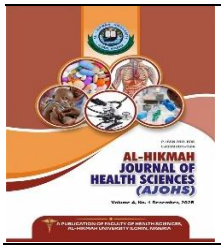
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**Original Article**

# Knowledge, Food Safety Practices and Behavioural Risks for Foodborne Antimicrobial Resistance among Food Vendors in Ilorin West Local Government Area, Kwara State, Nigeria

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**ABSTRACT**

**Background:** Antimicrobial resistance is a public health problem, and food can contribute to the transmission of resistant microorganisms. Food vendors play important role in food safety, while inadequate hygiene and unsafe practices may increase foodborne antimicrobial resistance risks.

**Objective:** To assess knowledge, food safety practices, and behavioural risks related to foodborne antimicrobial resistance among food vendors in Ilorin West Local Government Area, Kwara State.

**Methods:** A descriptive cross-sectional study was conducted among respondents in selected wards. Data were collected using a structured interviewer-administered questionnaire and an observational checklist. Of 410 questionnaires administered to food vendors and consumers, 335 were completed and analyzed.

**Results:** Food vendors constituted 224 (66.9%) and consumers 111 (33.1%) respondents. Overall, 68.3% agreed or strongly agreed that excessive antibiotic use contributes to antimicrobial resistance, while 66.1% recognized that market food could expose consumers to antimicrobial-resistant infections. Among respondents involved in livestock-related activities, 49.6% reported antibiotic use in animals. Only 47.2% of vending sites had functional handwashing facilities, while 37.6% lacked facilities.

**Conclusion:** Behavioural and environmental risks related to foodborne antimicrobial resistance remain prevalent in Ilorin West LGA. Food safety education, improved sanitation, antimicrobial stewardship, and routine inspection are needed to reduce these risks.

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## Introduction

Antimicrobial resistance (AMR) has appeared as one of the most important global public health threats of the twenty-first century, undermining years of progress in the prevention and treatment of infectious diseases (Adeosun *et al.,* 2022). The increasing ability of microorganisms to evolve to avoid being or inhibited by antimicrobials has resulted in increased morbidity, prolonged hospital stays, increased healthcare costs, and mortality. Major health governing bodies like the World Health Organization recognize AMR as a major challenge requiring coordinated action across the human, animal, food, and environmental sectors through the One Health

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approach. Foodborne antimicrobial resistance is an important avenue through which resistant microorganisms and antimicrobial resistance genes are transmitted from food-producing environments to consumption (Adeosun *et al.,* 2023). Foods may become contaminated during production, processing, transportation, preparation, or retail sale, particularly when food safety standards are inadequate. The indiscriminate use of antibiotics in crop preservation and livestock production, poor environmental sanitation, inadequate personal hygiene, and unsafe food handling practices add to the emergence and transmission of resistant microorganisms throughout the food chain. In low- and middle-income countries, including Nigeria, street-vended and ready-to-eat foods form an important source of daily nourishment for millions of people because of their availability, convenience, and affordability. However, these foods are often prepared and sold under conditions that may not consistently follow recommended food safety standards (Centers for Disease Control and Prevention [CDC], 2024). Limited access to potable water, inadequate sanitation facilities, poor waste management, and insufficient food safety training may increase the likelihood of food contamination and help the transmission of antimicrobial-resistant pathogens. Food vendors occupy a critical position within the food supply chain and therefore play an essential role in preventing foodborne antimicrobial resistance. Their knowledge of antimicrobial resistance, food hygiene principles, and proper food handling practices directly influences the microbiological safety of foods consumed by the public. Unsafe behaviors such as inadequate hand hygiene, cross-contamination between cooked and uncooked foods, improper food storage, and poor environmental sanitation may increase opportunities for the spread of resistant microorganisms.

Although awareness of antimicrobial resistance has increased globally, evidence suggests that knowledge of foodborne AMR among food handlers remains inadequate in many low- and middle-income countries, especially in sub-Saharan Africa (Gebeyehu, 2021). Earlier studies have shown variations in food vendors' knowledge and compliance with recommended food safety practices, showing persistent behavioural gaps that require context-specific public health interventions. In Nigeria, available studies have largely focused on general food hygiene and foodborne diseases, while few have specifically examined behavioural risks associated with foodborne antimicrobial resistance among food vendors. Understanding the level of knowledge and identifying behavioural practices that may contribute to foodborne AMR are essential for designing effective interventions aimed at improving food safety and antimicrobial stewardship. Therefore, this study assessed the knowledge, food safety practices, and behavioural risks related to foodborne antimicrobial resistance among food vendors in Ilorin West Local Government Area, Kwara State, Nigeria.

**Materials and Methods**

This study was conducted using a community-based descriptive cross-sectional design to assess knowledge, food safety practices, and behavioural risks associated with foodborne antimicrobial resistance (AMR) among respondents in Ilorin West Local Government Area (LGA), Kwara State, Nigeria. A cross-sectional design was considered appropriate because it allows the assessment of the prevalence of behavioural characteristics and associated factors within a defined population at a specific point in time (Setia, 2016).

**Study Setting:** The study was carried out in Ilorin West Local Government Area, one of the sixteen Local Government Areas in Kwara State, North Central Nigeria. Ilorin West is predominantly urban and serves as one of the state's major commercial hubs, characterized by numerous markets, restaurants, street food vendors, and other food service establishments. The high concentration of food vendors within the LGA makes it an ideal setting for investigating behavioural practices that may contribute to foodborne antimicrobial resistance. Food vending activities within the study area range from formal restaurants to informal street food businesses, serving a large proportion of the urban population daily. Consequently, food vendors and handlers play a significant role in ensuring food safety and protecting public health.

**Inclusion Criteria:** Participants were aged 18 years or older and were available within the selected study locations during data collection. Written informed consent were provided for participants to take part in the study.

**Exclusion Criteria:** Participants who declined participation, were seriously ill during the survey period, or were unavailable after repeated visits were excluded from the study.

Ethical Considerations: Ethical approval for the study was obtained from the Al-Hikmah University ethical approval committee before the commencement of data collection. Permission was also obtained from relevant local authorities and food vendor associations.

**Results**

A total of 410 questionnaires were administered in Ilorin West Local Government Area, of which 335 were completed and returned, giving an overall response rate of 81.7%. All returned questionnaires

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were suitable for analysis. Respondents demonstrated relatively good awareness of selected aspects of antimicrobial resistance, although gaps remained regarding foodborne transmission. Overall, 68.3% of respondents agreed or strongly agreed that excessive antibiotic use contributes to antimicrobial resistance, while 66.1% agreed or strongly agreed that food purchased from markets could expose consumers to antimicrobial-resistant infections. However, 22.9% were uncertain about the relationship between excessive antibiotic use and antimicrobial resistance, while 18.2% were uncertain about the possibility of acquiring resistant infections through food. The findings indicate that although awareness of the general concept of antimicrobial resistance was relatively high, understanding of the specific relationship between food handling, contaminated food, and antimicrobial-resistant infections was less consistent.

**Table 1. Age distribution of respondents**

| Age Group (Years) | Frequency | Percentage (%) |
|---|---|---|
| 18–25 | 88 | 26.3 |
| 26–35 | 103 | 30.7 |
| 36–45 | 69 | 20.6 |
| Above 45 | 75 | 22.4 |
| Total | 335 | 100.0 |

Participants were recruited from six administrative wards within Ilorin West Local Government Area. Adewole Ward contributed the largest proportion of respondents (23.3%), followed by Baboko (17.0%), Ajikobi (15.8%), Oloje (13.7%), Magaji Ngeri (13.1%), and other wards (17.0%).

Food Safety Practices among Food Vendors

Food handling practices among vendors demonstrated both positive behaviors and areas of concern. Half of respondents involved in livestock production (49.6%) reported using tetracycline or similar antibiotics in food animals, while 50.4% reported no such use. The substantial proportion reporting antibiotic use in livestock highlights a potential pathway for the emergence and dissemination of antimicrobial-resistant bacteria through the food chain.

**Table 2. Knowledge that excessive antibiotic use causes antimicrobial resistance**

| Response | Frequency | Valid percentage (%) |
|---|---|---|
| Strongly disagree | 4 | 1.2 |
| Disagree | 25 | 7.6 |
| Not sure | 75 | 22.9 |
| Agree | 122 | 37.2 |
| Strongly agree | 102 | 31.1 |
| Total | 328 | 100.0 |

Several food-handling practices with potential implications for foodborne antimicrobial resistance were identified. Among respondents providing information on water used for washing food utensils, 34.2% reported using tap water, while 21.1% used well water, 23.3% used sachet water, and 21.5% used other sources. Thus, 65.8% relied on water sources other than tap water. Hand hygiene was also inconsistent. Among respondents who provided valid responses to the handwashing item, only 42.8% reported always washing their hands during food preparation, while 31.1% reported rarely washing their hands and 26.1% reported never doing so consistently. Consequently, 57.2% did not consistently practice handwashing during food preparation. Overall, several behavioural risks persisted, including inconsistent handwashing, dependence on potentially unsafe water sources, opportunities for cross-contamination during food preparation, and antibiotic use in food animals.

**Table 3. Educational level of respondents**

| Educational Level | Frequency | Percentage (%) |
|---|---|---|
| No formal education | 32 | 9.6 |
| Primary education | 53 | 15.8 |
| Secondary education | 102 | 30.4 |
| Tertiary education | 148 | 44.2 |
| Total | 335 | 100.0 |

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**Environmental Risk Factors**

Observational assessment of food vending sites identified several environmental conditions that could increase the risk of food contamination. Less than half of the observed vending sites (47.2%) had functional handwashing facilities, while 37.6% lacked such facilities entirely. Similarly, 43.9% of vending sites were located close to open drainage systems or refuse dumps, environmental conditions that increase exposure to dust, insects, rodents, and pathogenic microorganisms. Unsafe handling practices were also common. Approximately 43.3% of vendors simultaneously handled money and ready-to-eat foods, increasing the likelihood of cross-contamination. Furthermore, flies and other pests were observed around 40.6% of vending sites, while only 44.2% of sites were free from visible pests during observation. Collectively, these observations demonstrate that infrastructural deficiencies and environmental sanitation remain important contributors to behavioural risks associated with foodborne antimicrobial resistance.

Association between Educational Attainment and Knowledge of Antimicrobial Resistance

Inferential analysis demonstrated a statistically significant association between respondents' educational attainment and knowledge that excessive antibiotic use contributes to antimicrobial resistance. The Pearson chi-square test showed a significant association ($\chi^2 = 126.145$, df = 12, $p < 0.001$), indicating that knowledge of antimicrobial resistance differed significantly according to educational attainment, with respondents with higher educational qualifications demonstrating better understanding of antimicrobial resistance. However, educational attainment was not significantly associated with discontinuation of antibiotics when symptoms improved ($\chi^2 = 1.626$, df = 3, $p = 0.653$). This suggests that although education was associated with improved knowledge, higher educational attainment did not necessarily translate into appropriate antibiotic-use behavior.

**Table 4. Association between educational attainment and selected AMR-related outcomes**

| Outcome | $\chi^2$ | df | p-value |
|---|---|---|---|
| Knowledge that excessive antibiotic use contributes to AMR | 126.145 | 12 | <0.001 |
| Discontinuation of antibiotics when symptoms improve | 1.626 | 3 | 0.653 |

**Discussion**

This study assessed the knowledge, food safety practices, and behavioural risks associated with foodborne antimicrobial resistance (AMR) among food vendors in Ilorin West Local Government Area, Kwara State, Nigeria. The findings demonstrate that although several respondents reported adherence to recommended food safety practices, important behavioural and environmental gaps remain that may contribute to the emergence and transmission of antimicrobial-resistant microorganisms through the food chain. These findings reinforce the importance of integrating food safety, antimicrobial stewardship, and environmental sanitation within the One Health framework for combating AMR (World Health Organization [WHO], 2023). The findings are consistent with the WHO (2023), which noted that awareness of antimicrobial resistance has improved globally following sustained public health campaigns. FAO (2022) similarly identifies antimicrobial resistance as an emerging food safety challenge.

Although respondents demonstrated relatively good knowledge, the findings indicate that knowledge alone did not consistently translate into appropriate practices. This discrepancy between knowledge and behavior has been reported in several public health studies, where individuals possess adequate information but fail to adopt recommended preventive behaviors because of economic constraints, cultural practices, convenience, or inadequate environmental support.

**Knowledge and Awareness of Foodborne Antimicrobial Resistance**

The study demonstrated relatively good general awareness of antimicrobial resistance, although important gaps remained in understanding foodborne transmission. Specifically, 68.3% of respondents agreed or strongly agreed that excessive antibiotic use contributes to antimicrobial resistance, while 66.1% recognized that food purchased from markets could expose consumers to antimicrobial-resistant infections. However, 22.9% were uncertain about the relationship between excessive antibiotic use and AMR, while 18.2% were uncertain about the possibility of acquiring resistant infections from food purchased in markets. These findings suggest that general awareness of AMR may be relatively high, but a proportion of respondents still lack a sufficiently clear understanding of the foodborne pathway of resistance. The observed relationship between education and AMR knowledge further reinforces the importance of health literacy. Educational attainment was significantly associated with knowledge that excessive antibiotic use contributes to AMR ($\chi^2 = 126.145$, df = 12, $p < 0.001$), with respondents having

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higher educational qualifications demonstrating better knowledge.

**Food-Handling and Hygiene Practices**

Despite relatively favorable levels of awareness, important deficiencies were identified in reported food-handling practices. Only 42.8% of respondents reported that they always washed their hands during food preparation, whereas 31.1% reported rarely washing their hands and 26.1% reported never doing so consistently. Thus, 57.2% did not consistently practice handwashing during food preparation. This gap between knowledge and practice is important from a public health perspective because hands can act as a vehicle for transferring microorganisms to ready-to-eat foods. The finding supports the argument that awareness campaigns alone may be insufficient to produce sustained behavioural change. Food vendors may understand the importance of hygiene but still fail to practice it consistently because of environmental limitations, workload, convenience, or inadequate access to appropriate facilities.

Water availability and quality also represent important determinants of safe food handling. Only 34.2% of respondents reported using tap water for washing food utensils, while 65.8% relied on well water, sachet water, or other sources. The environmental assessment further demonstrated that deficiencies in food vending environments remain an important public health concern. Less than half of the observed vending sites had functional handwashing facilities, while a considerable proportion were located near open drainage systems or refuse dumps. In addition, simultaneous handling of money and ready-to-eat food, together with the presence of flies around several vending sites, shows persistent opportunities for contamination. These findings are consistent with previous reports showing that poor environmental sanitation and inadequate infrastructure increase the risk of food contamination and foodborne disease transmission (CDC, 2024; FAO, 2022).

**Conclusion**

This study assessed the knowledge, food safety practices, and behavioural risks associated with foodborne antimicrobial resistance among food vendors in Ilorin West Local Government Area, Kwara State, Nigeria. Although many respondents showed awareness of basic food hygiene principles and reported adopting some recommended food safety practices, important behavioural and environmental risk factors that could facilitate the transmission of antimicrobial-resistant microorganisms through the food chain were identified. Deficiencies in hand hygiene facilities, environmental sanitation, food handling practices, and antibiotic-related behaviors highlight persistent gaps that require targeted public health interventions. Addressing these behavioural and environmental determinants through a coordinated One Health approach will contribute to reducing foodborne antimicrobial resistance and improving food safety within the study area and similar urban settings in Nigeria.

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