Water Safety and Hygienic Practices of Formal and Informal Food Outlets in Malawi

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Doi:10.19044/esj.2025.v21n12p15

Submitted: 10 October 2024
Accepted: 08 April 2025
Published: 30 April 2025

Cite As:
Phiri S.K. & Chibwe R. (2025). *Water Safety and Hygienic Practices of Formal and Informal Food Outlets in Malawi*. European Scientific Journal, ESJ, 21 (12), 15. https://doi.org/10.19044/esj.2025.v21n12p15

Abstract

Access to potable water is one of the most important aspects of ensuring consumer safety in food production. Interventions to improve the quality of drinking water and ensuring hygienic practices provide significant benefits to health. However, the monitoring of water quality and maintaining good hygiene remains a challenge in public food outlets where contamination of water may cause the outbreak of disease. The study aimed at assessing the water safety and hygienic practices of formal and informal food outlets in Malawi Community-based cross-sectional study design was conducted in Nkhotakota district, Malawi. A stratified random sampling technique was adopted to select 384 participating food outlets to assess water safety and hygiene practices. Data were collected through interviews and observational checklists. The study revealed that 31% (n = 384) of the food outlets had poor hygienic practices and half of the food handlers in the food outlets (50%, n = 376) had no knowledge of water contaminations. Furthermore, it was found that 96.6% of the food outlets (n = 384) use untreated water. Based on the findings, it was concluded that water being used was not safe for drinking due to poor hygiene and lack of knowledge by food handlers. Due to poor hygiene and lack of knowledge by food handlers, the study recommends widening the scope of policies in food outlets to provide special periodic orientation sessions to food handlers on sanitation and hygiene followed by evaluation in their respective food outlets. Food outlet owners should take responsibility for ensuring that hygienic conditions are followed at their business premises.

Keywords: Water contamination, water quality, water sanitation and Hygiene, Food outlets

Introduction

Water is an important resource for food production, which is often taken lightly in most food preparation and processing operations (Bhagwat, 2019). Water contamination and poor sanitation and hygiene are linked to the transmission of diseases such as cholera, diarrhea, dysentery, hepatitis A, typhoid fever, and poliomyelitis (Majiji et al., 2023). Lack of potable water or inappropriately managed water and sanitation services expose individuals or communities to preventable health risks affecting nearly 800 million people worldwide (WHO/UNICEF, 2020).

Water acts as a recipe for food preparation and has a wide variety of uses in food production such as cleaning and drinking (Filimonau et al., 2020). Though the significance is highly recognized, there is still a lack of water monitoring which has resulted in many individuals and communities being at risk of waterborne diseases (Cassivi et al., 2021). In recent years, there has been significant progress in the accessibility of potable water though nearly 700 million people across the globe are without access to improved water sources, and approximately 892 million people lack access to improved sanitation (WHO/UNICEF, 2021). As the global community celebrates the improvements and partial successes of the SDGs, concerns remain about whether water-access achievements are overstated, or whether the quality of water that is being accessed is within the standards of consumption as stated by WHO and MBS.

The WHO and the MBS regulate drinking water quality in public water systems and set limits for biological, physical, and chemical standards in water (MBS, 2017; WHO, 2022). Sometimes unsafe levels of harmful microorganisms and chemicals contaminate public drinking water (Chidya et al., 2019). These microorganisms and chemicals can get in the water at its source for example, groundwater or water from lakes or rivers or while water is traveling through the distribution system after the water has already been treated or due to poor sanitation at the point of use (Walker et al., 2019). MBS recommends that water should be tested for its quality to ensure that the drinking water is safe and free from contamination (MBS, 2005). Due to a lack of resources and capacity to access water that is verified to be safe for drinking, consumers of food in food outlets in Nkhotakota continue to drink water that is contaminated with microorganisms, hence an increase in diarrheal diseases which are caused by poor water quality (WASAMA, 2020).

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

The magnitude of water contamination associated with handling and storage patterns is not clear. As of the time of this study, there is limited data with details of levels of contamination associated with the handling and management of water resources in places where food is being sold in Malawi. However, the available reports on water storage practices and associated health problems show that there is a need for interventions for stakeholders (Balaka & Chagoma, 2022; Makwinja et al., 2019). Therefore, this study was conducted to evaluate water safety and hygienic practices of formal and informal food outlets in Malawi.

Theoretical and conceptual framework

This study is being conceptualized by the Integrated Behavioural Model (IBM-WASH model) for water, sanitation, and Hygiene. The model describes social and behavioral aspects that affect the adoption of WASH behaviors such as handwashing with soap, household water Chlorination, use of improved latrines and adoption of technologies in infrastructure-constrained settings (Dreibelbis et al., 2013). The choice of the model was consistent with recent conceptual and practical tools for improving the understanding and evaluation of multidimensional factors that influence WASH practices in food outlets.

The framework predicted contaminant flux and waste management, practices that contributed to contamination of water in a society, community, household and individual. This was used to answer alternative questions about contamination and the health implications of water used in food outlets. The model identifies three dimensions of WASH interventions and behaviors; Contextual, psychosocial and technological factors at all levels. This helps to understand the eminence of water quality issues and health implications which provides evidence for policy makers to make decisions to properly alleviate water issues in food outlets.

Materials and Methods

Description of the study area

The study was conducted in Nkhotakota District, central region of Malawi. Nkhotakota district is located to the west coast of Lake Malawi and borders Nkhata Bay District to the North, Mzimba District to the North West, Kasungu District to the West, Ntchisi District to the South West and Salima District to the South. It shares an international boundary with the Republic of Mozambique to the East. It is positioned at a latitude of 120 55’54.07” S and a longitude of 340 16’51.79” E.

The district is on the west coast of Lake Malawi. Figure 1 shows a map of Nkhotakota district.

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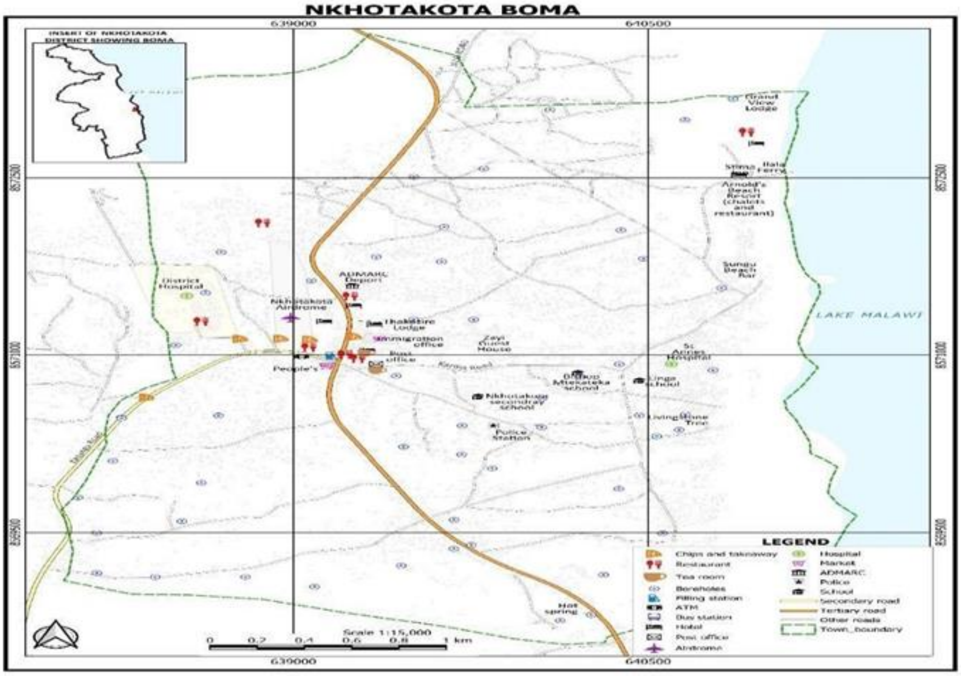

Figure 1: Map of Nkhotakota

Study design and source of population

A community-based cross-sectional design was used to assess the water safety and hygienic practices of food outlets and associated factors. The study focused on both formal and informal food outlets within the study area. Such outlets include restaurants, chips and takeaways, and tearooms that serve food to the public. Respondents in the questionnaire will be employed at the food outlet and the lead food handler or supervisor will be recruited for interview.

Sample size determination and sampling procedure

The sample size was determined using a single population proportion formula (EPI INFO version 7.2.2.6); with the assumption of 50% proportion (P) of food outlets with poor hygienic condition was considered and there was no similar investigation in the area, acceptable margin of error 0.05 (d), with 95% confidence level (Z (α/2) = 1.96) and 10% contingency rate for non-responses.

$$n = \frac{(Z^2) X\, P(1-P)}{d^2} = \frac{1.96^2\ X\ 0.5(1-0.5)}{0.05^2} = 384$$

Therefore, 384 food subjects were taken as the final sample size of this study. The list of all the food outlets was used as a sampling frame and food outlets were stratified by the type of service they give to make the sampling

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method more representative. Sample participants were selected using a stratified simple random sampling technique. To collect data, a list of informal and formal food outlets was collected from the Nkhotakota district council.

Data Collection Methods

Data were collected using a structured questionnaire and observational checklist. The checklist was used for establishing baseline indicators for the surroundings, hand washing facilities, water storage, handling practices and sharing of information for planning purposes. Information addressing the public health implications of drinking water supplied and possible interventions to reduce water contamination were obtained through a checklist. The Knowledge, attitude and practice of food handlers were assessed using questionnaires for comparative analysis. The data captured was done as guided by the questionnaire.

Data Management and Statistical Analyses

Data obtained from this study were verified for consistency and completeness during collection, entry and analysis. Data were captured into a computer and analyzed using a Microsoft Excel sheet and SPSS version 21. Binary logistic regression was used to identify the predictor variables associated with the outcome variable. A statistical significance test was assured using odds ratio at a cut-off value of 95% confidence interval (CI) and $p < 0.05$.

Results

Socio-demographic characteristics of the food handlers.

The study assessed 384 food outlets which include 58% restaurants, 22% Chips and takeaway and 20% Tea rooms. Of the total food outlets, 24% were formal and 76% food outlets were informal. Out of the 384 food outlets, 376 food handlers were able to respond to the questionnaire representing 97.9%. Of the total food handlers who participated, 67% were females and 33% were males. The food handlers who were able to read and write from the total participants were 99.3% and the age range was from 23 to 76 with the average age of 32.

Sanitation and Hygiene of Food Outlets

Hygiene of rooms and equipment

Most of the rooms where the water is being stored were dirty (69%, n = 384). The rooms were in bad condition which can create good conditions for microbial contamination. Most of the surrounding food outlets were dirty (69%, n=384) and staff were observed not cleaning their hands when handling equipment used for cooking and water storage. The hand contact surfaces, for

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example, work surfaces were not in good condition (51.7%, *n*=384) and they were not cleaned regularly. Figure 2 shows the hygienic conditions of water storage rooms, the surroundings and contact surfaces

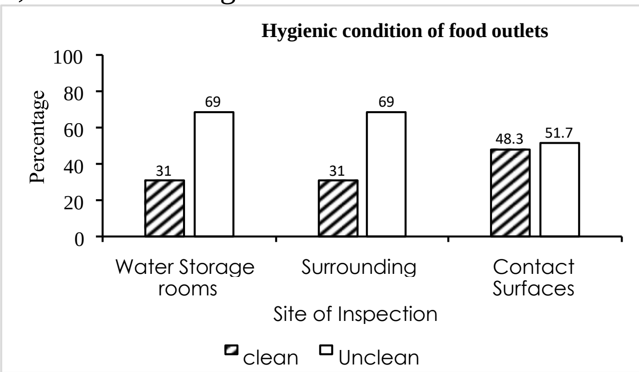

Figure 2: Graph showing the hygienic conditions of food outlets at Nkhotakota in September 2023

Most sites (68.9%, *n*=384) had no chemicals for cleaning the utensils after being used and no proper cleaning methods were followed. The separate cleaning clothes that are used to clean surfaces were not available in most of the food outlets (55.17%, *n*=384), and only one cleaning cloth was used to clean all the surfaces regardless of the infectious level of the surface. Waste management was observed to be a challenge and the waste generated was observed to have no designated place to be disposed of. Figure 3 shows the management of waste in some of the food outlets.

Figure 3: Pictures showing the management of waste in food outlets at Nkhotakota in September 2023

The waste that was generated at the food outlet was categorized as preparation waste, spoilage waste and plate waste. Preparation waste consists of waste generated during the processing of food for example peelings and wastewater. spoilages are wastes generated after expiry or damage, and plate waste is the waste generated after use, for example, overs. Figure 4 shows the waste disposal mechanism used by food outlets.

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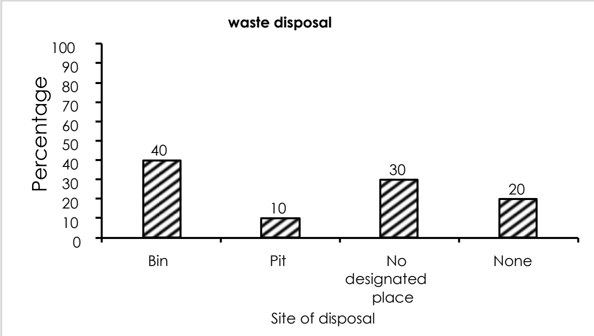

Figure 4. Graph showing waste disposal of food outlets at Nkhotakota in September 2023

Most food outlets used Bin (40%, *n*=384) to dispose of waste generated at the food selling point. Some food outlets have pits (10%, *n*=384) where they dispose of their waste. Some of the food outlets had no designated place (30%, *n*=384) to dispose of their waste and other food outlets had no site of disposal (20%, *n*=384). This means that the waste disposal mechanism that was practiced had the potential to contaminate water.

Water storage

Observation and inspections showed that in many food outlets, management of drinking water storage facilities in terms of sanitation and hygiene was a problem. Water storage facilities in most of the food outlets (58.6%, *n*=384) were uncovered and water was inappropriately stored. The place of water storage was not specific, other materials like cooking oil, the remaining foods and plates with leftovers. These materials have the potential to contaminate water. Most food outlets use closed buckets (43%, *n*=384), closed jars (23%), open jars (20%) and open buckets (13%) to store water.

Despite having the majority using closed buckets and closed jars for storage, the water transferring cups and the buckets were not cleaned regularly creating a potential for microbial contamination. Figure 5 shows how water was stored in food outlets.

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Figure 5. Picture showing the water storage in chips and takeaway outlet at Nkhotakota in September 2023

Water and food handling practices

Water management was a problem in most of the food outlets. Most of the food outlets (96.6%, *n*=384) were not treating water before use. Some of the respondents claimed that they use clean water from boreholes based on knowledge that water from boreholes is safe. The drinking water utensils such as cups were used for different people after use, but the cups were not cleaned regularly.

Most of the food outlets (69%, *n*=384) had hand washing facilities and it was placed in the right place. Despite having such, food handlers were not willing to wash their hands each time they wanted to touch food or utensils. The utilization of handwashing facilities was low.

Personal Hygiene

Personal hygiene of food handlers was observed when handling food, during food preparation, in cleaning utensils and in the sanitation facilities used. The observation and inspection of places showed that most of the food handlers (66%, *n*=384) did not wear personal protective clothes during work. The protective clothes include headgear, an apron and boots. Basins and other utensils that were used by the food handlers were found to be dirty (59%, *n*=384) and left unclean for long hours which attracted houseflies.

Knowledge, attitude and practices of food handlers

Knowledge of WASH and Health Implications

Half of the food handlers (50%, *n*=376) had knowledge of water, sanitation and Hygiene. The topics were learnt during health promotion programs which were aimed at reducing the impact of cholera and COVID-19. Figure 6 indicates the knowledge that the food handlers had. Most of the respondents were aware of the importance of personal hygiene (20%, *n*=376).

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The respondents showed attributes of knowing the importance of personal hygiene, how to use personal protective equipment to reduce microbial contamination, hand washing protocols, and infection prevention strategies. Some respondents (3.33%, *n*=376) had knowledge of diseases caused by poor water, sanitation and hygiene. Respondents who had such knowledge were able to explain some of the diseases that may come due to contaminated water and poor sanitation. The respondents acknowledged that no one among the food handlers was affected by diseases caused by poor sanitation.

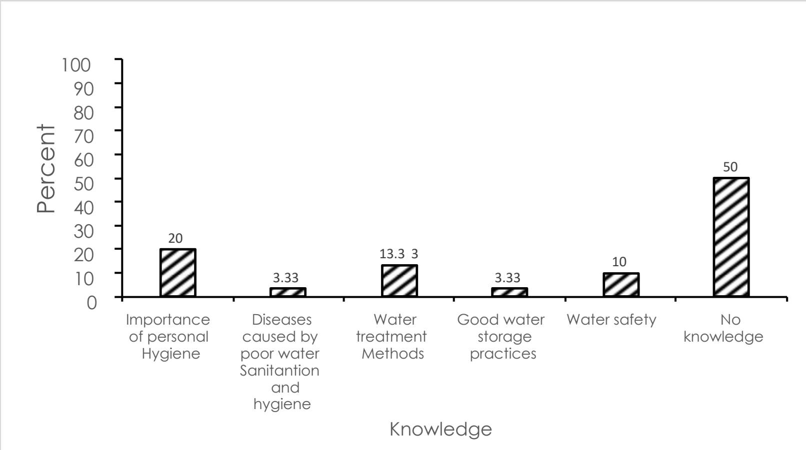

Figure 6. Graph showing knowledge levels of food handlers at Nkhotakota in September 2023

Some food handlers (13.33%, *n*=376) attended orientations on water treatment methods and they were aware of the preparation of chlorine in drinking water and other water treatment methods. Food handlers who had knowledge of water safety (10%, *n*=376) were able to explain water storage and handling practices.

Water quality and hygiene

The attitude and perception of food handlers on the water they use indicated that all the food handlers were satisfied with the water they use from the source to the point of use. Most respondents (97%, *n*=376) had a positive attitude towards the water they use and attributed that the water was suitable for use. A few respondents (3%, *n*=376) responded that the water they used was good but they were not sure if it was suitable for use. The respondents (83%, *n*=376) were confident that the water they used was of good quality by observing from the source. Most of the food outlets used water from boreholes. Some food handlers (10%, *n*=376) responded that the water quality they use was good considering the handling practices of water at the place. Few

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respondents (7%, *n*=376) knew about the reports for water quality testing and they attributed to it that water was good considering the report.

Microbiological and Physico-chemical water quality

Water samples were collected in all the 376 sites for microbiological and physico-chemical water analysis. The microbiological parameters tested includes Faecal coliform and Faecal streptococcus. Physico-chemical parameters tested includes the pH, turbidity, conductivity, total dissolved solids, Temperature, sodium and chloride.

The microbiological contamination identified was found in 4 informal sites for faecal coliform which registered 89 – 208 cfu/100mL and faecal streptococcus which counted 210 cfu/100mL. As compared to WHO and MBS standards, the values were far above the recommended standards of 0cfu/100mL. Across the sites, Faecal coliform showed no significant difference ($p<0.05$). The values registered indicate that water supplied from the affected water points was not safe for human consumption during the time of sampling.

The physico-chemical water quality parameters which includes pH, conductivity, Total dissolved solids, temperature, sodium and chloride were found to be within the recommended MS214:2013 standards. Turbidity were found to be within the range comparing with the MS214:2013 in formal food outlets, and out of range in informal food outlets ranging from 2 – 6.40NTU, mean of 2.1 and the standard deviation of 1.30. The variations were present in informal food outlets where the data points were far away from the mean. This signifies that there was a significant contamination of water in informal food outlets. Table 1 shows the summary of water quality parameters tested in formal and informal food outlets.

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Table 1: Summary of water quality parameters tested in foodoutlets in Nkhotakota

Variable	Units	Category	Mean	Std Deviation	Minimum	Maximum	MS214:2013
Faecal coliform	cfu/100ml	Formal	0.00	0.00	0.00	0.00	0.00
	cfu/100ml	Informal	18.75	55.50	0.00	208.00	0.00
Faecal streptococs	cfu/100ml	Formal	0.00	0.00	0.00	0.00	0.00
	cfu/100ml	Informal	7.50	39.69	0.00	210.00	0.00
pH		Formal	6.80	0.50	5.60	7.40	9.50
		Informal	6.50	0.30	6.00	7.30	9.50
Turbidity	NTU	Formal	1.20	0.70	0.40	2.90	5.00
	NTU	Informal	2.10	1.30	0.20	6.40	5.00
Conductivity	µS/cm	Formal	139.50	47.80	34.00	212.00	1500.00
	µS/cm	Informal	180.90	168.20	27.00	874.00	1500.00
Total dissolved solids	mg/dl	Formal	79.20	29.90	17.00	146.00	1000.00
	mg/dl	Informal	99.80	81.90	37.00	437.00	1000.00
Temperature	°C	Formal	25.70	4.90	11.80	30.60	
	°C	Informal	28.40	2.40	24.00	32.60	
Sodium	mg/L	Formal	63.91	26.18	40.00	145.00	200.00
	mg/L	Informal	52.14	20.42	28.00	98.00	200.00
Chloride	mg/L	Formal	71.36	27.13	28.00	129.40	200.00
	mg/L	Informal	76.36	24.41	43.00	149.70	200.00

Discussion

Sanitation and hygiene of food outlets

The general sanitation and hygiene of the food outlets were poor which had the potential to contaminate water. In this study, it was found that there was poor hygiene and food handling practices were not done according to the specified procedures. The water storage rooms were unclean and there was a mix-up of materials in the water storage rooms. The cooking oil, vegetables, and uncleaned plates were kept in a single room. This is consistent with the study by Nizame et al., (2019) which found limited facilities, poor hygiene and poor food handling practices in restaurants. During the structured observation, the surroundings of the food outlets was dirty and the waste generated had the potential to contaminate water as no proper cleaning of the surroundings were done regularly. Some food handlers admitted that the lack of cleanliness was due to the increase in the number of customers who needed to be served urgently. The study in Tamale, Metropolis found that some food joints do not seek permission before setting up their premises, and some are sited in unhygienic environments posing a danger to the safety of consumers

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(Abubakari et al., 2019). This therefore suggests that the authorities in the district council should take part in the allocation of food outlets and facilitate sanitation and hygiene.

Dining area cleanliness is one of the most important sanitary issues that people consider when patronizing food at any food outlet. The dining area gives more freshness to the surroundings and makes clients feel comfortable when eating (Malek et al., 2021). In most of the food outlets, the tables were not cleaned leaving food particles on the tables and floor. The contact surfaces were found to be dirty and the average of food outlets had no designated place to dispose of waste. This is contrary to the study by (Abubakari et al., 2019) which found that the tables were clean and tidy in most of the food joints. The cleanliness could be due to improvements in the hygiene of the area and the value of the knowledge of the food handlers on possible contaminants of food and water.

The overall physical appearance of the food handlers was not neat and most of the food handlers were not in personal protective clothes or uniform which made them look unprofessional. The staffing levels of the food outlets were not enough to cover the sanitary activities at the place. No food outlet had toilets, as such the food handlers and customers used public toilets for the district council. These findings confirm the statement of (Naumann et al., 1999) that restaurants with few food server hygiene factors lead to customer dissatisfaction and higher customer turnover. Few food servers could be one of the leading factors to poor sanitation. The consequences of poor sanitation are severe and may put customers at risk of infections.

Knowledge, attitude and practices of food handlers

Food handlers play a major role in the prevention of microbial contamination during food production and distribution. The handling practices of food handlers may determine the quality of water at the food outlet. The lack of knowledge of food handlers on the microbial contaminations found in this study is a major challenge as many practices were done out of ignorance hence leading to serious waterborne diseases. Nevertheless, it is not only ignorance that causes contamination of water but also lack of practice. The food handlers who had knowledge of the importance of personal hygiene and good water storage practices showed the attributes of knowledge but there was a lack of implementation. Several studies have demonstrated a lack of correlation between the orientation training of WASH and improvements in water quality (Alkandari et al., 2019; Kamboj et al., 2020; Ncube et al., 2020; Wan Nawawi et al., 2022). This confirms that knowledge alone does not lead to changes in water safety. The current study recommends widening the scope of policies in food outlets to provide special periodic orientation sessions to food handlers on sanitation and hygiene followed by evaluation in their

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respective food outlets. Further, the food safety training should place more emphasis on the use of techniques that promote behavioral change, and the acquisition of practical skills for the performance of recommended hygiene procedures.

The food handlers' attitudes toward the water they use were positive as the majority observed from the source. The physical observation does not provide evidence that water is clean unless water quality testing is done (Manini et al., 2022). Most food handlers were not washing hands during food preparation and serving arguing that they did not touch anything dirty that would contaminate their hands. In a related study by Abubakari et al., (2019), food servers were observed using their hands to handle money given to them by customers and also using the same bare hands to serve food. These practices have the potential to contaminate water with pathogenic microorganisms. The current study suggests the placement of handwashing facilities in food preparation areas could enhance convenience and improve the handwashing practice. The psychosocial aspect at the individual level was a section of the IBM-WASH model that involves self-efficacy, knowledge, perceived threat and disgust. The model largely explained the perception of food handlers where participants reported that they did not touch anything dirty and the perception that water is clean by just observing the source. Such perceptions are similar to those reported by (Al-kandari et al., 2019; Isoni Auad et al., 2019; and Kwol et al., 2020) which could hinder the handwashing practice.

The Health implications of water

Contaminated water and poor sanitation are linked to the transmission of diseases such as cholera, diarrhoea, dysentery, hepatitis A, typhoid and polio (WHO/UNICEF, 2020). The microbial contaminants caused by poor sanitation signify the presence of disease-causing organisms emanating from faecal matter and may cause disease outbreaks (Machado-Moreira et al., 2019). A long history of illness outbreaks and epidemics has demonstrated a relationship between the presence of fecal bacteria in water and the presence of other illness-causing organisms. These pathogens can be accidentally swallowed with water or eaten in contaminated plates due to poor sanitation of the surroundings. Absent, inadequate, or inappropriately managed water and sanitation services expose individuals to preventable health risks.

The faecal bacteria were associated with diarrhoeal diseases in sub-Saharan Africa including Malawi (Cabral, 2010; WHO, 2019).). In the current study, a few samples (17.2%, n = 58) were contaminated with Faecal coliforms and faecal streptococcus exceeding MS 214 standard levels of faecal contamination in drinking water. The WHO standard recommends the absence of faecal coliform in drinking water (WHO, 2022). Among them are some harmful bacteria like *E. coli* which causes diarrhea and dysentery, *Shigella sp.*

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which causes shigelosis and salmonella typhi which causes typhoid fever (Overgaard et al., 2021; Some et al., 2021).

The use of improved sources of water supply may not guarantee safe water at the consumption level. Therefore, good sanitation practices and proper handling of water should be done in addition to using improved water sources to overcome the burden of diarrhea diseases. High levels of turbidity may lead to staining of materials and interfere with the effectiveness of treatment methods. Turbidity is also a determinant of the presence of pathogens. Elevated levels of turbidity in the current study may have an implication of carrying pathogens that may affect human health. This is consistent with studies by Mena-Rivera & Quirós-Vega, (2018); Mkwate et al., (2017); Stevenson & Bravo, (2019) which found unsafe levels of turbidity in human health.

Conclusion

Food outlets play an important role in providing readily accessible food to the public. However, the quality of water used and hygiene in the food outlets must be taken into consideration in the prevention of contamination of water. This study evaluated the water quality and assessed the sanitation of food handlers at Nkhotakota. The study revealed that most of the selected food outlets used unsafe drinking water despite claiming that they used safe water. The microbial assessment indicated high levels of microbial contaminations in water used in selected food outlets and the physico-chemical water quality was found to be unsafe with elevated levels of turbidity. The overall results indicated that there was a strong linkage between microbiological water quality and hygiene, hence the food outlets with good hygiene practices had water of good quality than food outlets with poor hygiene. The study further reviewed that most food handlers (50%, n=376) were not aware of microbial contamination and the general sanitation and hygiene of the food outlets were poor. The findings concluded that water used in food outlets in the study area is contaminated and not safe for drinking.

Recommendations

Given the findings, it is hereby recommended that the following action should be taken;

a) widening the scope of policies in food outlets to provide special periodic orientation sessions to food handlers on sanitation and hygiene followed by evaluation in their respective food outlets
b) Due to poor sanitation and hygiene, food outlet owners should take responsibility for ensuring that hygienic conditions are followed at their business premises

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c) Due to elevated levels of water quality in this study, it is recommended to conduct frequent monitoring of water used in food outlets

Conflict of Interest: The authors reported no conflict of interest.

Data Availability: All data are included in the content of the paper.

Funding Statement: The authors did not obtain any funding for this research.

Declaration for Human Participants: This research followed the national ethical research guidelines for research involving human subjects. The research was approved by the University of Livingstonia research ethical committee.

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