords: Barbershop, Disinfection, Fungal Contamination, Public Health, Awka.

Introduction

The barbering industry in Nigeria represents a dynamic economic sector providing essential grooming services, ranging from standard haircuts to specialised treatments such as pedicures and dreadlock maintenance. Market projections suggest that revenue from this personal care segment has reached approximately $698.38 billion in March, 2026, underscoring its pivotal role in the local economies of urban centers (Statista, 2026). Operational modalities vary significantly across the country, ranging from sophisticated salons in high-end districts to informal itinerant barbers in rural areas; yet, they all share a reliance on sharp instruments and direct skin contact, necessitating rigorous hygiene standards (Mevo, 2019; Zenbaba *et al*., 2023).

The public health risks associated with these establishments are particularly acute within the West African sub-region, where high prevalence rates of dermatophytoses have been documented. Studies indicate that barbershops act as critical transmission hubs for pathogens. For instance, Coulibaly *et al*. (2015) reported a tool contamination rate of 73.2% in salons near Bamako, Mali, isolating anthropophilic dermatophytes such as *Microsporum audouinii* and *Trichophyton soudanense*. Similar trends have been observed within Nigeria, where Yusha'u *et al*. (2025) identified an 83.3% contamination rate on tools in Kano metropolis, with combs frequently harbouring pathogens such as *Microsporum gypseum* and *Trichophyton violaceum*. Bacterial contaminants, including *Staphylococcus aureus* and *Escherichia coli,* have also been recovered from salon equipment in Wukari, Taraba State, where 83.75% of tools were found to be colonised by potential pathogens. Clinically, these contaminants are not merely environmental bystanders; they are associated with conditions such as *Tinea capitis* (ringworm of the scalp), *Tinea barbae* (barber's itch), and bacterial folliculitis, which can result in painful pustules and permanent scarring if left untreated (Aso *et al*., 2022).

Although effective prevention of these infections theoretically relies upon strict adherence to decontamination protocols, practical compliance in Nigeria remains alarmingly low. Research conducted by Enemuor *et al*. (2012) in Anyigba, Kogi State, confirmed that combs, brushes, and clippers often harbour diverse fungal and bacterial species due to inadequate sterilisation. Furthermore, the use of inappropriate disinfecting agents is widespread; Adomi (2020) observed that barbers in Abraka, Delta State, frequently utilised suboptimal substances such as petrol, kerosene, and methylated spirit rather than approved hospital-grade disinfectants. Such practices may facilitate the persistence of fungal spores and viral agents on reusable equipment, perpetuating the cycle of community-acquired infection (Enemuor *et al*., 2012; Aso *et al*., 2022).

A critical barrier to safety is the disconnect between barbers' theoretical knowledge of health risks and their actual operational habits. Adomi (2020) highlighted this distinct disparity between knowledge and practice in Abraka, where 83.3% of barbers were aware of disease transmission risks, yet only 11.1% consistently disinfected their tools between customers. This selective negligence is often driven

by economic constraints and a lack of regulatory enforcement, leading to a scenario where mechanical tools, such as clippers, may receive superficial cleaning, whilst essential accessories like brushes and combs are largely neglected (Yusha'u *et al*., 2025).

While substantial data exists regarding salon hygiene in cities such as Kano, Wukari, Anyigba, and Abraka, there is a paucity of recent, localised information concerning Awka, the capital of Anambra State. Consequently, the primary objective of the current study was to assess the level of knowledge regarding disease transmission and disinfection practices among barbers in Awka, and to evaluate the extent of fungal contamination on their tools to establish a baseline for improved sanitary regulation.

Materials And Methods

Study Area

The study was conducted in Awka, the administrative capital of Anambra State, situated in the southeastern region of Nigeria. Geographically, Awka is located between latitude 6°06'N and longitudes 7°05'E and 7°15'E. As a major socio-economic hub, the metropolis is characterized by high commercial activity and a dense concentration of personal service establishments, including barbershops, which serve a diverse population across its 33 constituent villages (Nwanna and Ezenagu, 1995).

Study Design

A cross-sectional survey design was employed for this study, and it lasted for a period of six months (October, 2024 to March, 2025). Data acquisition involved a dual-approach methodology comprising a semi-structured questionnaire and environmental swab sampling.

Study Population

The study population comprised professional barbers operating within the Awka metropolis, aged between 16 to 41 years, and have practiced barbing at least one year.

Inclusion criteria

To ensure the assessment reflected established industry standards, only full-time professional barbers were included in the study.

Exclusion criteria

Part time barbers and apprentices were excluded.

Sample Size determination for barbering tools

The sample size (n) was determined using Cochran's formula (Suresh and Chandrashekara, 2012)

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

n = sample size

z = confidence interval (1.96)

p = Proportion of the population having the desired characteristic; p = 0.185, based on the 18.5% prevalence rate of keratinophilic fungi and other dermatophytes reported in Anambra State by Eze *et al*. (2019).

q = (1-p). Proportion of the population without the desired characteristics.

e = Degree of precision is margin of error that is acceptable (0.05).

$$n = \frac{Z^2 \times P(1 - P)}{e^2}$$

$$n = \frac{(1.96)^2 \times 0.185 \times (1 - 0.185)}{(0.05)^2}$$

$$n = \frac{3.8416 \times 0.185 \times 0.815}{0.0025}$$

$$n = \frac{0.5792}{0.0025} = 231.69 \approx 23$$

Ethical Considerations

Participation was voluntary, and informed verbal consent was obtained from all participants. Strict confidentiality protocols were observed to protect the anonymity of the respondents and their

establishments. The selected Barbering shops were visited and Barbers were sensitized on the research objectives, those that gave their consent were recruited, questionnaires were administered to get their demographic and other information, swab samples were then collected from their Barbering tools (Clippers,Combs, Brushes and Scissors).

Sampling methods and sample collection

In this study, stratified and random sampling technique were employed to recruit participants. The study area was stratified into three groups (Ifite, Amaenyi and Amikwo). A total of thirty Barbering shops were selected for this study. Ten (10) each were selected randomly from Ifite, Amaenyi and Amikwo. To assess the knowledge of disease transmission and disinfection practices, a semi structured questionnaire was administered to Barbers who gave their consent to be recruited in this study, in selected Barbershops.

To evaluate the extent of fungal contamination, tools including clippers, combs, scissors and brushes were randomly sampled from selected barber's shop and subjected to laboratory analysis.

Data collection using questionnaire

A semi-structured questionnaire was administered to 30 participants (Barbers that consent to be recruited in the study). The instrument was designed to elicit data regarding demographic characteristics, operational tools, disinfection protocols, frequency of sanitation, and the respondents' awareness levels concerning the transmission of infectious agents in a salon setting. Some of the respondents filled the questionnaires themselves immediately face to face while others gave verbal responses to the questions and were assisted in filling as appropriate.

Tool swab sample Collection

Sample Collection was carried out according to Agi *et al*. (2023). To evaluate fungal contamination, swab samples were collected from the tools used by the 30 Barbers recruited. From each of the 30 selected Barbershops, samples were obtained from four distinct tool types: clippers, combs, brushes, and scissors. One sample was collected for each tool type per barbershop. Consequently, a total of 120 swab samples (40 from each strata - Ifite, Amaenyi and Amikwo) were collected (30 barbershops (10 in each strata) × 4 tools) were obtained before, and then after disinfection of the tools. Thus, total samples collected for laboratory analysis was 240. The samples were aseptically collected and immediately transported to the laboratory of the Department of Applied Microbiology and Brewing, Nnamdi Azikiwe University, Awka for mycological assay.

Mycological Analysis

Media Preparation

Sabouraud Dextrose Agar (SDA) was prepared in strict adherence to the manufacturer's specifications. To enhance the selectivity for dermatophytes and suppress the growth of saprophytic contaminants, the medium was supplemented with cycloheximide. Sterilization was achieved by autoclaving at 121°C for 15 minutes. The medium was subsequently allowed to cool before being poured into sterile Petri dishes.

Isolation of Fungi

The collected swab samples were aseptically inoculated onto the solidified SDA plates. The cultures were incubated at room temperature (28 ± 2^{o}C) for a period of 3 days, plates that showed no visible growth were incubated for 4 more days for isolation of dermatophytes. Upon the appearance of visible growth, distinct colonies were sub-cultured onto fresh SDA plates to establish pure cultures. These isolates were maintained on SDA slants in bijou bottles for preservation and subsequent identification (Agi *et al*., 2023).

Identification of Fungal Isolates
Taxonomic identification of the fungal isolates was performed based on macroscopic morphology (colony texture, pigmentation, and growth rate) and microscopic features (conidial and mycelial architecture) (Tijjani *et al*., 2019).

Microscopy (Lactophenol Cotton Blue Mount)
Wet mount preparations of the fungal isolates were made using Lactophenol Cotton Blue (LPCB) for the preliminary identification of the fungal isolates. Mycelial fragments were teased apart on a slide, covered with a coverslip, and examined under a light microscope at 10 × and 40 × magnifications for conidial and mycelial structures (Ebuara *et al*., 2020).

Slide Culture Technique for the identification of the mould isolates
To preserve the i*n-situ* arrangement of sporulating structures, a slide culture technique was utilised. An inoculated agar block was incubated between a slide and coverslip at 25°C for 5 days, allowing for the observation of undisturbed reproductive structures essential for accurate identification (Peralam and Kanika, 2016). All identifications were validated by comparison with standard mycological atlases (Agu and Chiedozie, 2021)

Germ Tube Test for the identification of the yeast isolates
For the presumptive identification of *Candida albicans*, yeast-like colonies were subjected to a germ tube test. A small inoculum was incubated in human serum at 37°C for 3 hours and examined microscopically for germ tube formation (Sheppard *et al*., 2008).

Sugar Assimilation Test for the confirmatory identification of the yeast isolates
The sugar assimilation test was carried out to determine the ability of yeast isolates to utilize different carbohydrates as their sole carbon source. The test was carried out according to Devadas *et al.* (2017). Basal yeast nitrogen base (YNB) medium without a carbon source was prepared, sterilised, dispensed in sterile petri dishes and allowed to solidify. Each of the yeast isolates was standardized to match 0.5 McFarland standard, they were inoculated on the basal media using sterile swab sticks. Sterile filter papers impregnated in 2% of each of the different sugars (Glucose, Maltose, Lactose, Galactose and Arabinose) were aseptically placed on the inoculated organisms using sterile forceps. The plates were incubated at 30^{o}C for 96 hours. Halo growth around the discs indicated positive assimilation result (+).

Statistical Analysis
Data generated from the study were analysed using the Statistical Package for Social Sciences (SPSS) version 27 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including frequencies and percentages, were utilised to summarize demographic characteristics and practice-related variables. Relative frequency (%) of isolates across the tools and strata were calculated using the equation: $\frac{No\ of\ isolates}{Total\ no\ of\ isolates} \times 100$). Inferential statistical analyses were performed using the Chi-square test and McNemar's test to assess the association between disinfection practices and fungal contamination rates before and after disinfection. The Fisher-Freeman-Halton Monte Carlo exact test was used to determine the differences in fungal prevalence across the strata in the study. A p-value < 0.05 was considered statistically significant.

Results
The demographic profile of the respondents is detailed in Table 1. The majority (83.3%) of the barbers were male, with the largest age group being 21-25 years (36.7%). Most respondents were married (53.3%) and had completed

secondary education (46.7%). In terms of experience, the highest proportion of barbers (36.7%), had been in the profession for 11-15 years.

Table 1: Demographic Information of Respondents (n = 30)

Variables	Categories	Frequency	Percentage (%)
Gender	Male	25	83.3
	Female	5	16.7
Age	16-20	3	10.0
	21-25	11	36.7
	26-30	6	20.0
	31-35	4	13.3
	36-40	5	16.7
	41 and above	1	3.3
Marital status	Single	10	33.3
	Married	16	53.3
	No response	4	13.3
Educational status	Primary	7	23.3
	Secondary	14	46.7
	Tertiary	9	30.0
Years of Experience	1-5	4	13.3
	6-10	6	20.0
	11-15	11	36.7
	16-20	4	13.3
	21 and above	5	16.7

Table 2 shows the weekly customer volume. The range is 10 to > 100 customers per week. Majority of barbers (36.7%) attend to 51-60 customers weekly.

Table 2: Number of Customers Attended to Weekly by Barbers in Awka (n=30)

Number weekly	Frequency	Percentage (%)
10-30	4	13.3
31-40	5	16.7
41-50	5	16.7
51-60	11	36.7
61-100	3	10.0
> 100	2	6.7

Table 3 presents the barbers' self-reported knowledge and practices concerning disease transmission and tool disinfection. Over half of the respondents (53.3%) acknowledged that diseases could be transmitted through barber tools, and

56.7% stated that they disinfect their tools. Rashes (26.7%) were the most reported skin, scalp, and infectious health conditions associated with barbering tools. When asked about the frequency, the most common practice was disinfecting "*After attending to a customer*" (23.3%).

Table 3: Knowledge of Disease Transmission through Barbering Tools

Variables	Category	Frequency (n=30)	Percentage (%)
Do you know that diseases are transmitted through barber tools?	Yes	16	53.3
	No	4	13.3
	No Response	10	33.3
Do you disinfect your tools?	Yes	17	56.7
	No	6	20.0
	No Response	7	23.3
How often do you disinfect tools?	Once a day	6	20.0
	After a customer	7	23.3
	Before and after use	4	13.3
	No Response	13	43.3
Do you know the Common skin, scalp, and infectious health conditions associated with barbering tools?	Rashes	8	26.7
	Dandruff	5	16.7
	Ringworm	6	20.0
	Lice	3	10.0
	Head bumps	4	13.3
	HIV	4	13.3

Table 4 details the specific disinfection practices for different tools. For clippers, the most common practice was disinfecting "Before and after use" (46.7%), with heat being the primary agent (33.3%). In contrast, other tools like scissors and combs were most commonly disinfected "Once daily" (53.3%), primarily with methylated spirit (43.3%).

Tables 5 and 6 present the identification of fungal isolates recovered from the tools. A total of five distinct fungal species were identified based on macroscopic and microscopic characteristics. They were: *Aspergillus niger*, *Rhizopus stolonifer*, *Candida albicans*, *Penicillium* spp., and *Microsporum audouini.*

Table 6 presents the sugar assimilation result for the yeast isolates only. The 21 isolates subjected to this confirmatory test were *Candida albican.*

Table 7 summarizes the fungal contamination status of the 120 barbering tools screened before and after the disinfection process. Prior to disinfection, all 120 tools (100%) were positive for fungal growth. Following the disinfection procedure, only 51 tools (42.5%) remained positive for fungal contamination, while 69 tools (57.5%) tested negative.

A McNemar's test was conducted to evaluate the efficacy of the disinfection

process by comparing fungal contamination levels before and after disinfection on the same set of tools (N = 120). The analysis revealed a highly statistically significant reduction in contamination ($\chi^2 = 68.0$, $p < 0.001$), confirming that the disinfection protocols reduced fungal contamination, although 42.5% of the tools remained contaminated after disinfection.

Using the post-disinfection contamination data in Table 7, out of the 120 post-disinfection tool swab samples examined, 51 were contaminated, giving an overall post-disinfection prevalence of 42.5%. The prevalence by tool type was highest in brushes, 18/30 (60.0%), followed by combs, 13/30 (43.3%), scissors, 11/30 (36.7%), and clippers, 9/30 (30.0%). From the 51 contaminated samples, a total of 109 fungal isolates were identified. *Aspergillus niger* was the most frequently occurring fungus, accounting for 44.0% of all isolates (Table 8).

Table 9 shows the stratified absolute (n) and relative frequency (%) of fungal isolates from barbering tools by location. Ifite recorded the highest number of fungal isolates, 46 (42.2%), followed by Amaikwo, 34 (31.2%), while Amaenyi had the least, 29 (26.6%). Although the distribution varied descriptively across the locations and tool categories, the Fisher-Freeman-Halton Monte Carlo exact test showed no statistically significant difference among the strata ($p = 0.907$).

Table 4: Disinfection Practices for Main Tools

Variables	Category	Frequency (n=30)	Percentage (%)
How often do you disinfect clippers?	Once daily	4	13.3
	3 times a day	4	13.3
	Before and after use	14	46.7
	No response	8	26.7
Disinfecting agents used for clippers	Heat	10	33.3
	Methylated spirit	7	23.3
	Petrol	8	26.7
	Heat and chemical	4	13.3
	Hydrogen peroxide	1	3.3
How often do you disinfect other tools (Scissors, combs, brushes)?	Once daily	16	53.3
	3 times a day	10	33.3
	Before and after use	0	0.0
	No response	4	13.3
Disinfecting agents used for other tools	Heat	6	20.0
	Methylated spirit	13	43.3
	Petrol	3	10.0
	Heat and chemical	5	16.7
	Hydrogen peroxide	3	10.0

Table 5: Colony Morphology and Microscopic Identification of Fungal Isolates

S/N	COLONY MORPHOLOGY	MICROSCOPY	PROBABLE ORGANISM
1	Rapidly growing; colonies are initially white, quickly turning black due to heavy/abundant conidial production; surface powdery or granular; reverse pale to yellow.	Septate hyphae; long conidiophores, smooth, terminating in a globose vesicle covered with biseriate phialides; conidia are rough, brown to black, forming radiate heads.	*Aspergillus niger*
2	Fast-growing; fluffy to cottony colonies; white that later turn grey to black with sporangia; Spreading rapidly reverse pale to yellowish brown.	Broad, ribbon-like, non-septate hyphae; presence of stolons, rhizoids, and sporangiophores sporangia are round with black sporangiophores, sporangiosphores; arise opposite rhizoids.	*Rhizopus stolonifer*
3	Smooth, creamy, pasty colonies, white to cream in colour; moist or mucoid texture reverse pale to cream.	Oval budding yeast cells, presence of pseudohyphae.	*Candida albicans*
4	Velvety to powdery colonies; initially white, later bluish-green with a white border; reverse pale to yellow.	Septate hyphae; conidiophores branched into secondary branches (metulae) bearing phialides; brush-like arrangement.	*Penicillium* spp.
5	Colonies are slow-growing, flat, suede-like to downy; grayish surface; reverse reddish-brown; often produces little aerial mycelium.	Hyphae septate; macroconidia are spherical and have thick walls.	*Microsporum audouinii*

Table 6: Sugar Assimilation Test for Yeast Isolates

Isolates	Glu	Mal	Suc	Lac	Gal	Ara	Germ Tube test	Gram staining	Probable organism
Candida albicans (n = 21)	+	+	+	-	+	+	+	Positive	*Candida albicans*

***Key**: Glu: glucose, mal: maltose, suc: Sucrose, lac: lactose, gal: galactose, raf: raffinose, xyl: xylose, ara: arabinose, (+) = positive and (-) negative.*

Table 7: Fungal Contamination of Barbering Tools Before and After Disinfection

Tools	Number of samples	Number (%) Positive for fungal Contamination	
		before disinfection	after disinfection
Clippers	30	30 (100)	9 (30)
Comb	30	30 (100)	13 (43.3)
Brushes	30	30 (100)	18 (60)
Scissors	30	30 (100)	11 (36.7)
Total	**120**	**120**	**51 (42.5)**

Table 8: Frequency of Occurrence of Fungi Isolated from Barber Tools in Awka

S/N	Isolate	Frequency	Percentage (%)
1	*Aspergillus niger*	48	44.0
2	*Rhizopus stolonifer*	12	11.0
3	*Penicillium* spp	26	23.9
4	*Microsporum audouinii*	2	1.8
5	*Candida albicans*	21	19.3
	Total	**109**	**100.0**

Table 10 presents the distribution of fungal isolates across the different tools. A Chi-square test was performed to examine whether the distribution of fungal species was dependent on the tool type from which they were isolated. The analysis revealed no statistically significant association (χ^2 = 7.785, *df* = 12, p = 0.802). This indicates that the type of fungus found is independent of the tool type; in other words, no specific fungal species showed a statistically significant preference for any particular tool.

Tables 11-14 evaluate the efficacy of disinfection methods separately for each barbering tool. Across clippers, combs, brushes and scissors, the Heat + Chemical method was the most effective because it eliminated all fungal isolates after disinfection. Petrol was the least effective because *Aspergillus niger* and *Rhizopus stolonifer* persisted on several tools, while heat alone and methylated spirit produced slight efficacy.

Table 9: Stratified Absolute (n) and Relative frequency (%) of Fungal Isolates in the Barbering Tools

Location	Fungal isolate	Clippers n (%)	Scissors n (%)	Combs n (%)	Brushes n (%)	Total

Location	Fungal isolate	Clippers n (%)	Scissors n (%)	Combs n (%)	Brushes n (%)	Total
Ifite	*Aspergillus niger*	6 (30.0)	3 (15.0)	4 (20.0)	7 (35.0)	20
	Rhizopus stolonifer	1 (20.0)	2 (40.0)	1 (20.0)	1 (20.0)	5
	Penicillium spp.	4 (36.4)	2 (18.2)	2 (18.2)	3 (27.3)	11
	Microsporum audouinii	1 (50.0)	0 (0.0)	0 (0.0)	1 (50.0)	2
	Candida albicans	1 (12.5)	3 (37.5)	3 (37.5)	1 (12.5)	8
Amaenyi	*Aspergillus niger*	3 (25.0)	2 (16.7)	2 (16.7)	5 (41.7)	12
	Rhizopus stolonifer	0 (0.0)	1 (33.3)	0 (0.0)	2 (66.7)	3
	Penicillium spp.	2 (25.0)	2 (25.0)	2 (25.0)	2 (25.0)	8
	Microsporum audouinii	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0
	Candida albicans	1 (16.7)	1 (16.7)	2 (33.3)	2 (33.3)	6
Amaikwo	*Aspergillus niger*	2 (12.5)	3 (18.8)	6 (37.5)	5 (31.2)	16
	Rhizopus stolonifer	1 (25.0)	2 (50.0)	1 (25.0)	0 (0.0)	4
	Penicillium spp.	2 (28.6)	2 (28.6)	1 (14.3)	2 (28.6)	7
	Microsporum audouinii	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0
	Candida albicans	1 (14.3)	2 (28.6)	1 (14.3)	3 (42.9)	7

Table 10: Absolute (n) and Relative frequency (%) of Fungal Isolates across the Barbering Tools

Isolate	Barbering tools			
	Clippers n (%)	Comb n (%)	Scissors n (%)	Brushes n (%)
Aspergillus niger	12 (25.0)	13 (27.1)	8 (16.7)	15 (31.3)
Rhizopus stolonifer	2 (16.7)	2 (16.7)	4 (33.3)	4 (33.3)

Penicillium spp	6 (23.1)	5 (19.2)	6 (23.1)	9 (34.6)
Microsporum audouinii	1 (50.0)	-	-	1 (50.0)
Candida albicans	3 (14.3)	8 (38.1)	6 (28.6)	4 (19.0)

Table 11: Fungi isolated from clippers before and after sterilization

Disinfectant	**Time**	**Fungi isolates**				
		A. niger	***R. stolonifer***	***Penicillium* spp.**	***C. albicans***	***M. audouinii***
Heat	Before	+	+	+	+	+
	After	+	-	-	-	+
Petrol	Before	+	+	+	+	+
	After	+	+	+	-	+
Methylated spirit	Before	+	+	+	+	+
	After	+	-	+	-	+
Heat + Chemical	Before	+	+	+	+	+
	After	-	-	-	-	-
Hydrogen peroxide	Before	+	+	+	+	+
	After	-	-	-	-	+

Table 12: Fungi isolated from combs before and after sterilization

Disinfectant	**Time**	**Fungi isolates**				
		A. niger	***R. stolonifer***	***Penicillium* spp.**	***C. albicans***	***M. audouinii***
Heat	Before	+	+	+	+	-
	After	+	-	-	-	-
Petrol	Before	+	+	+	+	-
	After	+	+	+	-	-
Methylated spirit	Before	+	+	+	+	-
	After	+	-	+	-	-
Heat + Chemical	Before	+	+	+	+	-
	After	-	-	-	-	-
Hydrogen peroxide	Before	+	+	+	+	-
	After	-	-	-	-	-

Table 13: Fungi isolated from brushes before and after sterilization

Disinfectant	**Time**	**Fungi isolates**				
		A. niger	***R. stolonifer***	***Penicillium* spp.**	***C. albicans***	***M. audouinii***
Heat	Before	+	+	+	+	+

Petrol	After	+	-	-	-	-
	Before	+	+	+	+	+
	After	+	+	-	-	-
Methylated spirit	Before	+	+	+	+	+
	After	+	-	+	-	-
Heat + Chemical	Before	+	+	+	+	+
	After	-	-	-	-	-
Hydrogen peroxide	Before	+	+	+	+	+
	After	-	-	-	-	-

Table 14: Fungi isolated from scissors before and after sterilization

Disinfectant	**Time**	**Fungi isolates**				
		A. niger	***R. stolonifer***	***Penicillium* spp.**	***C. albicans***	***M. audouinii***
Heat	Before	+	+	+	+	-
	After	+	-	-	-	-
Petrol	Before	+	+	+	+	-
	After	+	+	-	-	-
Methylated spirit	Before	+	+	+	+	-
	After	+	-	+	-	-
Heat + Chemical	Before	+	+	+	+	-
	After	-	-	-	-	-
Hydrogen peroxide	Before	+	+	+	+	-
	After	-	-	-	-	-

Key: + = fungal growth detected; - = no fungal growth detected.

DISCUSSION

The findings of this study reveal a concerning public health scenario within the barbering profession in Awka, characterized by moderate awareness of disease transmission but inadequate disinfection practices. Table 1 presents the demographic characteristics of barbers who participated in the study. The parameters assessed (age, gender, educational qualification, marital status and years of barbing experience) provided essential background information for interpreting the respondents disinfection practices and awareness of fungal contamination risks. The findings revealed that a great number of the respondents were males (83.8%), reflecting the dominance of men in the barbing profession within the study area. Majority of barbers were young adults aged 21-25years (n=11, 36.7%). This demography aligns with the age group most economically active and engaged in small-scale service occupations in Nigeria. This age range also implies that the respondents are physically capable of maintaining hygiene standards but may vary in adherence depending on their level of awareness/ training. Experienced barbers who lack knowledge of infection control may inadvertently contribute to tool contamination.

Knowledge and awareness of disease transmission among barbers plays an important role in determining the effectiveness of their hygiene practices. In line with the data in Table 3, a greater number of respondents (53.3%) acknowledged that infectious diseases could be transmitted through barber tools.

This awareness mirrors findings by Nwachukwu *et al*. (2023) in South eastern Nigeria. This high level of awareness suggests that most barbers in the study population have knowledge of the risk associated with unhygienic practices in their profession. Despite high awareness, compliance remains suboptimal. This finding aligns with Oladipo *et al.* (2021), who reported that awareness does not always translate into practice among Nigerian barbers, particularly where economic constraints limit access to effective disinfectant use. However, a small proportion (20.0%) indicated ignorance, while 23.3% gave no response, which may reflect either lack of knowledge or reluctance to provide an answer. The study also noted that 23.3% of barbers disinfected tools after each customer, whereas 20.0% did so once daily. The variation in frequency suggests that some practitioners underestimate the risk of fungal and bacterial transmission. The common skin, scalp, and infectious health conditions reported among barbers were rashes (26.7%), dandruff (16.7%) and ringworm (20.0%), while awareness of HIV and head bumps was low (13.3% each). This suggests limited awareness of specific infections, which corroborates findings by Adeoye and Eze (2023), who reported low specific awareness of fungal infections among hair professionals in southern Nigeria. While 53.3% of the surveyed barbers acknowledged that diseases could be transmitted through their tools (Table 3), when comparing these findings to broader literature, the awareness level in Awka (53.3%) appears lower than that reported in other regions. For instance, Adomi (2020) reported an 83.3% awareness level among barbers in Abraka, Nigeria. Similarly, while 23.3% of barbers in this study disinfected tools after a customer (Table 3), the majority of respondents in Awka relied on ineffective or inconsistently applied disinfection methods. As shown in Table 4, 43.3% of barbers used methylated spirit for accessories (scissors, combs and brushes), and 40.0% used heat for clippers. The isolation of pathogenic and opportunistic fungi, including *Microsporum audouinii* (50.0%), *Aspergillus niger* (44.0%) and *Candida albicans* (19.3%) (Tables 5, 6 and 8), confirms that barbershops in this metropolis serve as active reservoirs for dermatophytic infections. McNemar's test showed that fungal contamination reduced significantly after disinfection ($p < 0.001$), indicating that disinfection lowered contamination levels but did not fully eliminate residual fungal growth.

The study highlights a distinct disparity in hygiene compliance depending on the tool type as shown in Table 7. Non-electrical accessories were more contaminated than clipper; brushes exhibited the highest contamination rate (60%), followed by combs (43.3%), scissors (36.7%), and clippers (30%). This aligns with the self-reported practice data, where 46.7% of barbers claimed to disinfect clippers "before and after use," whereas 53.3% admitted to disinfecting accessories like combs and brushes only "once daily". This suggests a pattern of "selective hygiene," where barbers prioritize the sterilization of clippers, likely due to their perceived value or customer scrutiny, while neglecting the brushes and combs that directly contact the scalp and hair shafts. This specific neglect of brushes and combs corroborates the findings of Ebuara *et al*. (2020) in Wukari, Nigeria, who also isolated a higher microbial burden on accessories compared to clippers. *Aspergillus* spp, *Rhizopus stolonifer*, *Penicillium* spp., *Candida albicans*, and dermatophytes were frequently isolated from clippers, combs, scissors, and brushes before any disinfection procedure (Aso *et al*., 2022). This high level of contamination highlights the potential of grooming instruments to serve as reservoirs for opportunistic fungi, posing a potential risk of infection transmission particularly in

immunocompromised individuals (Oliveira *et al*., 2020).

The efficacy data in Tables 11-14 reveal that while the Heat + Chemical treatment was 100% effective, petrol was largely ineffective and methylated spirit showed variable results. For clippers, *Aspergillus niger* and *Microsporum audouinii* persisted after some treatments; for combs, *Aspergillus niger* persisted after heat, petrol and methylated spirit; for brushes and scissors, *Aspergillus niger* also remained after heat, petrol and methylated spirit, with *Rhizopus stolonifer* persisting mainly after petrol. This indicates that commonly used informal disinfectants may reduce contamination but do not reliably eliminate fungal spores.

The predominance of *Aspergillus niger* (44%) among the isolates is particularly worrisome. *Aspergillus* species are environmental moulds that produce spores resistant to mild disinfection, which explains their survival on tools treated merely with methylated spirit or insufficient heat. The presence of *Candida albicans* (19.3%) is also significant, as it indicates a risk for transmitting candidiasis (thrush) via shared equipment. These findings differ from Agi *et al.* (2023) in Rivers State, who reported zero fungal isolates on clippers but they align more closely with the work of Shekeri *et al*., (2011) who identified similar fungal profiles in equipment used in both female and male salon. The persistence of these pathogens on 42.5% of "disinfected" tools suggests that the methods currently adopted by barbers in Awka - the use of methylated spirit and petrol - is ineffective on the fungal isolates.

CONCLUSION

This study establishes that professional barbershops in Awka, Anambra State, currently serve as active reservoirs for potential fungal pathogens, including *Aspergillus niger* and *Candida albicans*, despite a moderate level of self-reported awareness (53.3%) regarding disease transmission among practitioners. The findings confirm a critical knowledge-practice gap, where the theoretical understanding of health risks does not translate into effective hygiene protocols. Specifically, the study identifies a pattern of selective sanitation, where mechanical tools like clippers received prioritisation over essential accessories such as brushes and combs, which were found to be significantly more contaminated. The statistical association between disinfection frequency and fungal presence confirms that the current sporadic application of disinfectants (often inappropriate agents like methylated spirit or inadequate heating by boiling/ autoclaving of non-metallic items) is insufficient to break the chain of transmission. Consequently, without intervention, these establishments pose a significant public health risk for the spread of dermatophytic infections and other communicable diseases within the Awka metropolis.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed

1. Regulatory bodies must enforce the exclusive use of approved, hospital-grade fungicides and virucides while explicitly mandating immersion sterilization for neglected non-electrical tools like brushes and combs.
2. The State Ministry of Health and Barber Unions should organize mandatory, periodic workshops that move beyond general awareness to provide practical demonstrations on proper contact times and dilution ratios for disinfectants.
3. A system of regular, unannounced sanitary inspections should be implemented where the renewal of business operation permits is strictly contingent upon passing hygiene audits.

4. Barbershops should be encouraged and incentivized to invest in UV light sterilization cabinets to ensure effective dry decontamination for electrical clippers and delicate accessories.
5. Public health campaigns must be launched to educate clients on the risks of unsterilized tools and encourage them to demand sterilization or provide their own personal grooming kits to prevent cross-contamination.

Conflict of interest
Authors declare no conflict of interest

Funding
Authors did not receive any funding for the work.

Author's contribution
VIA – Conceptualization, ATE - Methodology, CCE – Writing original draft and review, CGA – Final editing, OA – Data analysis, CAN – Review and data analysis

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