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PERSPECTIVE

Food safety in vulnerable populations: A perspective on the challenges and solutions

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Abstract

Vulnerable populations are a particular group that are not capable of fending for themselves due to a number of limitations. Among many things, of particular concern is the food safety challenges faced by these individuals and the high risk of susceptibility to foodborne diseases. In this paper, an attempt is made to point out the various challenges faced by vulnerable populations that make them more susceptible to foodborne illness than other healthy adults. Also, the paper highlights possible improvement pathways through which these people can have access to safe and nutritious food, and the current interventional steps taken to address the food safety risk associated with food handling activities of food meant for vulnerable groups.

KEYWORDS

challenges, food safety, intervention, vulnerable population

1 | INTRODUCTION

World Health Organization (WHO)[1] reports that unsafe food leads to foodborne disease and malnutrition especially in neonates, children, the aged, and the ill. The WHO report revealed that about thirty-one foodborne hazards were responsible for foodborne diseases affecting about 600 million people with an accompanying 420 000

Abbreviations: USDA, United States Department of Agriculture; WHO, World Health Organization.

deaths in 2010 alone. Globally, the most common agents implicated in foodborne diseases are diarrheal agents such as norovirus and Campylobacter spp.[2]

According to United States Department of Agriculture (USDA),[3] food safety refers to the practice of preserving the quality and safety characteristics of food to reduce the risk of contamination and foodborne diseases. Food safety is a major concern that affects everyone, but they are a group of people who are deemed to be more susceptible to the impact of unsafe food due to a number of reasons. Food-related pathogenic microorganisms have a high capacity to cause infections leading to minor or major health complications in vulnerable people than in healthy adults.[4,5]

Although there are different ways of defining what or who is considered vulnerable or not vulnerable, vulnerability in this paper is viewed in terms of physiology, precisely in connection to the body's immunity and the ability of one's immune system to resist foodborne disease.[6] The vulnerable population includes, but is not limited to, people who are not capable of securing their personal interests. Pregnant women, infants, children, unborn babies, convicts, physically and mentally disadvantaged, people with little or no income, and displaced and hospitalized patients can be classified as part of a vulnerable population.[7] According to the WHO report of 2010, forty percent of the total foodborne illness burden was borne by children under the age of five amounting to about 125 000 deaths per annum.[1]

In this review article, a careful evaluation of the vulnerable populations and their susceptibility to foodborne disease is carried out. We discussed the current food safety gaps and challenges facing vulnerable populations, as well as the pathways for possible improvements. We conclude with suggested interventional steps and measures that can be taken to reduce the proneness of vulnerable groups to foodborne hazards and potential diseases.

2 | FOOD SAFETY GAPS/ CHALLENGES FACED BY VULNERABLE POPULATIONS

Vulnerable populations are usually at high risk of yielding to foodborne pathogens compared to healthy adults. Therefore, it is necessary to observe precautionary food safety measures to safeguard the health of vulnerable populations to avoid an increase in the susceptibility to illnesses implicated by foodborne pathogens among this population. There are several factors that can contribute to this susceptibility. These include age, availability of drugs and medications, and underlying illnesses (acute or chronic).[5,8]

The vulnerable population generally includes the very young, elderly, and people with immunosuppressed or immunocompromised conditions including those with diseases and solid organ transplants recipient.[9] According to Lund and O'Brien,[10] these populations make up over 20% of the United States and the United Kingdom. In low- and middle-income countries such as Nigeria, poor access to proper water and sanitation also contributes to the vulnerability of the masses regarding food safety and food security. The findings of the Nigerian Comprehensive Food Security and Vulnerability Analysis (CFSVA) in 2012 showed that poverty and food security are inextricably linked. In their study, it was found that forty-five percent of their study group does not have access to decent toilets, and 85% does not have an appropriate refuse disposal system. It was also pointed out that vulnerable and food insecure groups were mostly found in the rural areas, North-west and northeastern states of Nigeria.[11]

Foodborne diseases are usually implicated by foodborne pathogens which range from parasites, protozoa, bacteria, and viruses. Some of these pathogens include *Salmonella*, *Bacillus cereus*, *Staphylococcus aureus*, and *Caliciviridae* (Norwalk-like) viruses.[12] High-risk foods including meat and poultry, eggs, dairy products, seafood, fruits and vegetables, and unpasteurized juices are often implicated in the transmission of these diseases, also among vulnerable populations.[13] Toxins from these pathogens also pose risk to vulnerable populations. In a risk assessment conducted by Adetunji et al.,[14] infants and children are susceptible to the effects of mycotoxins due to their immune systems that are not fully developed and their high intake of foods and water per kg body weight.

Street-vended foods also pose an intricate food safety risk to vulnerable populations, most especially among people of low-socioeconomic status. Due to factors including affordability and accessibility, consumers with little income prefer street-vended food and do not usually consider food safety while purchasing these foods.[15] This is further aggravated by poor policy management on food safety. As opined by Ifenkwe,[16] the lack of enforcement of food safety laws and policies in Nigeria further aggravates the food safety issues in rural communities.

3 | POSSIBLE IMPROVEMENT PATHWAYS

Foodborne pathogen-related morbidity and mortality are more likely to be observed in the vulnerable population than in healthy people.[5] Chronic or acute disease, medicine, and/or age can all increase vulnerability. The severity of this heightened vulnerability varies depending on the cause. Before attempting to reduce foodborne diseases in vulnerable populations, a critical understanding of the underlying etiology is essential. Food insecurity among

the poor, inadequate sanitation and hygiene, illiteracy, a weak health system, and consumption habits are some of these causes, according to Wang et al.[17]

To prevent foodborne diseases and ensure the safety of food, the food system must be redesigned to assure human health, ecological health, social equity, and economic prosperity while having the least detrimental influence on the environment.[18] In a well-structured food system, the food value chain, which includes input supply, production, processing, distribution, food preparation, and consumption, must be well-designed and consider consumer safety.[19] This is especially important in low- and middle-income nations, where sophisticated technology is lacking to keep track of all aspects of the system.

The government, with the aid of food safety officials, should also make it a priority to raise public awareness about the importance of cultivating healthy diets, particularly among the vulnerable population. In most developing nations, small- and medium-sized enterprises (SMEs) are the principal food providers in rural regions, and they should be made to adhere to food safety and quality standards as well as market laws.[20] However, they may lack the expertise to apply legislation, and informal constraints may hamper their expansion. In this case, governments should serve as facilitators, providing targeted support and laws to help them grow.[21] The government can take several measures to promote the growth and production of healthy food by SMEs. One way it can do this is through fiscal policies, such as tax incentives, subsidies, or grants, which encourage SMEs to invest in equipment, research and development, and new facilities that support the production of healthy food. These policies can create a more favorable environment for SMEs to produce healthy food. Additionally, the government can establish penalties or fees for companies that produce unhealthy or processed foods, which creates an economic incentive for consumers to purchase healthy food products.[22] The government can also promote traditional food cultures and practices that emphasize the consumption of healthy food. By contributing to the growth of food values and cultures, the government can create a more supportive environment for SMEs that are producing healthy foods. It can also establish labeling and certification standards that identify healthy food products, making it easier for consumers to identify and purchase these products.

The European Union food hygiene regulation, as well as related regulations in England and Wales, requires food business operators to implement permanent procedures based on hazard analysis and critical control point principles (HACCP).[5] This applies to meals provided in hospitals and other institutions, as well as other food businesses. Developing countries should try to adopt this practice as it is especially critical that food for vulnerable groups be sourced from trustworthy suppliers that strictly follow regulatory standards and have an acceptable food safety management system. To ensure the full implementation of policies regarding food safety, the government could reward SMEs who comply with these regulations, as this will undoubtedly keep them motivated and subsequently enhance consumer nutrition.[22]

Although smallholder farmers, a major component of SMEs, play a critical role in food production in developing countries, most of them experience food insecurity and malnutrition and are also part of the vulnerable population. They are the least able to respond to climate change by investing in their businesses to keep producing.[23] As a result, the government must provide these people with access to innovative technologies and research to avoid food insecurity and foodborne disease.

Gender equality and empowerment are also important factors in promoting good nutrition.[24] Women's empowerment is critical to improving family and societal nutrition. Women are frequently the main caregivers and food providers in their households.[17] They also require more nutrition due to physiological needs, notably during pregnancy and breastfeeding. All initiatives to enhance nutrition for mothers, their children, and other household members should focus on empowering women. When women are malnourished, their offspring are more likely to be malnourished in the first three years after conception.[25] According to research, advances in women's status are responsible for more than half of the reduction in child stunting between 1970 and 1995.[26] Future progress in women's empowerment would likely result in a decline in the number of cases of foodborne diseases among this group of people, as well as an overall improvement in health.

Gender equality is the most crucial factor influencing food security as it has a significant positive impact on a nation's economic development, according to Abu-Ghaida and Klasen[27] and the World Bank.[28] The responsibility for processing and preparing food for households typically falls on women, who also have a larger role in ensuring nutrition, food safety, and quality. Therefore, initiatives that encourage men to contribute more to the care economy are critical for food and nutrition security, as stated by Asian Development Bank (ADB).[29]

In times of crisis, both men's and women's livelihood strategies could alter, so it is essential to evaluate the new work allocation to maintain the household's nutritional well-being and food security. Inter-Agency Standing Committee (IASC)[30] notes that the assumption of vast populations being homogenous rather than made up of diverse socioeconomic groups with differing demands and interests has led to failures in food security programs and policies. Gender-based discrimination or the denial of women's human rights is one of the leading

causes of poverty and food and nutrition insecurity. Empowering women by giving them the same access as men to productive and financial resources, income opportunities, education, and services leads to an increase in agricultural output and a significant reduction in the number of poor and hungry people. When women are empowered, they can influence the allocation of resources, including food, in the household, benefiting the health and nutrition of the entire family, as noted by CARE.[31]

The commitment to fund infrastructure and labor-saving technologies that benefit women and girls by reducing their domestic burden and affording them the opportunity to attend school or participate in the labor market is included in the 2010 Millennium Development Goals summit outcome document, as stated by ADB.[29]

Safeguards in the manufacturing and distribution of meals are also required to protect vulnerable persons in hospitals, care homes, and the community, and advice on the avoidance of specific foods should be provided to vulnerable people.[32] Patients with diabetes mellitus, for example, must be made to understand why they should eat low-sugar meals, whereas hypertension patients should have low-sodium meals. Advice could come from a certified medical practitioner or as a label on food items.

Early schooling interventions, such as educational programs that teach safe food handling practices and mentor the next generation to bring home best practices to their families, could be an effective strategy for reducing foodborne illnesses in disadvantaged communities. Consumer education on safe food handling procedures is necessary for the prevention of foodborne infections and should be included in foundational food safety education courses.[33] Since habits formed in infancy can persist into adulthood, educating children on safe food handling practices can have long-term benefits for their health and well-being.[34] Children are particularly vulnerable to foodborne illnesses since their immune systems are still growing, and childhood diarrhea, mostly caused by foodborne infections, can negatively impact malnutrition and child mortality globally.[35,36]

Providing food safety education (FSE) for school-aged children has been shown to be a successful approach to preventing food poisoning, according to Dietz.[37] However, little information is available on FSE programs for elementary school pupils in Africa. FSE-related initiatives in Africa typically focus on personal hygiene education rather than teaching good hygiene concepts, with the most popular initiative being the Water, Sanitation, and Hygiene (WASH) campaign.[38] Therefore, implementing FSE programs in African schools could be a potential strategy for reducing foodborne illnesses in disadvantaged communities. These programs could also have a positive impact on the food safety practices of families, as children could bring home the knowledge they have learned in school and encourage their families to adopt safe food handling practices.

The importance of local public health oversight and educational guidance for low-income communities cannot be overstated in ensuring enhanced food safety and nutritional value for an affordable yet healthy, safe diet. Research has shown that food safety interventions should focus on educating the public about new behavioral theories, including the intended audience in research, and developing community-based education programs to improve food safety practices.[39,40]

For instance, Takanashi et al.[41] conducted a study on a community-based education program's long-term effects on the practices of those who look after children between the ages of 6 months and 4 years. They noted a substantial decrease in the incidence of diarrhea in children between the ages of 6 months and 4 years from 21.6% at baseline to 7.6% and 5.9% at the first and second evaluations, respectively. This highlights the potential benefits of community-based education programs in enhancing food safety and improving health outcomes. The EatSafe initiative's report discussed the use of written instructions and manuals, which were comprehensive, as well as record-keeping procedures in training programs for literate participants. However, for those with lower literacy levels, various alternative media were employed to make the messages more memorable. For instance, some programs used brief slogans such as “Clean food, happy baby”,[42] parades with local school children to spread the message throughout the community,[43] and composing folk songs to convey food safety messages,[44] among other methods.

However, vulnerable populations face numerous challenges that make them more susceptible to foodborne illnesses than other healthy adults. Factors such as a lack of awareness about suggested methods for food safety and a higher risk of exposure to food safety hazards due to their living conditions and limited resources put them at a higher risk. Therefore, it is crucial to ensure that they have access to safe and nutritious food through educational guidance and capacity development, including tools, education and training, and bringing together stakeholders.[45]

4 | CURRENT INTERVENTIONAL ACTIONS TAKEN

For the most part, research about vulnerable populations is focused on food insecurity, with limited in-depth research into the safe food-handling activities of “vulnerable”

groups such as older people and those responsible for their food preparation and cooking.[6] So far, important steps are being taken to protect vulnerable populations from food safety risks, including:

4.1 | Food recommendations to ensure the microbiological safety of food taken by the "vulnerable"

Since specific foods that are of particular concern to vulnerable people are also highly susceptible to microbial contamination, it is critical that food meant for the vulnerable must be cooked thoroughly. Also, foods that are deemed not microbiologically good for them should be avoided, and where possible, recommend alternative types of foods that are prepared with a less negative impact on the dietary and food safety qualities of the food.

Several hospitals adopt low-microbial diets for vulnerable patients, which eliminate foods with the greatest risks of containing pathogenic microbes and replace them with foods of lower risk of containing these microorganisms of concern. For example, low-microbial diets called neutropenic diets are fed to patients with low neutrophil counts in hospitals and other caregiving institutions. Other persons with conditions that increase vulnerability to foodborne illness are also advised to feed on such neutropenic diets.[5,46]

4.2 | Adherence to HACCP and good hygiene practices when preparing foods met for vulnerable individuals

Mistakes in food selection and preparation can be potentially disastrous, especially for vulnerable groups of people. Food service providers and Food providers, including those in hospitals and care homes, are expected to have processes based on HACCP and apply good hygienic practices based on HACCP as well as apply good hygienic practice (GHP) and good manufacturing practice (GMP) to assure the microbiological safety of the food given to the vulnerable population. Other hygiene measures such as personal hygiene, integrated pest control, proper waste disposal, and environmental monitoring must be enforced at the food service sites and by every food handler involved in selecting, preparing, storing, and serving foods met for these groups of people, as important steps to protect them from foodborne disease or food allergen. Food handlers who do not comply with food safety regulations should face consequences, such as being restricted or prohibited from entering the food establishment.

4.3 | Development & control of reputable food vendors (avoid food from unsafe sources)

When providing food to vulnerable populations, avoiding microbiological contaminants (such as *Salmonella* and *Listeria*) is essential. As a result, pathogen contamination of food must be reduced, not only through consistent hygiene procedures but also through careful ingredient and recipe selection. It is crucial to buy food from trustworthy food suppliers that adhere to laws regarding food safety, has a food safety management system based on HACCP principles in place, and employ safe food handling procedures. Homemade foods should not be allowed to be served for public consumption in a food outlet.[5]

In addition to sourcing and labeling various kinds of foods based on food safety specifications, food makers involved in serving vulnerable populations are often subject to higher standards of hygiene. For food products that will not be subject to further processing such as cooking, it is important to avoid sourcing such foods from unsafe vendors. Such foods include raw vegetables and fruit, raw or unpasteurized milk, etc.[5] In order to improve the bacteriological and chemical safety of food, Riyanto et al.[47] proposed using food preparation safety education for street food sellers near public elementary schools for 20 to 30 min each week for six weeks. Following the intervention, there was a decrease in the frequency of food hazards (*Coliform*, *Escherichia coli*, sodium borate/borax, formaldehyde, rhodamin B, and yellow methanol), as well as a rise in the proportion of food that was chemically and bacteriologically safe by 29.6% and 59.3%, respectively.

4.4 | Ensure adequate cooking

In terms of cooking foods, the recommended time–temperature conditions for cooking meals to adequately kill vegetative pathogens of concern should be adhered to. Such organisms include Campylobacter spp., and *Listeria monocytogenes*, which are very heat resistant. Also, to ensure proper cooking, it is advisable to use a food thermometer to check for the temperature. Food safety is a more significant issue in less affluent nations due to the prevalent lack of sanitation and inadequate education and training of food handlers. However, training must be tailored to each situation, taking into account differences in food operation levels and catering unit sizes.[48]

4.5 | Prevent cross-contamination of foods

Raw foods and ready-to-eat foods should be well separated. Food-contact surfaces and equipment, including meat slicers, should be cleaned thoroughly. Separate equipment and utensils should be used for each item of raw food and cooked food.[5]

4.6 | Ensure control of holding temperature

For some microorganisms such as *Clostridium perfringens*, ordinary cooking temperatures are insufficient to render them inactive. Food that is not intended to be consumed almost immediately after preparation should be allowed to get cooled within 2 h from 57 to 21°C and within six hours from 57 to 5°C to avoid foodborne illness caused by *C. perfringens*. For the food not to support the sporulation of *C. perfringens* spores and their subsequent vegetative growth, it is important not to leave foods at a temperature around 12 and 50°C. Before serving meals that have been stored after preparation, ensure it is reheated for 15 s at 74°C before serving.[5]

4.7 | Improving the current food environment policy

An individual's exposure and vulnerability to both good and negative environmental factors are shaped by their socioeconomic status. Considering the significance of a person's food environment in influencing dietary intake and the impact of one's diet in supporting health, increased exposure to and exacerbated vulnerability to unhealthy food environments in part contributes to health inequities among socioeconomically underserved populations. With the development of various policies aimed at enhancing food environments, it is important to put in place measures that assess the overall impact of these policies, especially for those groups that are more vulnerable to foodborne disease risks.[49] This is in addition to taking advantage of key points in the supply chain to create healthier food environments for everyone.[50]

5 | CONCLUSION AND RECOMMENDATION

To tackle the wide range of challenges of food safety issues affecting vulnerable groups, there is a need to increase awareness regarding food safety issues within the community, which would consequently lead to the adoption and safe practices of food safety rules and guidelines by food handlers and relevant stakeholders.[51] Vulnerable populations are known to have limited resources dedicated to their health, hence they are largely dependent on others.[52] To a large extent, the fate of vulnerable populations lies in socioeconomic status, literacy, sensitization, and governmental roles in establishing and enforcing proactive food safety policies and regulations.

It is also essential for enforcement agencies to monitor food value chains to ensure raw materials used for food production are safe and do not pose any risk of zoonoses and infectious disease outbreaks,[53] especially for vulnerable groups. As Grace[13] suggested, low-risk foods with low microbial contents should be used in place of high-risk foods. In addition to this, food producers should ensure good hygienic and manufacturing practices that conform to food safety guidelines and procedures such as the HACCP principles.[54]

Additionally, the availability of food does not always translate to its safety. This is true as the prevalence of unsafe foods defeats the purpose of food security, making the vulnerable populations fall at higher risk.

In conclusion, the limited research on food safety among vulnerable populations, particularly those facing economic challenges, underscores a lack of informed data and inadequate action to address existing gaps. It is crucial to conduct regular studies to address this issue and inform policy-making aimed at enhancing the resistance of vulnerable populations to foodborne hazards and illnesses.

AUTHOR CONTRIBUTIONS

Esther Ibe Njoagwuani developed the concept for this review. Esther Ibe Njoagwuani, Ifeanyi Michael Mazi, Hope Akegbe, Iyiola Olatunji Oladunjoye, Chidinma Ezinne Ochulor, and Adeola Dolapo Omotosho wrote the first draft of the manuscript. Helen Onyeaka, Ifeanyi Michael Mazi, and Esther Ibe Njoagwuani assisted with proofreading and language edits. Esther Ibe Njoagwuani and Ifeanyi Michael Mazi revised the manuscript based on feedback from Helen Onyeaka, Olumide A. Odeyemi, and Ogueri Nwaiwu. Helen Onyeaka supervised the project and critically revised the final manuscript. All authors contributed to the manuscript and approved the submitted version.

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