FOOD POISONING IN NIGERIA: TRENDS, RISK FACTORS AND PREVENTIVE MEASURES- A NARRATIVE REVIEW BETWEEN 2020-2024

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ABSTRACT

Introduction: **Food borne illnesses cause serious health problems and a major contributor to malnutrition in developing nations. The severity of symptoms of food poisoning may vary depending on the amount of the offending agent consumed in the food and the general health of affected individuals. Hence, the infant and elderly populations are more likely to develop more serious symptoms because of their weak immune status or defense mechanisms.**

Aim and objective: **The rationale for this narrative review is that knowledge of recent trends in food poisoning as documented across literatures in Nigeria may help mitigate the occurrence of food borne illness**

Methods: **This study followed the guidelines for performing a review proposed by the Joanna Briggs Institute (JBI). Search terms used for this study included "food poisoning , risk factors for food poisoning, public health proposals against food-borne disease outbreaks AND Nigeria" to search for manuscripts that were relevant to the research's focus and target population. The manuscripts included were those published between 2020 and 2024. To document evidence that is easily accessible and available in the free scientific and medical database domain, PubMed and the Oxford Academic database were specifically chosen and used for this study. Only manuscripts with full articles which were published in Enlgish language were included in this analysis. The data of the relevant information points necessary for this study were extracted into Microsoft Excel spread sheet and synthesized into this manuscript.**

Results: **After review of the results of the search, a total of 20articles were ultimately included in our narrative review. This narrative documented six (6) major recurring food poisoning agents that have great health economic implications for both animals and human beings: these included Salmonella, Escherichia coli (E. coli), Methicillin-resistant Staphylococcus aureus (MRSA), Clostridium botulinum, filth flies and toxic metals such as heavy metals, which are present in soil, crops, poultry, ready-to-eat foods, daily meat being consumed, and in human being. These channels of infections, together with excessive chemical use, chemical pollution through human activities, and unhygienic conditions during processing, impaired both human and animal health.**

Conclusion: **This narrative review revealed risk factors and effects of food poisoning on both human and animal which can result to Public Health crises. Micro-causing pathogens appeared to be more common as these reoccurred across multi-stages of food production. Improper handling, processing, and storage of food immensely contribute to foodborne illnesses -a leading cause of malnutrition in Nigeria. To mitigate against reoccurrence, farmers and food handlers must be properly educated on food safety from farm to table in reducing food poisoning incidence.**

Keywords: Food poisoning, Food safety, Diarrhea, Nigeria

BACKGROUND

Food poisoning is defined as an illness caused by consuming contaminated food or drink, usually resulting in acute gastroenteritis.[1] It is often infectious or toxic, caused by bacteria, viruses, parasites, or chemicals entering the body[1]. Symptoms include fever, headache, nausea, vomiting, abdominal pain, and diarrhea.[1,2] Unsafe foods remain a global health concern, particularly in the developing countries of Africa.[3] Microbial contamination is the major risk associated with unsafe foods, and are, themselves, a major public health concern. In recent time, documented incidences of foodborne diseases have

significantly increased over the past few decades in most countries with case-reporting systems.[3]

Food poisoning caused by contaminated food and water can cause a serious health problem in both developed and developing countries.[2,4] It is one of the main etiological factors of malnutrition in developing countries due to its role in the causation of diarrhea.[5] Frequently, food poisoning and diarrhea kill about 5 million children per year globally.[4,5,6,7,8,9] Globally, an estimated 600 million and almost 1 in 10 people fall ill, and 420,000 die annually as a result of consuming contaminated food.[1] Diarrhea disease, being the most common illness resulting from unsafe food, has led to 550 million people falling ill every year, including 220 million children under the age of 5 years.[1] In a case report in Africa, approximately 91 million people ate a contaminated food that resulted into illness and death of over 137,000 persons.[10,11,12] Similarly, over 26% of street food sampled in Lagos, Nigeria, were analyzed to have contained *B. cereus* and 16% of *S. aureus*.[2]

The severity of symptoms of food poisoning may vary depending on the amount of the causative agents consumed. Hence, the infant and elderly populations are more likely to develop more serious symptoms because of their weak immune status or defense mechanisms.[3] Food contamination have been identified to have been caused by series of factors. For instance, poverty is considered the underlying cause of the consumption of unsafe foodstuffs that are likely to cause food poisoning because it exacerbates food safety problems through unsanitary living conditions[2,13,14] Across both rural and urban settings, lack of access to clean water, unhygienic transportation and food storage system, and low education level among consumers and food handlers, together with a false sense of invulnerability, have contributed to the emergence of food-borne illness.[3] More worrisome is the fact that food safety control laboratories generally do not exist in some parts of the country[15], and/or where they exist, they do not function because of a lack of skilled human resources, material, and financial resources.[15]

Nigeria has food regulatory bodies[15], yet the application of food standards in the food industries seems to be problematic[15] right from the selection of seeds to sowing in line with the appropriate cultural practices, until harvesting and marketing, food safety cannot be guaranteed.[16] However, despite the high burden of food poisoning and its attendant consequences on the causation of ill health and death especially among the extremes of age and in developing nations, most countries do not have appropriate policies and legislation to deal with these issues.[6] The rationale for this narrative review is that knowledge of recent trends in food poisoning as documented across literatures in Nigeria may help mitigate the occurrence of food borne illness. Reviews of existing public health actions and interventions may significantly enhance the adoption of similar procedures against such outbreaks, thereby providing evidence-based procedures for safety and health care authorities for better service provision. More so, this review will ascertain gaps and recommendations for further actions. Hence, this review aims to answer the following questions: What are the recent food poisoning discoveries in Nigeria in the last 5 years? What are the risk factors of food poisoning in Nigeria? What are the public health recommendations against these food-borne disease outbreaks in Nigeria?

METHODS

The guideline for conducting a review, as postulated by the Joanna Briggs Institute (JBI)[17] was adopted for this study. The JBI framework recommends organizing the review process into nine stages: defining and aligning the review objectives and questions; developing and aligning the inclusion criteria with the objective and questions; describing the planned approach to evidence searching, selection, extraction, and charting. Others included searching for evidence; selecting the evidence; extracting the evidence; charting the evidence; and summarizing the evidence with the objectives and questions and constant. All nine (9) processes were adopted for use in this study.

Search methods and strategy

Scells *et al.* and Leonardo suggested developing a research question and searching for the relevant literature, and finding an evidence-based practice to formulate and shape the literature review search process and design[18]; this influenced the selection and usage of the PICO (Population, Intervention, Comparison, and Outcome) tool, which helped to frame and answer the research question.[18,19] The focus and target population for the research were searched with syntax: "food poisoning, risk factors for food poisoning, public health proposals against food-borne disease outbreaks AND Nigeria" from 2020-2024. Database from PubMed and Oxford Academic were purposely selected and used for this study: the choice was to document evidence that is readily available and deposited in the free scientific and medical databases domain.

Study selection (inclusion and exclusion)

Our inclusion criteria centered on 1) peer-reviewed works 2) studies that fall in a predetermined time window were utilised from 2020-2024 and 3) works conducted, reported and published in the English

language and 4) Studies that included the keywords. On the other hand, the exclusion criteria were 1) non-research materials or items (such as editorials and opinion pieces) 2) studies that only concentrated on food poisoning and 3) studies that do not cover the keywords.

We manually searched and sorted the articles by designing an Excel sheet for the purpose. Three reviewers carried out this task, and the search was conducted between 12th and 30th September 2024, and we identified 84 articles; title screening excluded 37 articles during title/abstract screening, giving rise to 47; eligibility criteria expunged 27 meta-analyses/systematic/reviews. The final extraction yielded 20 articles; thus, a total of 20 articles were finally included in our narrative review. This was illustrated in the PRISMA-NaR flowchart (Figure 1).[20]

The review's inclusion and exclusion criteria centred on 'food poisoning' (Table 1). Only peer-reviewed works released in English during a predetermined time window (1st January 2020 - 30th, September, 2024) were utilized. Non-research items (such as editorials and opinion pieces) and studies that only concentrated on other such as clinical trials, animal testing/experiment, soil analysis amongst others, were excluded. Systematic, narrative, meta-analysis and other reviews were excluded because they have more representative information than narrative reviews or cross-sectional studies. Randomized controlled trials, retrospective case notes studies, empirical, descriptive, both quantitative, qualitative or mixed method approaches, observational cohort studies on the topic were included. In addition, the eligibility criteria were not subjected to any further critical appraisal skills program since it is a narrative review.

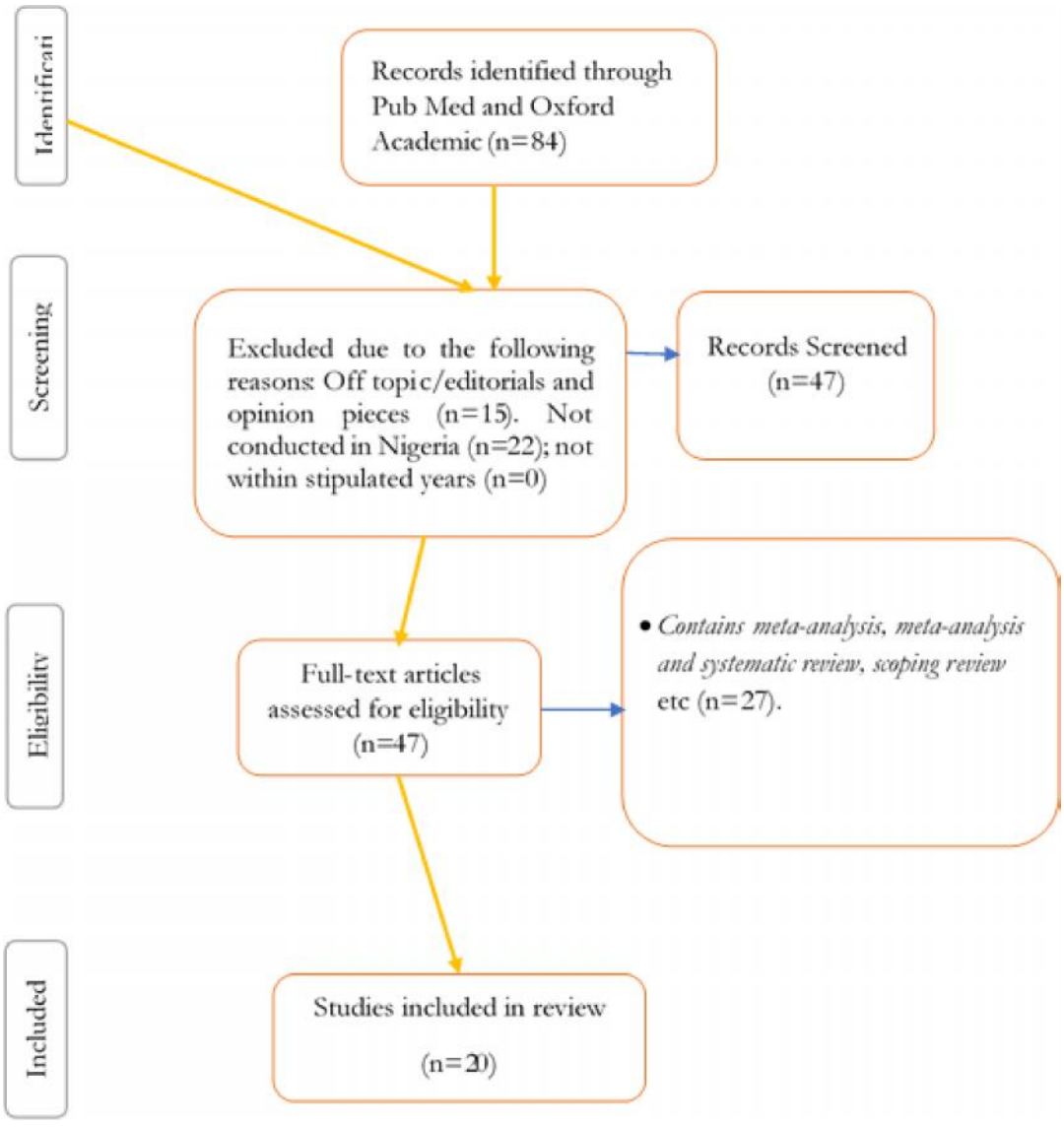


Figure 1: Preferred reporting items for systematic reviews and meta-analyses for narrative review (PRISMA-NaR) flow diagram of selected articles as used by Otis *et al.*[21]

Data were extracted into Microsoft Excel and synthesized manually. Each study extracted were collectively reviewed by the researchers to assess its consistency with the review objectives. Three researchers extracted data and conducted data plotting fields. All studies identified and selected for inclusion in the review were reported. This was accompanied by the use of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Narrative Review (PRISMA-NaR) flowchart as recommended by Moher *et al.*[20] (Figure 1). All key concepts from the papers compiled from the extraction were analyzed through narrative thematic analysis.

RESULTS

Study designs and spread of included research

A total of 20 manuscripts were obtained after literature search and evaluation for suitability for this review. The majority (62.5%) of studies were observational. There is also a notable number (25%) of cross-sectional studies. The inclusion of two (12.5%) cohort studies[22,23] highlighted some longitudinal aspects of the topic under discussion. All studies are recent, primarily conducted in 2020-2024, with a notable (37.5%) trend of increased research activity in 2023[9], about 31.3% in 2020[22,24,25,26], 12.5% from the year 2021[27] and 2022[28,29] respectively, while an article 6.25% was recorded in the year 2024.[23]

The studies were spread across multiple states: Delta[30,31], Ebonyi[24], Edo[31], Enugu Metropolis[28], FCT[22], Kwara[32,33,34], Kano[35], Ogun[27], Oyo[26,29], Osun[38], and Northern Nigeria.[40]

Trends of food poisoning in Nigeria

This narrative identified and documented five (5) major recurring food poisoning pathogens that have great health and economic implications for both animals and human beings. Salmonella was identified as a significant zoonotic pathogen, particularly from poultry, and also causes salmonellosis in humans.[23] Escherichia coli (E. coli), particularly enteropathogenic strains, was noted in ready-to-eat foods.[28] Methicillin-resistant Staphylococcus aureus (MRSA) was reported in hospitals and in daily meat being consumed.[31] Okunromade *et al.* reported the presence of Clostridium botulinum, which found its way into crops, causing foodborne illness.[22] The presence of toxic metals, though not pathogenic, was discussed due to their continuous leaching into crops[33], creating a great challenge to agricultural practices and food poisoning through excessive chemical use and pollution.[26] The issue of filth flies was also noted.[41] foodnorne disease epidemic are mostly due to suboptimal personal hygiene among food vendors was.[35] The abuse and misuse of antimicrobial agents in the poultry sector have been linked to increase resistance of antimicrobial.[27]

Risks factors of food poisoning in Nigeria:

In our review, we found four basic risk factors to food poisoning in Nigeria. These include pathogen transmission/contamination, poor food handling and hygiene practices, environmental and agricultural factors, and regulatory challenges. In the pathogen transmission/contamination, Igbinosa *et al.* identified animal-derived foods (e.g., eggs, milk, meat) as primary sources of contamination, with commercialization and globalization facilitating the widespread of foodborne illnesses.[31] For instance, Salmonella was frequently cited as a major concern across several studies[27,31,32], indicating a strong link between poultry production and salmonellosis. Even though these pathogens are present, the concerns about their re-emergence due to their antimicrobial-resistant strains, particularly of Salmonella and Staphylococcus aureus, pose a great public health concern.[27,31]

While pathogen transmission/contamination routes may not be a widely accepted factor enabling food poisoning in Nigeria, Agbaje *et al.*, however, highlighted that the channel of food production, as the case with egg production, can become contaminated during various stages of handling: from packing to market sales as a result of various touches by multiple buyers.[31] Onwugamba *et al.* further buttressed this with the case of flies, which often serve as vectors for pathogens, aiding transmission of diseases of various kinds. Through these approaches, outstanding preservative mechanisms may become vulnerable, thus posing a challenge to this mechanism.[41]

In their opinion, Adegoye *et al.* noted that improper handling, processing, and storage in agricultural farming, especially as it relates to aquaculture and fisheries, contribute to malnutrition and foodborne illnesses.[30] This is further compounded by suboptimal personal hygiene among food vendors[35], which is compounded by their poor knowledge of food processing.[28] Environmental factors causing damage to fruits[38], or because of urbanization and industrialization[38], or climate change[26] were identified as factors influencing the prevalence of food poisoning diseases. Since these are not by themselves 'causative agents, it is noticeable that lack of stringent regulations and oversight by appropriate authorities[28], lack of reporting and misdiagnosis of foodborne illness cases[22], and neglect of safety measures[46] were noted as major contributing factors to food poisoning in Nigeria.

Similarly, multiple studies emphasized the global and national public health challenges posed by foodborne illnesses. In this regard, the issues of the importance of food safety for health, economic prosperity, and social development, and their implications for national and regional health are always emerging and re-emerging public health concerns across recent research.[24,29,35] It is thus imperative to know that while microbes contribute significantly to food poisoning, human activities such as environmental pollution, degradation, and poor waste management are themselves the major cause of food poisoning experience in Nigeria.

Preventive measures

In Nigeria, food safety indicators play important role in protecting public health and ensuring the safety of the food supply chain.[4] There are rules and procedures to guide both the professional and consumer since both are equally responsible for the safety of food. Food safety is best ensured by the shared responsibility of everybody involved with food, from professionals to the consumer.[41,42] All along the food chain, various procedures and good practices are implemented to ensure that the food that reaches the consumers is fit for consumption and risks of contamination are minimized so that the population as a whole is healthier from the benefits of safe, quality food.[4] To safeguard public health, a strong and up-to-date regulatory framework for the regulation of food quality and safety from production through the supply chains is crucial.[43,44] Nigerian food safety policy sets out the principles, values, priorities, and strategies necessary to enable the development of actions to address the main concerns of the sector.[45] The food safety regulatory framework in Nigeria currently functions as a sectoral Food Safety Control System involving multiple agencies.[46] Furthermore, in today's globalized world with rapid movement of people and goods, many countries depend heavily on the import of food products. This increases the need for regulation to ensure that food products imported into or exported from nations meet basic international standards in terms of quality and safety.[43] There is a need to take appropriate and pragmatic steps to ensure food safety and quality for domestic consumption and export. An effective national food safety policy assures that food supplied to consumers is adequate, nutritious, of good quality, and wholesome.[47] In Nigeria, the responsibility for implementing food safety laws is shared among the three levels of government: federal, state, and local government bodies. The key institutions at the federal level that are responsible for facilitating food safety are the Ministries of Health, Environment, Science and Technology, Agriculture, and Trade and Investment.[48] Equally, the National Policy on Food Safety (NPFS) seeks to coordinate all existing laws for the regulation of food safety practices in Nigeria and revamp existing food control systems at the different levels of government.[49] By implementing the National Policy on Food Safety (NPFS), Nigeria has successfully developed its food safety policy.

Recent public health interventions in curbing food poisoning in Nigeria

Adegoye *et al.*[30] indicated that creating educational materials in an easy-to-read format with high-quality graphics aids contributes to food safety.[30] Adegoye *et al.*[30] developed a low literacy module seven-module flipbook on nutrition and safe handling and processing of fish in Nigeria, which has been successfully validated and considered suitable and culturally appropriate for the target population.[30]

Furthermore, enforcement involving the training of food vendors and issuance of fitness certificates to all food vendors[35] or proper hygiene measures in poultry farms to monitor foodborne salmonellosis.[31] Surveillance on food vendors and their product by way of investigating the microbiological quality of ready to use food to reduce the possible risk of food poisoning.[28]

Moreover, the poultry environment could likely serve as a reservoir for Salmonella serovars[31] or methicillin-resistant Staphylococcus, which could cause food poisoning due to high prevalence of enterotoxins.[31] It was revealed that the prevalence of various *Salmonella serovars* and the emergence of multidrug resistance to commonly used antibiotics have increased among the general populace.[31,32] Also, Salmonella occasionally spreads through eating raw or cooked shellfish that are naturally contaminated.[28] This further revealed that multidrug-resistant organisms are increasing challenges to human and livestock health worldwide[29] and detection and reporting of botulism is rare in Nigeria.[22] Agbaje *et al.*, suggested continuous collection of data in the poultry sector to aid relevant authorities in making decision-making[27] or prudent use of antibiotics is essential and its continuous use of growth promoter needs to be re-examined for food safety can further enhanced by funding industries and government in Nigeria in improving food safety measures.[31] More so, a well-integrated natural surveillance system for monitoring Salmonella and antimicrobial resistance in poultry should be critical.[29] The global health body needs to address the poor capacity building in curbing botulism outbreaks in developing countries.[22]

Oladosun *et al.*, indicated various parasites and bacteria in fruit that can lead to public health crisis.[38] Sanni *et al.*[23] noted one health coverage intervention was cost-

effective against non-typhoidal Salmonella in Nigeria.[23] Oladosu *et al.*, recommended awareness of the usefulness of proper washing and disinfecting of fruits before consumption[38], while Sanni *et al.*, noted that identified limitations such as resources allocation must be improved to optimize benefit association.[23]

Further education about food-borne parasites should target healthcare professionals at all levels.[24] Since health professionals have solid knowledge on transmission routes and prevention strategies, they will be able to further educate the populace better.[24)]

Orosun *et al.*, revealed high concentration of toxic metals in soil which exceeded WHO recommendations.[33] ETAPOD harnesses the potential improvement of cocoa and discourages fungicide misuse among local cocoa farmers[26], while Jiangin *et al.*[25] revealed cryptosporidium Felis adaptation and geographic isolation.[25] Orosun *et al.* therefore recommended remedial actions in combating chemical food poisoning such as using phytoremediation, and phytoextraction for further research on the redistribution of metals in bioavailability in the environment.[33] Etaware *et al.*, on their part, recommended that ETAPOD (a forecast model for prediction of blackpod outbreak in Nigeria) has a pertinent tool that can effectively minimize the prevalence of black pod disease in Nigeria with minimal chemical application.[26] Also, further studies involving more samples are needed to confirm and improve the understanding of zoonotic pathogens transmission.[25]

Ibrahim *et al.*[35], noted poor personal hygiene knowledge among two groups of food handlers.[35]

Recommendations towards improving food safety in Nigeria

Improving Food Safety Infrastructure: Omemu *et al.* emphasized strengthening the infrastructure of food safety to paramountly prevent foodborne illnesses in Nigeria. This includes banking in sanitation facilities, water quality improvement and management, most importantly, enhancing regulatory frameworks to guarantee hygiene standards compliance. Public-private partnerships can expedite food safety implementation initiatives and promote best practices for industry-wide adherence.[50]

***Enhancing food hygiene education*:** Consumer's education, food industry stakeholders, and food handlers have focused on proper food hygiene practices, which is an essential foodborne illness reduction strategy.[51] Training programs, public enlightenment campaigns, and community initiatives outreach can energize individuals towards the adoption of prepared practices and safer food handling. Highlighting the need for handwashing, proper cooking approaches, and safe food storage can contribute to the promotion of food safety culture and behaviour change.[51]

Intensifying surveillance and response readiness: surveillance systems enhancement for foodborne diseases and strengthening response capacities to outbreak are critical for early detection and restriction of foodborne illnesses.[52] This includes setting up sentinel surveillance centres, conducting infection analysis, and laboratory capabilities enhancement for detection and characterization of pathogens. Emergency response crews and coordinated interdisciplinary teamwork are necessary for effective management of foodborne outbreaks and preventing onward transmission.[52]

Public health actions: research has established that result-oriented public health efforts play a central role in alleviating the impact of food poisoning in Nigeria.[53] These strategies encapsulate investigation of outbreaks and response, Surveillance of foodborne illness and reporting, law enforcement, and collaborative teamwork within public health entities, food processing industry stakeholders, and healthcare providers. Establishing partnerships, sharing insights and evidence-based interventions and implementations are crucial for burden reduction on foodborne illnesses and public health security.[53]

CONCLUSION

This narrative review revealed risk factors and effect of food poisoning on both human and animal which can result to Public Health crises. The four main risk factors found are pathogen transmission contamination, poor food handling and hygiene practices, environmental and agricultural factors and regulatory challenges. It is crucial that farmers and food handlers be properly educated on food safety from farm to table, which can lead to reduction in food poisoning incidence.

Conflict of interest

The author declare that there is no conflict of interest.

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