The Cause and Effect of the Nutrition Transition in Nigeria:

Analysis of the Value of Indigenous Knowledge & Traditional Foods in Enugu

State, Igboland

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Abstract

The objective of this study is two-fold: one, to analyze the presence of the nutrition transition in Nigeria through assessment of national food consumption trends, obesity, and noncommunicable diseases (NCDs) data over time, and two, to assess the role that indigenous knowledge and foodways can play in promoting healthy diets in the country through the case study of Enugu State, Igboland. A mixed-methods approach was utilized with quantitative data from the Nigerian Living Standards Survey (NLSS) and Demographic Health Survey (DHS) to measure changes in obesity, diabetes, hypertension, and food consumption across Nigeria from 2003 to 2018 using Natural Language Processing (NLP) and Trend Analysis. Primary qualitative data in Enugu State was collected through semi-structured interviews in 2021 with random sampling technique undertaken to analyze the status of indigenous Igbo foods and traditions to curb the negative effects of the nutrition transition, as well as to document the motivations behind using or abandoning traditional foods in the present generation. The findings of the study depict the nutrition transition in Nigeria in multiple forms. The combined overweight and obese population in the country has experienced a 29% increase in the 15-year study period, while the NCDs hypertension and diabetes have experienced a combined 21% increase. Consumption patterns have shifted, though not always in the ways predicted from the literature, with statistically significant increases displayed in the consumption of Breads and Pastries, Starchy Roots and Tubers, Legumes, Plant and Animal Fats, Seafoods, Milk and Dairy Products, Beverages, Non-alcoholic Drinks, Vegetables, and Red Meats. The primary data analysis displayed that the traditional Igbo foodscape is defined by local, nutritious whole foods. The data depicted significant recent trends towards using ultra-processed seasoning cubes instead of local herbs as spices, with a huge shift from 0% frequency usage identified in the parents' generation to a 35% frequency in the current generation. Eighty-three percent of the community surveyed stated that they believe that the diets of the younger generation are changing, with the majority stating that the change is for the worse. Participants from the community provided recommendations for curbing the nutrition transition and empowering indigenous foodways through policy, investment, and mindset change. Though consumption patterns are changing and Nigeria's obesity and NCD rates are increasing, it is still far behind the rate of obesity in countries farther along in the nutrition transition such as its former colonizer Britain. Interviews conducted around Enugu State show how the indigenous food system is centered on fresh, healthy foods, primarily local tubers, legumes, vegetables, and spices. There is extensive knowledge and pride in the indigenous food system, even though there was a consensus that Igbo food culture is currently undergoing immense changes in part due to some of the younger generation's new tastes for processed foods and convenience.

Keywords: Nutrition transition, Indigenous knowledge, Nigeria, Natural Language Processing, Nigerian Living Standard Survey

1. Introduction

Africa has more arable land and endemic species than any other continent yet somehow still struggles with food insecurity (1). West Africa and Nigeria specifically have a long history of good nutrition and productive food systems, and traditional African diets have proven health benefits (2). For example, recent studies show that Black Africans eating a traditional diet are 13x less likely to develop colon cancer than Black Americans eating a Westernized diet (3). Additionally, the United Nations Food and Agriculture Organization (FAO) states that indigenous African ways of agriculture such as agroecology—as opposed to industrial agriculture— "promote local, stable and diverse diets with year-round integrated production of healthy and nutritious foods, since it is anchored in diversified, resilient, and sustainable territorial production systems"(4).

However, the spread of industrialized agriculture and processed foods in Africa is causing a nutrition transition that is negatively affecting the health of both humans and ecosystems. The nutrition transition has been defined as when populations "move from traditional diets high in fiber and micronutrients, to more highly processed diets high in sugar, fat, salt, low in fiber and less nutrient dense– with these dietary changes accompanied by changes in eating behaviors and physical activity patterns" (5). It also signifies an increased dependence on foods that are ultra-processed, altered, and adulterated in factories, and therefore indicates an increase in the intake of potentially harmful chemical food additives.

Indicative of the nutrition transition, the literature points to Nigerians' consumption of potentially dangerous food additives rising substantially in the past few decades. One notable instance of this has been the shift from using natural, health-promoting herbs and spices to flavor dishes, to using processed spiced cubes that are filled with emulsifiers, artificial flavors, coloring agents, hydrolyzed protein, and monosodium glutamate (MSG). Some of the chemical additives present in ultra-processed foods have been shown to increase an individual's risk for noncommunicable diseases including cancer (6)(7).

Nigeria is currently experiencing a triple burden of malnutrition, meaning that undernutrition, obesity, and micronutrient deficiencies are coexisting epidemics in the country, sometimes even existing in the same household (8). The most recent FAO data states that 24.6 million of the population is undernourished— a figure that has been steadily increasing since a brief drop in the mid-2000s. With 32% of children under the age of five being stunted, Nigeria has the second most stunted children in the world (9). Nearly half of the reproductive-aged women in the country suffer from anemia, while nine percent of them are acutely malnourished (9).

The nutrition transition in Nigeria is rooted in the economic and environmental disruptions by European colonialism and has been concurrent with the global regime to transform Africa's agricultural system to one that mirrors the Wests', complete with dependence on chemical inputs, mechanization, and monocropping of a few staple crops at the expense of all others. The pathway

for multinational food companies to infiltrate and contaminate the Nigerian marketplace was set in place by the policies set by international institutions with formal institutional reforms, beginning with the Structural Adjustment Program (SAP) in 1986 and membership with the World Trade Organization (WTO) which opened Nigeria to the influence of globalization. African countries were net exporters in food (growing surpluses) before these programs. Now most are net importers (10).

Modern industrialized agriculture, as opposed to indigenous and agroecological forms of agriculture, is reliant on chemical inputs including fertilizers, herbicides, and pesticides which pollute soil and water while having devastating effects on human health. Moreover, the industrialized agricultural system is antithetical to sustainability and is responsible for ⅓ to ½ of all global greenhouse gas emissions (11)(12). The system is inefficient and wasteful with one-third of all food that is produced being wasted, while another third is poorly utilized as animal feed (12)(13).

The modern diet is the direct result of the industrial agricultural system and it causes billions of people to be either chronically food insecure or obese, leading to noncommunicable diseases being cited as causing nearly three-quarters of all deaths worldwide (10). Despite the multiple and interconnected negative externalities of the industrial agri-food system, outsiders including international institutions, foreign governments, and multinational corporations have been attempting to eradicate traditional agriculture and food systems on the African continent and replace the diverse, culturally-rich, nutritious, and place-based African diets with the high-input, high-waste, and noncommunicable disease-inducing Western ones (14).

Further, while native African crops have been sent to the background by colonial policies and neo-colonial preferences, the knowledgebases of the indigenous populations have been sidelined, ridiculed, and marginalized, which has contributed to the younger generation's embracement of the new Westernized system (15). To illustrate this, the former president Burkina Faso Thomas Sankara is credited with saying one should simply "look at your plate" to see the effects of imperialism in Africa (16).

Considering the recent and on-going changes in Nigerian food systems, the purpose of this paper is to evaluate the status of the nutrition transition in Nigeria while assessing the role that indigenous knowledge and foodways play in promoting healthy diets and mitigating disease incidence. This will be achieved through a literature review of the drivers of the nutrition transition in Nigeria, its associations with colonialism and neo-colonialism, and the evidence of the health promoting effects of indigenous African diets. Analysis of NLSS and DHS data will then be undertaken to determine trends in obesity and noncommunicable disease burden in the country and using NLP to analyze interviews with locals of Enugu State to document the pillars of the traditional food system of indigenous Igbo people as well as the changes in process that are occurring because of the nutrition transition.

The Igbos are the third-largest ethnic group in Nigeria, and the South-East region of the country including Enugu State is considered 'Igboland.' Igbo people were chosen as the focus group of this study because of the ethnic group's established knowledge of native plants as well as Igboland's association with impressive biodiversity, productive agricultural systems, and economic success (17) (18)(19).

2. Literature Review

2.1. Health benefits of Traditional African Diets

A 2015 study in the Lancet used self-reported diet information to analyze the consumption of healthy foods like whole grains, fish, fiber, fruits, and vegetables versus unhealthy foods including sugar, salts, saturated fats, and processed meats from 187 countries, and concluded that West Africans have one of the healthiest diets in the world (23).

A collection of Western-led empirical studies comparing Africans who are consuming Western diets to those who are not arrived at similar conclusions of the superior health outcomes resulting from indigenous diets. For instance, Dr. Weston A. Price's 1939 book "Nutrition and Physical Degeneration" is based on empirical observations on the superior health outcomes of indigenous people worldwide who were not consuming Western foods. His findings state that people eating indigenous diets experienced "superb health," while those eating a "modern"/ Westernized diet saw significant negative outcomes, notably in their dental arches, jaw development, and overall immunity to dental infections. In Africa, the people he studied who were eating indigenous diets also had no cases of appendicitis, gallbladder malfunctions, cystitis, ulcers or malignancy. These findings were directly contrasted with the counter group of African people who had transitioned to more Westernized diets, where negative health outcomes were seen directly within one generation (2). *Figure 1* depicts visual evidence of deterioration in tooth and jaw health following some peoples' adoption of the "modern" diet.
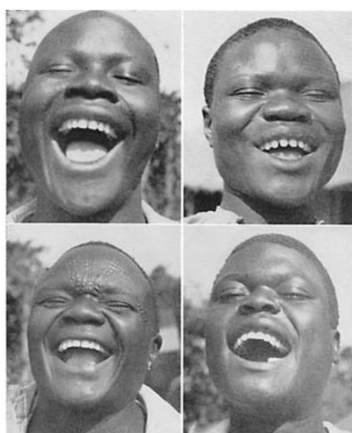
Figure 1. Differences in tooth and jaw health in Africans eating traditional versus modern diets. Adapted from Price's "Nutrition and Physical Degeneration" (1939).

Albert Schweitzer, a colonial doctor in West Africa also arrived at similar conclusions about the superiority of traditional African diets. According to Schweitzer, cancer incidence was non-existent before Western lifestyle changes. On his arrival in Gabon in 1913 he wrote that he was, "astonished to encounter no case of cancer." But by the end of his time in Gabon four decades later, he had unfortunately witnessed a steady incline in cancer incidence in the region. This led him to write that his "observations incline [him] to attribute this to the fact that the natives were living more and more after the manner of the whites."(24).

Similarly, Dr. Burkitt studied the effects of the high-carbohydrate, high-sugar Western diet on cancer incidence in 1973. In his research, he used Africa as a control group to the Western world. He found that, in the African control group, 44 hospitals had never seen an instance of colon cancer, appendicitis, or heart disease, and 25 hospitals had fewer than 3 cases of appendicitis annually. Burkitt partially attributed this low burden of chronic disease partially to the fact that the traditional African diet is extremely high in fiber, with the average person consuming four times the amount of fiber the average American does today (24).

Fruits and vegetables are key sources of fiber, and research shows that many endemic African varieties are both more nutritious and easier to cultivate than their introduced counterparts and have great potential to curb malnutrition and lower disease incidence on the continent (5). Additionally, traditional Nigerian spices have been cited numerous times as being functional foods with bio-active properties and medicinal potential, with Ene-Obong et. al, concluding that, "some common Nigerian herbs and spices have been reported to possess pharmacological activities such as anticancer, anti-inflammatory"(25). They list Calabash nutmeg (ehuru in Igbo) and Ashanti

pepper (uziza in Igbo) among others as having significant medicinal potential, while other researchers have also touted the benefits of the three most popular fermented Nigerian spices: ogiri—made out of fermented castor oil bean or melon seeds, okpei from mesquite seeds, and ugba from African oil bean. The fermentation of these spices have been associated with improving microbiome diversity and gut health, as well as providing amino acids, protein, vitamins, and minerals (26).

2.2. Drivers of Nutrition Transition in Nigeria

a. Colonization in Nigeria & the Subjugation of Indigenous Knowledge

One of the main drivers of the nutrition transition in Nigeria is the existing legacy of the colonial suppression of indigenous African foodways. Raschke and Cheema state that the "deleterious influence" of colonial and neocolonial forces in Africa become "glaringly evident" if one is to make any "legitimate inquiry" into the multiple disease epidemics afflicting the continent, including the seemingly new "nutrition transition." (14).

Abukutsa-Onyango adds that a key aspect of European colonialism in Africa centered around suppressing traditional agri-food systems including through the stigmatization of local fruits and vegetables and the introduction of foreign varieties which labeled them as "out of fashion," "poor man's foods," or fit for a child. Abukutsa-Onyango points out that the lower class began to imitate the higher classes that were rejecting these food sources and accepting new "exotic" foreign alternatives, leading the indigenous species to be abandoned (22).

In addition to this colonial neglect, many indigenous knowledge sources, including those pertaining to food, are not written down, and elderly people are the gates to all their information, making it so vulnerable to extinction. Younger generations have been shown, for a variety of factors, to be less receptive to maintaining these traditions as they can seem "outdated and unpopular" due to Western education systematically invalidating indigenous knowledge systems (15).

b. Neo-colonial Interventions

The nutrition transition in Africa is propelled by negative attitudes toward indigenous practices and knowledge by international organizations and other foreign parties who possess staggering financial capabilities. As recently as September 2022, the foreign-led Alliance of a Green Revolution in Africa (AGRA) pledged $550 million over the next four years towards meddling in African food systems (20). This is in addition to the 1 billion USD that African governments have been encouraged and enabled to spend on subsidies for chemical inputs and hybridized seeds for agriculture *each year* (10), as well as the hundreds of millions that AGRA has received from a combination of billionaire 'philanthropists,' NGOs, and corporations since its inception in the mid-2000s. The Bill & Melinda Gates foundation, notable for their indoctrination of Africans against

their own agricultural capabilities as well as their pressures to utilize GM crops and other biotechnology, contributes two-thirds of the organization's funding.

In a groundbreaking recent report, the Institute for Agriculture and Trade Policy's Senior Advisor Timothy Wise found that the food insecurity situation in Africa has become more dire since AGRA's implementation. He writes that, "AGRA has failed to catalyze a productivity revolution in African agriculture. Farmers' yields have not grown significantly, poverty remains endemic, and the number of chronically hungry people in AGRA's 13 focus countries increased 30 percent" (21). Specifically in Nigeria, there have been reductions in yields of staple crops since implementing AGRA principles in 2006, and the number of undernourished people in Nigeria doubled (10). Ultimately, AGRA policies are an economic extension of Western neo-colonial rule that undermines African autonomy and power.

2.3. Study Contribution

The contributions of this paper are threefold. First, though other studies analyze the nutrition transition either more broadly or in other contexts, this is the only study which measures the effects in Enugu State, Nigeria through analyzing by comparing the consumption of indigenous Igbo foods between the older and younger generations, while contextualizing the role that colonialism and predatory investment has played in shaping food systems in the region. Second, the study also relies on nationally representative NLSS and DHS data to compare nutrition transition across four periods in time in Nigeria as well as the prevalence of non-communicable diseases in Nigeria. Third, this is the first study to rely on Natural Language Processing to elicit nutrition transition and trends in diseases in Nigeria and Enugu State. We believe that results from this study will be important for policymakers and international organizations concerned about malnutrition and nutrition insecurity in Nigeria, as well as elsewhere in Africa.

3. Methods
3.1. Data

The study relied on both secondary and primary data collection and analysis.

Secondary Data

The secondary data consists of the 2003 and 2018 NLSS and DHS survey for 2003, 2008, 2013, and 2018. Both the NLSS and DHS are comprehensive surveys with proportional representation from all 36 of Nigeria's states and federal capital area, with respondents from rural and urban areas, both genders, all ages, and ethnic groups.

The NLSS is conducted over the course of 12 months with the goals to 1) provide critical information for production of a wide range of socio-economic and demographic indicators; 2) monitor population welfare; and 3) provide statistical evidence to measure the impact of existing and proposed government policies. The most pertinent information to our study is food consumption. A total of 18,770 and 22,122 respondents participated in the data collection in 2003 and 2018, respectively.

The DHS Survey concentrates on generating data to provide basic demographic and health indicators. The main objective for using the DHS is to provide comprehensive evidence on the trends in obesity and noncommunicable diseases in the country and compare it with trends in food consumption in the NLSS datasets. The DHS dataset comprised of 7446, 32462, 7446, and 15234 for 2003, 2008, 2013 and 2018, respectively. The reason for the lower sample for 2013 and 2018 is as a result of a large number of zero responses.

Primary Data

The primary data was collected using a random sampling technique, semi-structured interviews were conducted based on an open-ended survey by two research assistants who were born and raised in Enugu state. Depending on the fluency of the interviewees, the interviews were either conducted in English or Igbo. The answers were then translated and transcribed by the research assistants into a Google Forms survey.

The interview questions included the themes of: Most Important Igbo Food Traditions, Foods, and Crops; Spices Used by Parents' Generation versus Current Generation; Igbo Medicinal Foods; Foods Associated with Poverty; Foods Associated with Affluence; Changing Local Foodscapes & Potential Endangerments/ Extinctions; Local Perceptions of Nutrition Transition in Enugu State; and Policy Recommendations from Study Participants.

The interviews were concentrated on the provinces surrounding Enugu state that are highly recommended and known for their popular Igbo food including Nsukka province, Udi province, Ezeagu province, Nkanu province, and Nike province. The interviews took place in July of 2021, and each interview took approximately 15 minutes. Participants were randomly selected, and overall, 54 people were surveyed. Seventy-five percent of the 54 people interviewed were female, while only 25% were male. This was intentional because traditionally Igbo women are traditionally the ones in charge of choosing foods and cooking for their families. Men were still interviewed to see if there were differences or similarities in their opinions, and to provide a more representative sample of the overall population. Though a few of the participants had no formal schooling whatsoever, the majority had had some level of formal education, ranging from some primary schooling to graduate degrees. The current professions of the participants were also vast, ranging from current students to petty traders to farmers to housekeepers to businesspeople. Most respondents were fluent in both English and Igbo while 12 people (22% of the sample) were fluent only in Igbo.

The ages of those surveyed spanned from 20 to 80, 15 respondents were under 40, 9 of whom were under 30, with the remaining 39 respondents being over 40, 11 of whom were over 60. More old people than young were interviewed because of the research which shows that elders often have more knowledge on indigenous food systems, and getting an active catalog of indigenous foods, crops, and preparation methods was one objective of this study. Participants from the younger generations were also sought out to measure changing preferences and ideals between generations.

3.2. Method of analysis
   a. Natural language processing
To analyze trends in indigenous knowledge and food consumption, natural language processing (NLP) technique was used. NLP is a branch of artificial intelligence that gives the computer the ability to understand text and spoken words in the same way as humans. It uses computer programs to transform linguistic knowledge with the assistance of artificial intelligence. NLP has widely been used in many papers to analyze a variety of topics. For instance, (Agarwal et al., 2018) used NLP to assess hospital readmissions for patients with chronic obstructive pulmonary disease in the United States. Hu et al., (2021) also used NLP to determine the prevalence of cannabis, tobacco, and vaping device mentions in online communities. Finally, Kim et al., (2019) combined NLP and Machine Learning to identify brain MRI reports with acute ischemic stroke. In nutrition, Choi, Kim, and Kim, (2022) attempted to use the NLP preprocessing methodologies to extract dietary pattern in Korea using the National Health and Nutrition Examination Survey. Their results indicate considerable increase in Western dietary patterns. However, there is no known study using natural language processing to understand differences in indigenous knowledge and nutrition patterns in Nigeria.
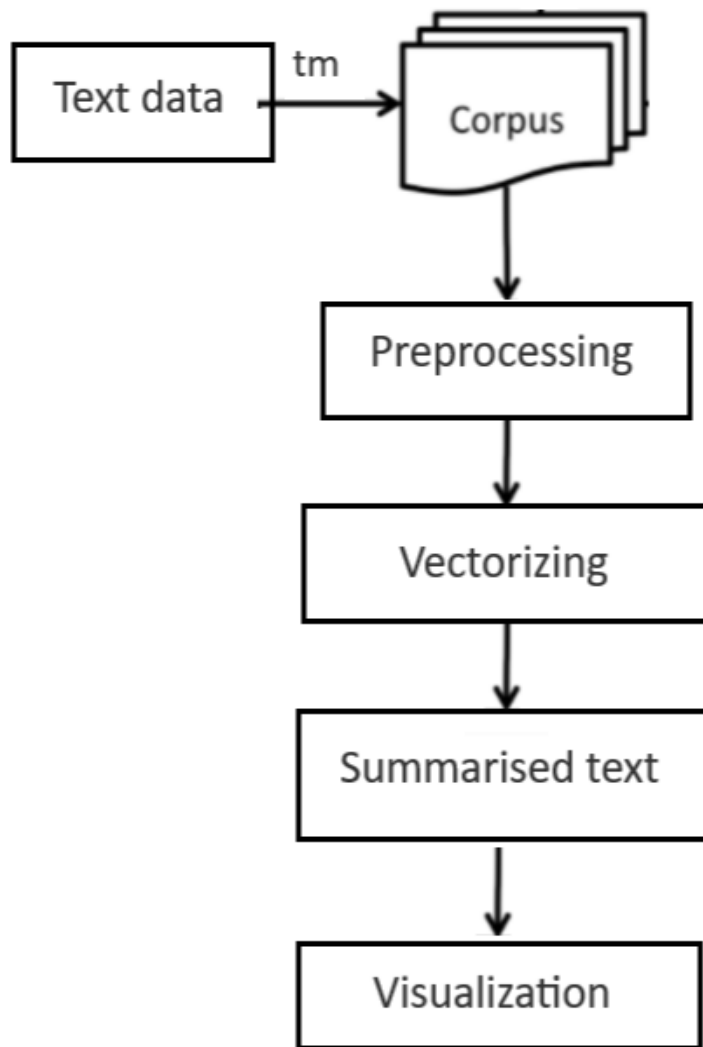
Figure 2. Flow chart of Natural Language Processing
Source: Office of National Statistics Learning Hub (2022)

The NLP method used to process our data involves a series of steps: 1) Converting text data into a corpus by creating a matrix consisting of document and terms 2) Text cleaning: this involves (i) removing stop words, (ii) removing punctuation, (iii) removing white space and numbers, (iv) removing stop words, and (v) stemming & lemmatization. Clustering and classifying menus using fasttext; 3) Analysis, at this stage the researcher can perform sentiment analysis, topic modeling, word cloud, etc. In this paper results from the NLP are presented as frequency tables and bar plots.

Application of the NLP in this paper follows *Figure 2*. The text data in the excel file is loaded into the statistical package as a vector. The vector containing the text document e.g., frequently consumed Igbo foods is converted into a corpus (giving the number of documents in the vector). The preprocessing stage is the most important stage in the text analysis. During the preprocessing stage, numbers, punctuation, stop words, white spaces are removed from the documents in the corpus. Also, all text can be changed into lower cases to simply the analysis. From the stage a

document term matrix is created. This is a mathematical matrix that describes the frequency of terms that occurs in a collection of documents. From this stage the document term matrix can be analyzed using quantitative techniques of the matrix. For this study, we summarize the text using frequency counts by simply summing over all columns in the document term matrix. This is then used to create bar graphs to visualize the results. This procedure was repeated for all questions addressed at identifying indigenous knowledge and dietary patterns.

b. Trend Analysis

Trends in the prevalence of obesity, diabetes and hypertension were analyzed and compared across different time periods. In addition, we compared and tested for differences in the consumption of different food categories in Nigeria.

Obesity trends: The Demographic and Health Survey for the years 2003, 2008, 2013, and 2018 measured the weight and height of all respondents, which was used to measure each respondents Body Mass Index (BMI) - individual's weight in kilograms divided by their height in meters squared. BMI measurements were chosen to measure the status of the nutrition transition in Nigeria because of the BMI's proven usefulness and simplicity as a tool for measuring noncommunicable disease risk including premature death, cardiovascular diseases, high blood pressure, osteoarthritis, some cancers, and diabetes. Based on BMI estimates, individuals were grouped into underweight (BMI <18.5 kg/m^2), Normal weight (BMI $= 18.5 - 24.9$ kg/m^2), overweight (BMI $= 25 - 29.9$ k/m^2) and obese (BMI$=> 30$ kg/m^2).

Diabetes and Hypertension Analysis: the 2003 and 2018 Nigeria Living Standards Survey was used to produce and compare tables of illnesses that were self-reported by survey respondents who visited the hospital 30 days prior to data collection. The noncommunicable diseases were separated from the communicable diseases because of the well-established relationship between diet and non-communicable disease risk, whereas there is not the same correlation between diet and communicable diseases. Two important noncommunicable diseases were analyzed: diabetes and hypertension, whose burden has been shown to increase as a country goes through the nutrition transition.

Consumption trends: the raw consumption data from the Nigerian Living Standards survey for the years 2003 and 2018 were used to generate frequency tables for the number of times individual foods were consumed in a week and number of respondents consuming the food product. For simplicity, the food products were aggregated into seventeen main food groups. We went further by estimating Asin values for the proportion of individuals consuming each food in the two data sets. This allowed us to test for statistical differences in the number of persons consuming the food in 2003 and 2018.

4. Results

4.1. Increases in Overweight & Obesity in Nigeria

From 2003 to 2018, the percentage of normal weight people decreased from 65% to 59%. Concurrently, the combined overweight and obese population increased from 21% to 27%, amounting to nearly 29% increase in the percentage of overweight and obese people in the fifteen-year period.
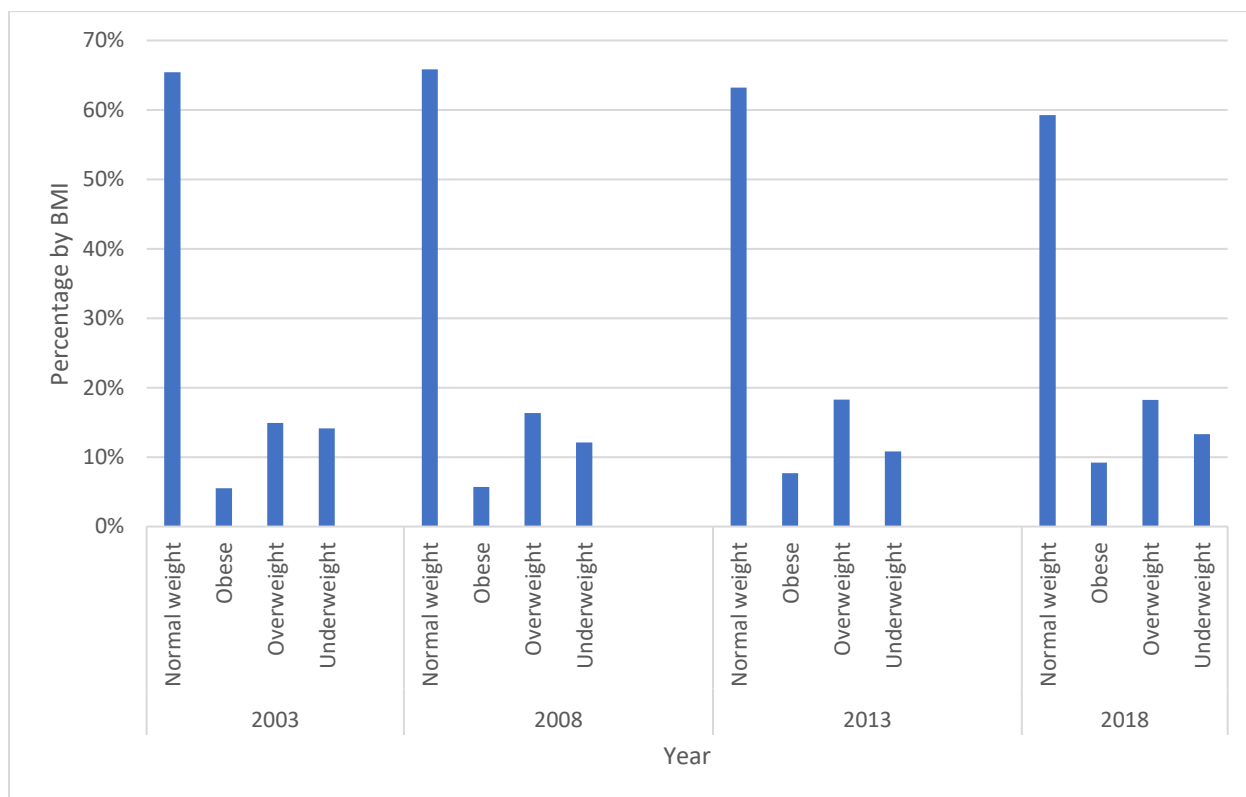

Figure 3. Distribution of body weight in Nigeria from 2003 to 2018

4.2. Burden of Non-Communicable Diseases

Consistently over the 15-year period, the most common first visit to a hospital was for malaria. From 2003 and 2015 malaria has been the cause of over half of all illnesses, only marginally reducing from 54.5% in 2003 to 51.4% in 2018.
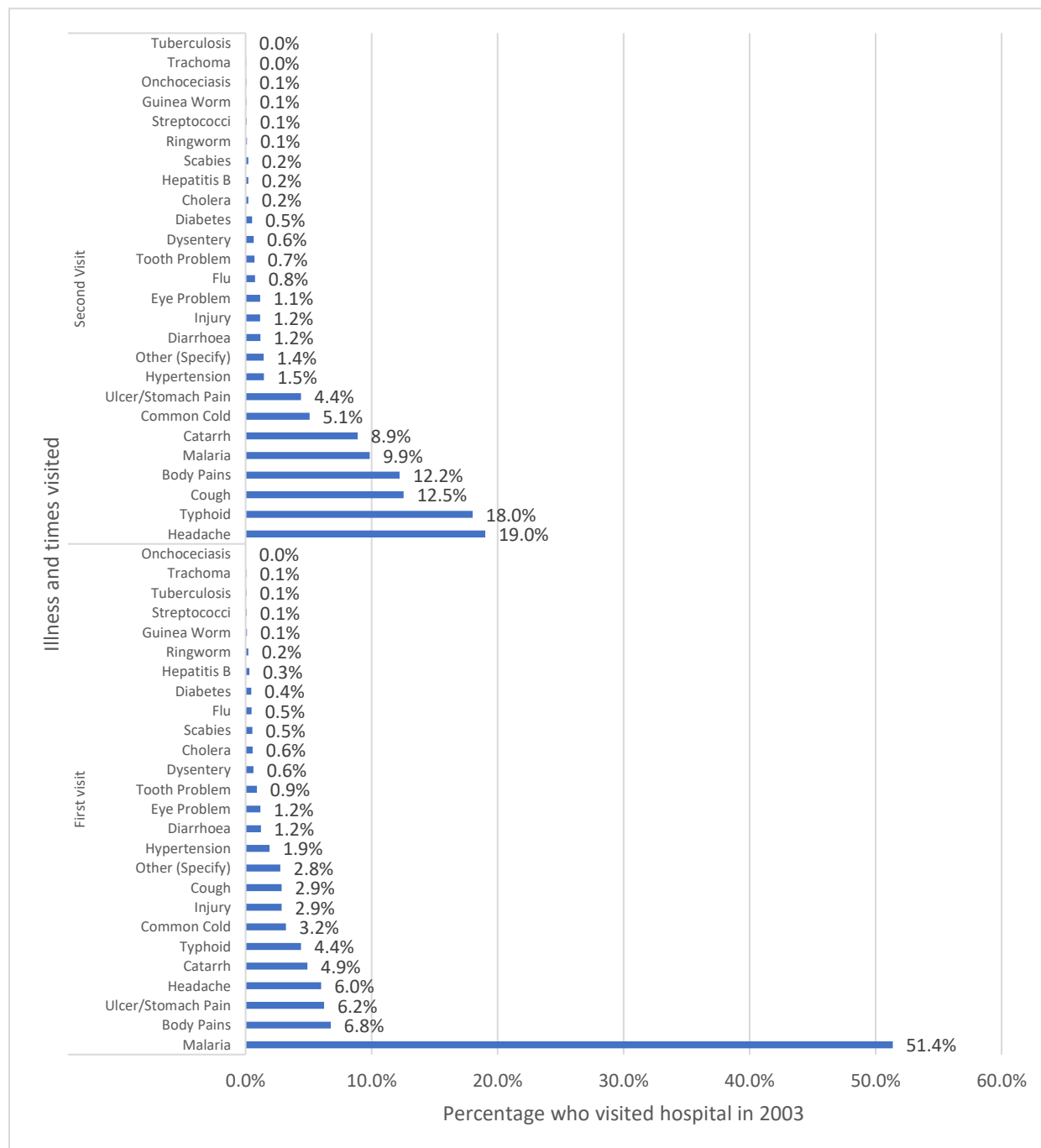

Figure 4. Percentage of first and second visits to the Hospital in 2003

Concurrently, 0.5% of all first hospital visits in 2003 were for diabetes while 1.4% were for hypertension. By 2018, the diabetes rate fell slightly to 0.4% while hypertension had increased to

1.9%. This indicates that the combined noncommunicable disease burden increased from 1.9% to 2.3% over the period, comprising a growth of 21%.

The second hospital visit hypertension rate visits rose from 1.3% to 1.5%, while the second-visit diabetes burden fell from 0.8% to 0.5% during the same period, comprising a minor change from 2.1% to 2.0%, amounting to a decrease of 5%.
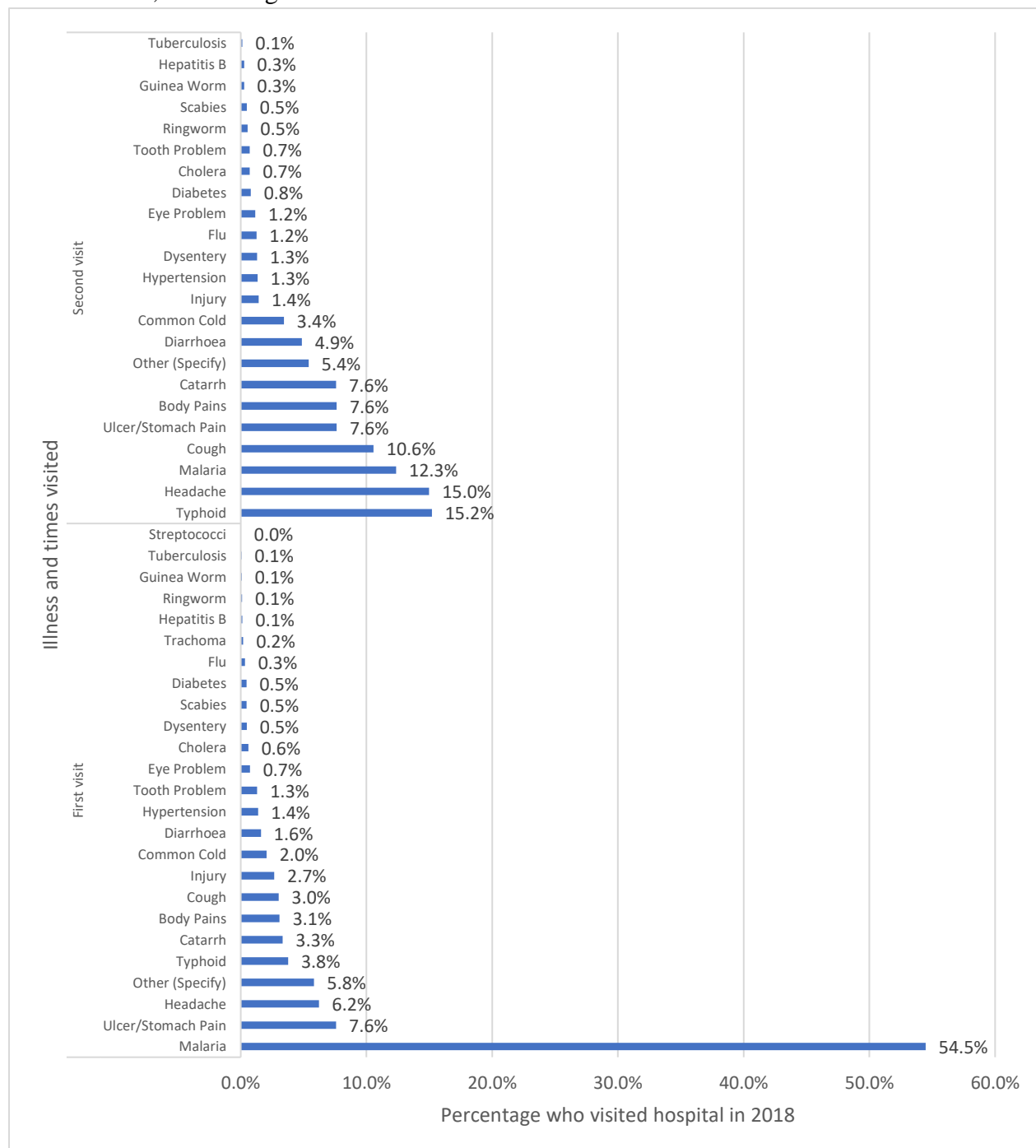

Figure 5. Percentage of first and second visits to the Hospital in 2018.

4.3. Shifts in Overall Consumption

On the national scale, consumption patterns have shifted in the 15-year period, with every category but Grains experiencing an increase in the number of households purchasing them. There was overall higher household consumption in 2018 than 2003. *Table 1* displays how from 2003 to 2018 there were statistically significant increases in the consumption of Breads and Pastries, Starchy Roots and Tubers, Legumes, Plant and Animal Fats, Seafoods, Milk and Dairy products, Beverages, Non-alcoholic Drinks, Vegetables, and Red Meats.

Table 1. Nigerian Consumption in 2003 versus 2018

	Percentage of consuming households		**t test for differences**	**Sig.**
Food Category	*2003*	*2018*		
Grains	26%	23%	0.17	
Bread and pastries	15%	22%	0.01	***
Starchy roots and tubers	19%	23%	0.06	*
Legumes	21%	26%	0.01	***
Nuts	12%	13%	0.32	
Plant and animal fats	29%	32%	0.06	*
Seafoods	12%	17%	0.02	**
Milk and dairy products	7%	12%	0.07	*
Beverages	8%	17%	0.08	*
Confectionary	22%	24%	0.47	
Spices	28%	33%	0.01	***
Non-alcoholic drinks	9%	14%	0.01	***
Alcoholic drinks	2%	3%	0.19	
Fruits	10%	16%	0.11	
Vegetables	41%	46%	0.06	*
Poultry and poultry products	5%	9%	0.11	
Red meat	6%	11%	0.05	**

***, **, * means significant at 10, 5 and 1 per cent, respectively.

In both 2003 and 2018 vegetables were consumed at over 40%, making it the food group that was purchased by the most amount of households, while alcoholic drinks—comprising 2% the share of consumption in 2003 and 3% in 2018— were consistently the least purchased. Oil and Fats, and Spices/Condiments were the most used food groups, both consumed 6 times a week in both periods. The frequent intake of oil and fats suggest that most household derive their basic energy

from this category. Spices and condiments are used in all cooking as they make food taste better even those with limited amount ingredients. Fruits and Milk/milk products were the least frequently consumed food group in 2003 and 2018. These groups are considered expensive and low in energy as a result they are not frequently consumed. Surprisingly, the frequency of consumption of vegetables increased from 5 times a week in 2003 to 6 times a week in 2018 indicating an improvement in vegetables consumption. The number of times grains and flour were consumed in a week declined from 6 to 5 times a week indicating a marginal shift from energy-dense foods. The number of times animal sources of protein were consumed in a week remained the same, but plant protein sources increased from 3 to 4 times a week. In summary, there has been improvement in the number of times vegetables and plant sources of protein are consumed per week.

Table 2. Comparing average number of times food groups were consumed per week in 2003 and 2018.

	Average number of times per week		
Food groups	2003	2018	Variance
Fruits	3	3	0
Grains and Flours	6	5	-1
Meat, Fish and Animal Products	4	4	0
Meat, Fish and Animal Products used as spices	3	4	+1
Milk/Milk Products	3	3	0
Oil and Fats	6	6	0
Pulses, Nuts and Seeds	3	4	+1
Spices/Condiments	6	6	0
Starchy Roots, Tubers, and Plantains	4	4	0
Sugar/Sugar Products/Honey	4	4	0
Vegetables	5	6	+1

4.4. Most Important Igbo Foods

When asked which Igbo foods were the most important, thirty-five different foods were identified, with ede (cocoyam), ji (yam), akidi (black beans), fiofio (pigeon peas), and ukwa (breadfruit) being the most common responses. All of the foods mentioned as staple Igbo foods were natural in origin and either completely unprocessed or minimally processed. No packaged foods or ultraprocessed spices were considered as most important to the local food landscape or traditions.
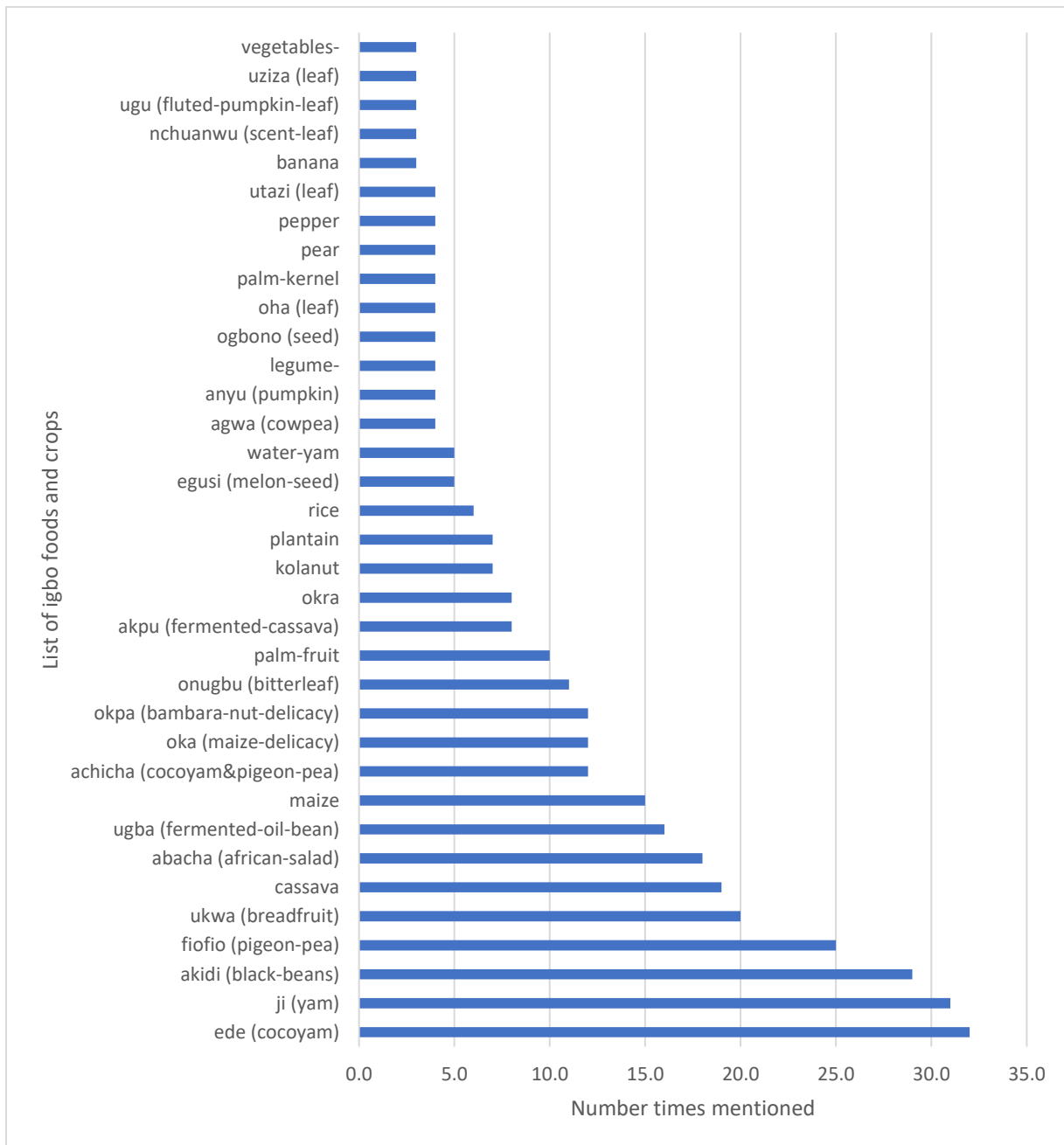
Figure 6. Most Important Igbo Foods and Crops.

4.5. Spices Used by Parents' Generation versus Current Generation

The most frequently listed spices used by the older generation was reported to be ogiri okpei (fermented castor seeds) followed by nchuanwu (scent leaf), uda (negro pepper), utazi (leaf), and uziza (leaf).
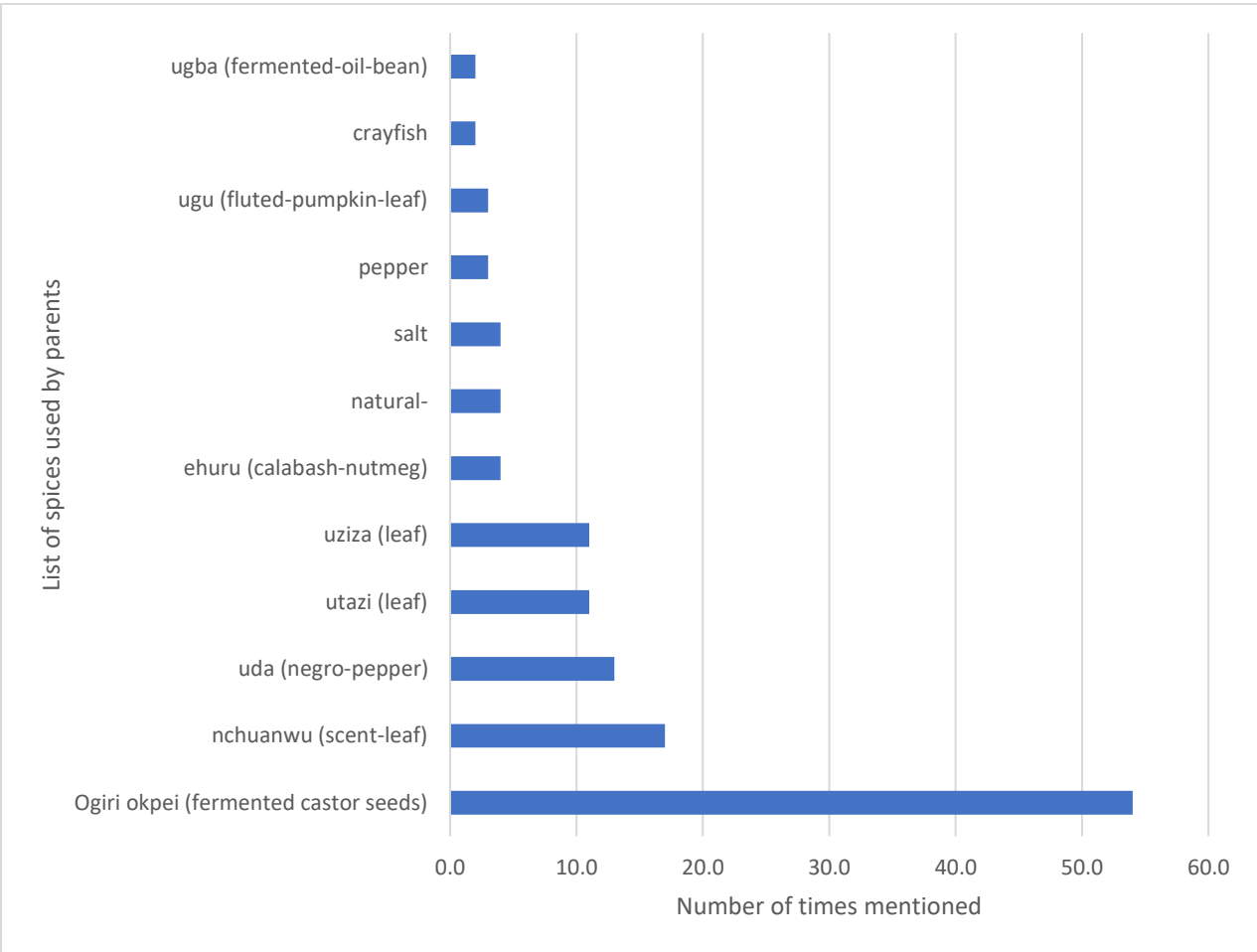
Figure 7. Top spices frequently used by parents'(older) generation

The results indicate that the younger generation is abandoning these traditional natural spices. The most used spice among them is seasoning cubes, most notably the Maggi, Benny, and Kitchen Glory brands. Although seasoning cubes were not mentioned as being part of their parents' generation's cooking, seasoning cubes comprised 35% of all spices the current generation listed as using. Curry, thyme, and ehuru (calabash nutmeg) lagged in second, third, and fourth place. The natural and local ogiri okpei (fermented castor seed), nchuawu (scent leaf), uda (negro pepper), utazi (leaf), and uziza (leaf) ubiquitous in their parents' generation are shown to be becoming thoroughly neglected by the youth.

Many respondents had negative reactions towards the transition from spices that are natural in origin to those that are processed into additive-laden spice cubes. Respondents shared that, "*The old ingredients that were used to prepare food have been replaced with some modern ingredients which has made the taste of foods too different,*" and that, "*Instead of the local ingredients like ogiri that was being used in soups, it's being replaced with Maggi cube and that ends up changing the taste.*" One other person shared that, "*Before everything was natural and fresh but now, in other things easier people tend to use preserved spices and all this already made ingredients*" and

another that, *"the parents' generation] used natural and fresh stuff, but now it's mostly already preserved ingredients."*
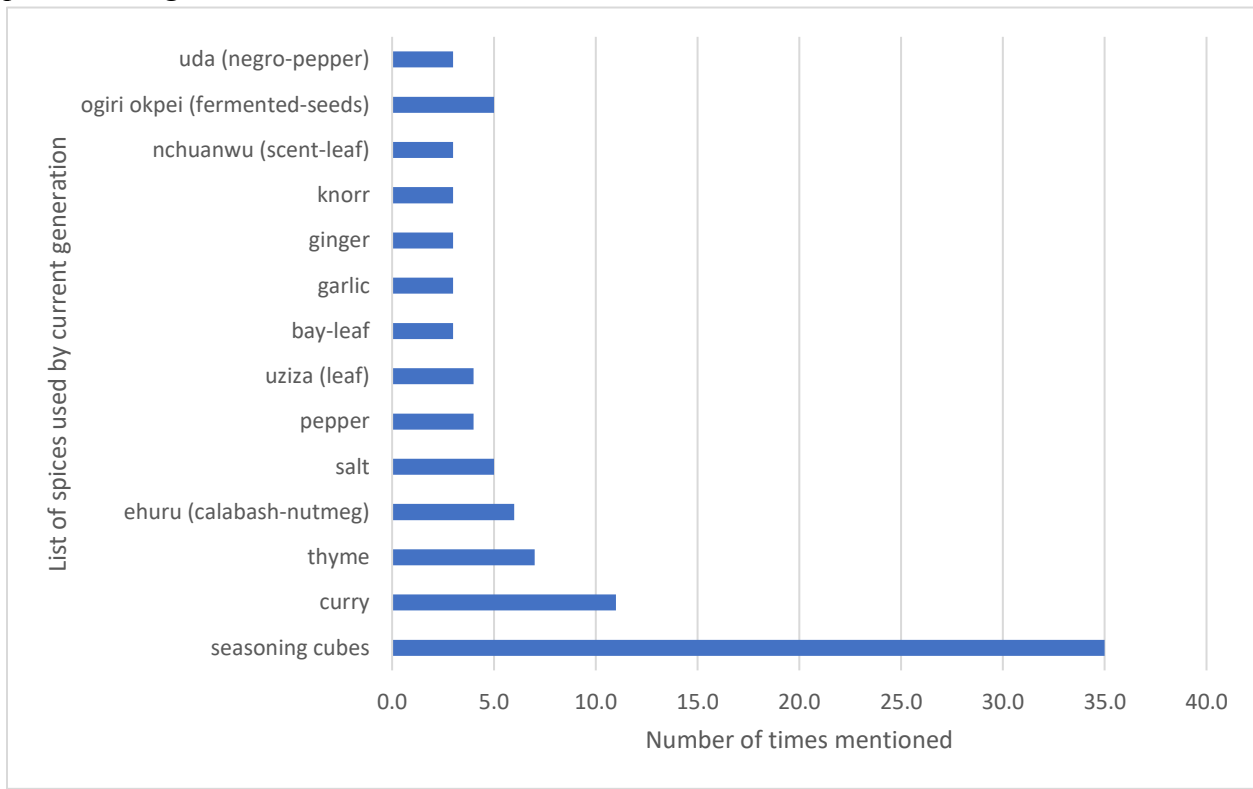

Figure 9. Top Spices frequently used by current generation

4.6. Igbo Medicinal Foods

When asked which foods they believed to have medicinal properties, the most common answers were beans including akidi (black beans) and fio-fio (pigeon peas), as well as vegetables including garden egg, ugu (fluted pumpkin leaf), onugbu (bitterleaf), fiofio (pigeon pea), utazi (leaf), uziza (leaf), and more.

After beans and vegetables, the next most common response was *"all Igbo foods."* One respondent stated that they believed the healthiest foods were, *"Fresh yams and vegetables just harvested from the farm,"* while another stated that, *"every local food is organic and as such healthier than inorganic foods."* One interviewee stated that, *"all our [Igbo] vegetables"* and *"all our [Igbo] spices"* have health-promoting and medicinal properties with another person adding that, *"All our local foods are healthy."* These responses indicate sizable community pride in local Igbo foods.

There was also some emphasis on health-promoting effects of proper food preparation, including the acknowledgment of eating foods in the correct proportions, as well as consuming enough protein and vitamins. Some people also indicated that the different foods had different properties for different conditions, such as recommending uda seed (negro pepper) for pregnant women.
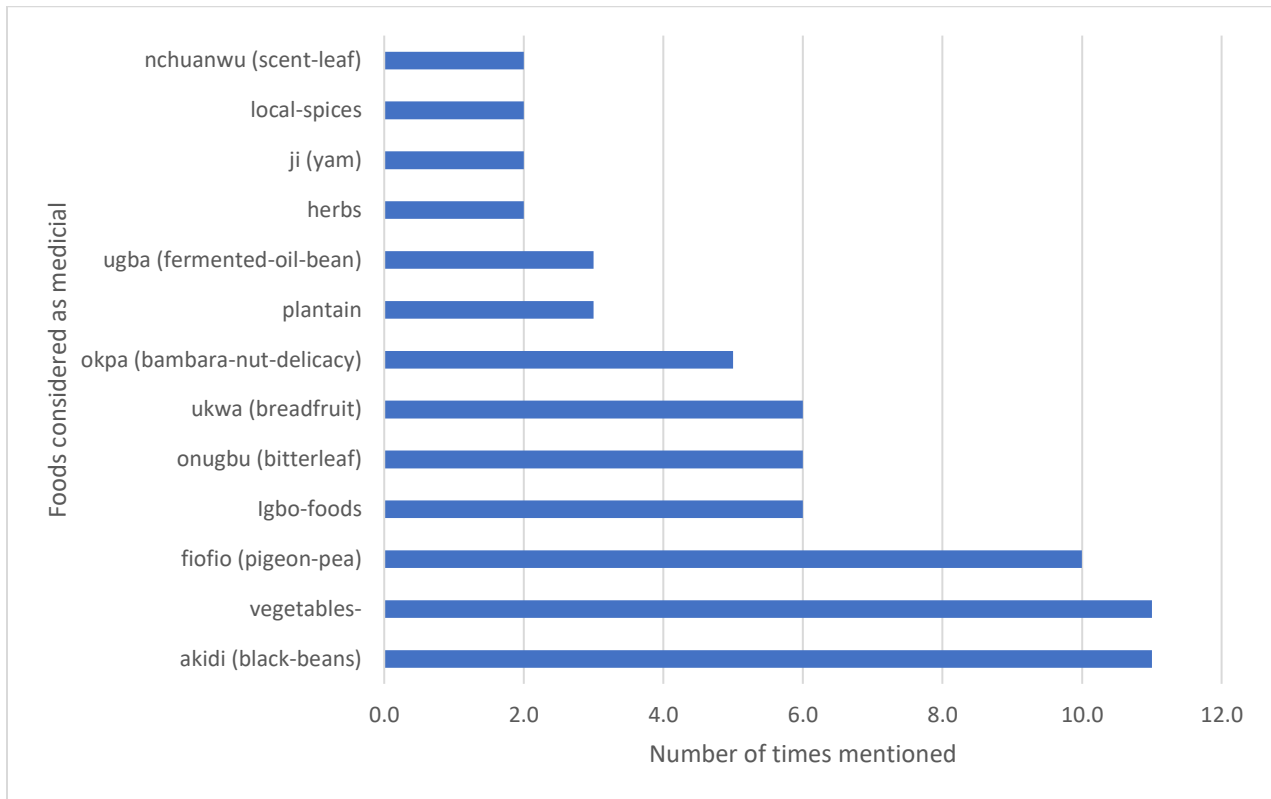
Figure 10. Frequently listed medicinal foods in Igbo land

4.7. Foods Associated with Poverty versus Foods Associated with Affluence

Ji (yam), the historic tuber of the Igbos, was the food most associated with affluence. Ukwa (breadfruit), and rice followed close behind, with meats, beans, and various vegetables also receiving multiple mentions. No explicitly Western or industrialized processed foods were listed as foods associated with affluence, although one respondent did answer, "Chinese food."

Overwhelmingly, the foods that participants identified with poverty were cassava-based. Garri (cassava flour) —a staple food in Nigeria—was most associated with poverty, followed closely by abacha (African salad) which is commonly made of cassava, followed by plain cassava tuber, and akpu (fermented cassava) —a local swallow with a strong sour odor. Overall, no respondents associated cassava-based foods with affluence, while 78% of the foods mentioned that were associated with poverty were made from cassava.
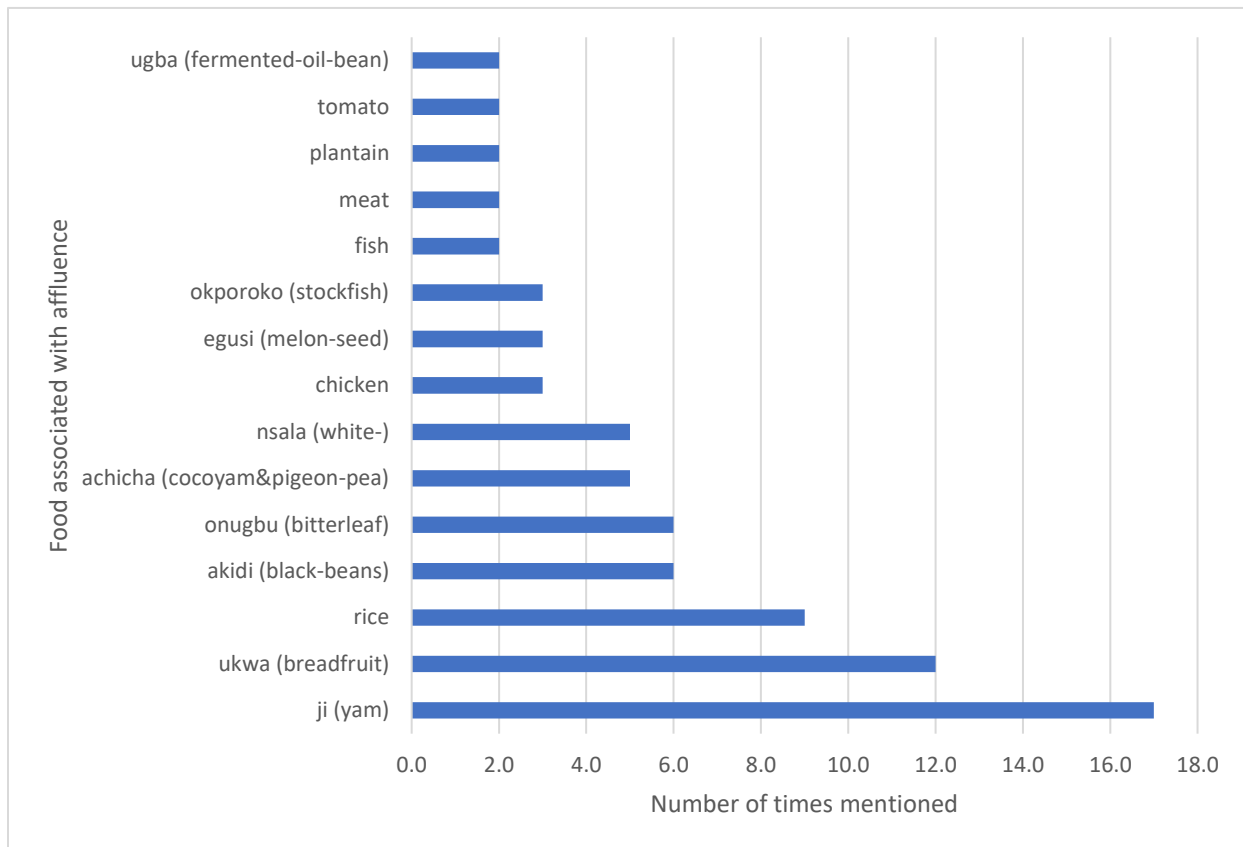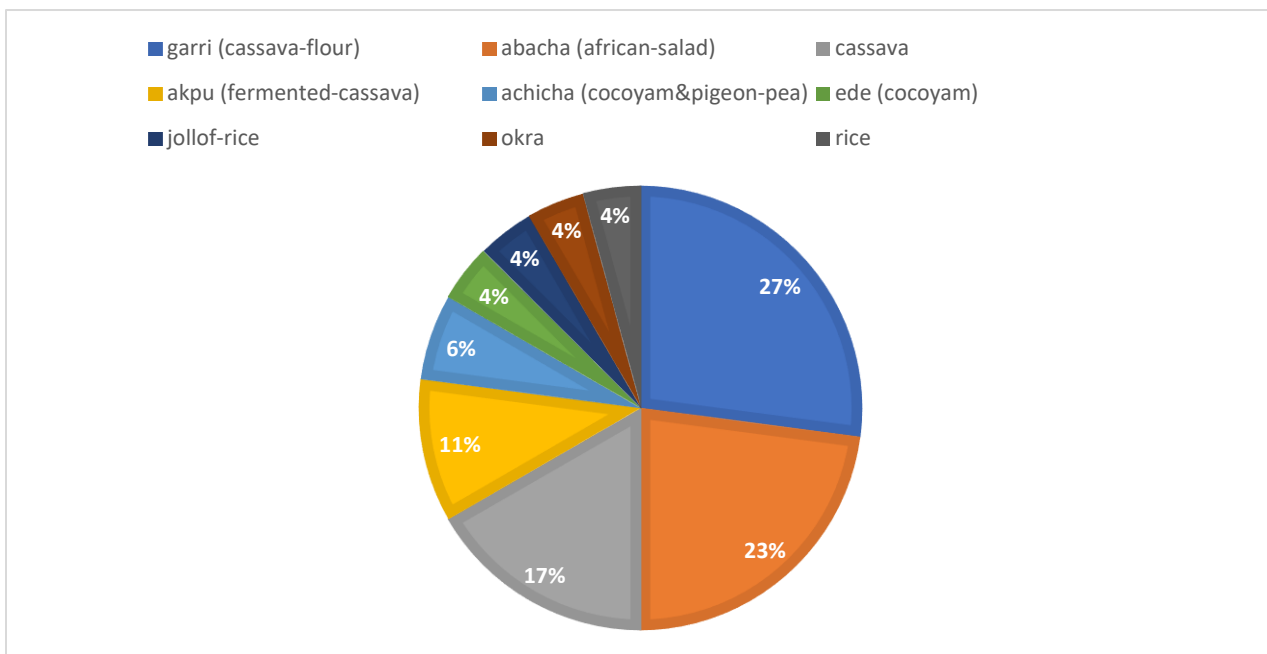
Figure 11. Foods Associated with Affluence

Figure 12. Foods Associated with Poverty.

4.8. Changing Local Foodscapes & Potential Endangerments/ Extinctions

Aerial Yam (Adu), Akidi (black bean), Una (bitter yam), Three-leaf yam, Ichipe, and Ihwi were listed as foods that are no longer commonly consumed in the area, while red-cassava, Adu (aerial Yam), yellow-yam (ji oku), akidi (black bean), abi (flat yellow yam), and various unnamed vegetables and mushrooms were also listed as potentially having gone in extinct in the area in the past few decades. One interviewee also indicated that, beyond specific species that are going extinct, *"almost all the traditional species of these groups are being replaced by hybrids. Traditionally grown original species are scarce*."

4.9. Local Perceptions of Nutrition Transition in Enugu State

There was consensus among the participants that the way people eat in Enugu State is changing. When asked to elaborate how so and in what ways, respondents overwhelmingly indicated that they believe that diets are changing for the worst.

Of the 54 people questioned, only 8% of people surveyed said that they did not believe that diets are changing, 9% did not answer, and a whopping 83% said: yes, they are. When asked "how" they are changing, the answers had similar themes of diets transitioning away from local, whole food sources and towards ultraprocessed imports.
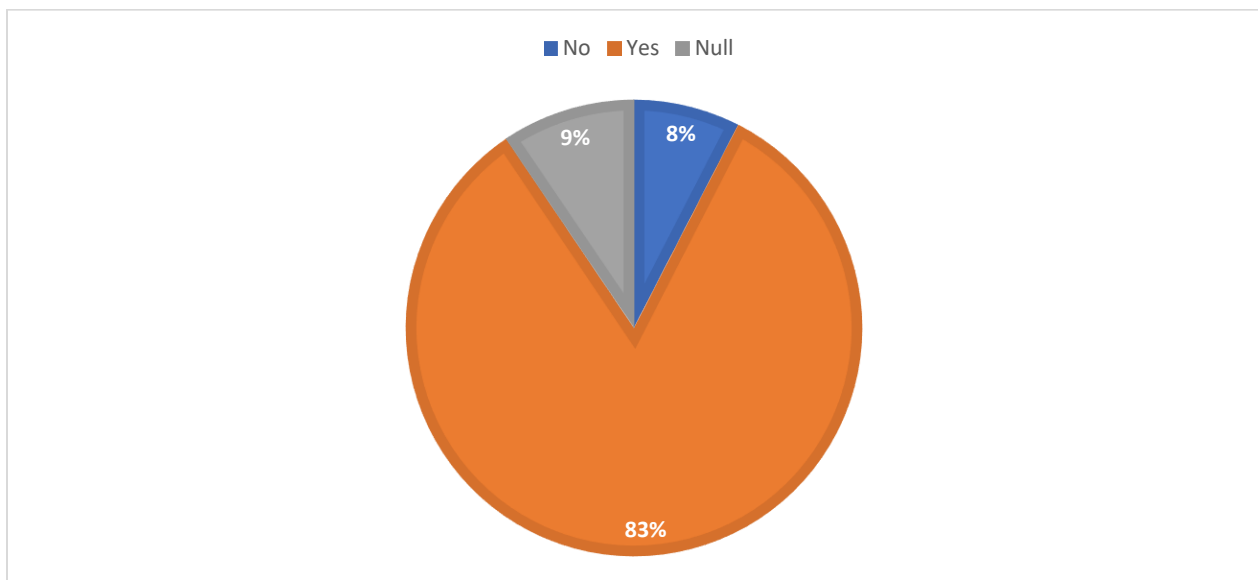
Figure 13. Local Perceptions of Changing Diets.

Rationales for how diets are changing ranged from descriptive answers, such as:*"The younger generation neglected the Igbo traditional food,*" "*Fast food has taken over,*" "*There is too much reliance on packaged foods,"* and *"There is a lot of sugar in most food now,"* to more specific, such as, *"From Abacha to Indomie"* (natural African salad to packaged processed noodles,) *"They [the younger generation] do not want to spend time and cook. Noodles and fast foods are their*

meals of choice," "Children depend on noodles," and *"Some youths and children do not like local foods such as cocoyam, Abacha and local beans, many youths and children prefer pizza, shawarma."*

Explanatory responses included, *"It's changing because of civilization. Most people live in the city so are far away from nature,"* and *"Many are now taking to Western diet coz of their filtration into the market and ease of preparation and refined foods."*

Some interviewees even attributed poor health outcomes in the younger generation stating that, *"Diets have changed in the younger generation because they don't eat balanced diet and food that will build the body and prevent sickness. They are more into processed foods which has some health implications,"* and *"The younger generation eat more sweets that damage their body system."*

A few answers attributed the nutrition transition to the West stating that, *"Socialization or Westernization have the greatest impact on the preference of the younger generation. They crave continental dishes more than local foods,"* with another participant historicizing that, *"Because of Western influence and the race to imitate the white man so the new generation ends up loving burgers and French fries."*

4.10. Policy Recommendations from Study Participants

Throughout the interviews, Enugu locals had many recommendations for policy interventions to curb the negative effects of the nutrition transition. One participant stressed that, *"More encouragement and mobilization should be given to Igbo farmers to enhance productivity"* while another called for the Nigerian government to specifically empower Igbo farmers to produce more Igbo crops.

One participant acknowledged that, *"The world is now a global village. People access information easily and embrace new ideas."* But that, beyond policy interventions, *"Parents should advise their kids on the health benefit of local dishes"* and that *"Parents need to educate their kids on the nutrition value of Igbo food and our traditional meal,"* with another person declaring that: *"This present generation needs to be encouraged to go back to traditional food."*

5. Conclusion

Overall, the data analyzed from the Nigerian Demographic and Health Services and World Bank Living Standards Survey clearly depicts the Nutrition Transition in Nigeria in multiple forms. First, in the past fifteen years the combined overweight and obesity rate in Nigeria has increased by 29%. The burden of two major noncommunicable diseases—diabetes and hypertension—has similarly increased by 21%.

Concurrently, food consumption in all categories increased. The analysis of national food consumption data also displays that the fruits and vegetables consumed at a national level are primarily of introduced and non-native varieties. Very few are African in origin, likely due to the lack of market for them due to over a century of colonial and neo-colonial underinvestment in indigenous fruit varieties leading to their devaluation. The absence of markets for fruits endemic to Africa is a problem that should be addressed given their proven health benefits and the role that they can play in ensuring local food security and economic development (27).

Though Nigeria's current obesity rate of 9% is concerning as it has been steadily increasing for years, it is still far behind the rate of obesity in countries farther along in the nutrition transition, including Western nations. Britain's obesity prevalence, for comparison, is currently 28% while the United States' is staggering at a sizable 42% (28). This demonstrates that Nigeria is still worlds behind the West in terms of the status of its nutrition transition but is also illuminative that measures must be taken to curb the deterioration of the country's indigenous and healthy agri-food system while it is still in its early stages.

The burden of diet-related chronic diseases in the Western world is similarly something that Nigeria is not prepared to deal with and should be avoided at all costs. Today, one-third of all deaths in the United States are attributable to heart disease and stroke, which alone costs the health system 214 billion USD each year in direct healthcare costs, in addition to the 138 billion USD in lost economic productivity (29). According to the United States Center for Disease Control (CDC), diabetes costs another 327 billion USD in medical costs and lost productivity annually. In fact, 90% of the country's nearly 4 trillion USD healthcare expenditure goes towards costs associated with chronic disease (29).

Beyond having the potential for being fiscally costly, Nigeria's rising obesity rate is especially concerning, given the fact that a large portion of the country is still underweight, which increases the country's risk of double and triple burdens of malnutrition and is destructive to national public health (30). One example that Leocádio points out is that, "Contaminated environments, early childhood diarrhea and enteric pathogens have been associated with intestinal dysbiosis, increased risk of developing obesity and neurodegenerative diseases." Furthermore, obesity has been proven to contribute additional dangers to an individual who is also experiencing malnourishment or hidden hunger, and children who are malnourished early in life are more likely to become obese and have metabolic disease later in life than those who are not (30).

Analysis of the traditional Igbo foodscape depicted that the cataloguing of traditional Igbo foods demonstrated how definitions of "traditional" versus "modern" are occasionally arbitrary. The "traditional" is always evolving and non-static, which is why the current identification of traditional foods and most important foods include introduced crops (31). All of the foods identified were natural, fresh-from-earth and either completely unprocessed or minimally-

processed through fermentation, pounding, sun-drying, or cooking. Nothing mentioned was factory-made or ultraprocessed. Many of the crops listed are endemic to the region, while others are native to other continents. Cassava, for example, is native to South America, though Nigeria is now the world's largest producer of the crop. The tuber has been part of the Igbo food landscape for centuries and is prepared in locally-specific ways, for example fermented into the staple foods garri and akpu. Recently, the Nigerian government has even mandated that all bread produced in the country must contain cassava flour to boost its production.

The literature review showed that the nutrition transition in Africa is mainly displayed through the transition of traditional foods that have been shown to prevent the development of noncommunicable diseases have been replaced with foods that are directly correlated with increased incidence of noncommunicable diseases— including but not limited to processed vegetable oils, sugar, refined flours, and commercial additives (14). This trend was displayed through the data that was analyzed for this study. Specifically, in the Igboland case study the transition from natural superfood spices to seasoning cubes laden with artificial colors, flavor enhancers, emulsifiers, and undisclosed flavoring agents was clearly depicted through an increase of 0% to 35% in perceived use of spice cubes in the parents' generation to their own use.

Because of the risk factors of non-nutritional components of industrially processed foods, it is especially important to recognize that no members of the community surveyed in Enugu State listed any ultraprocessed foods as being central to Igbo food culture. However, it points to why the marked shift to a reliance on processed spice cubes in Igboland is concerning.

The literature review suggested that indigenous foods are sometimes thought of as being "foods of poverty", specifically by the younger generation, which leads them to be abandoned and is a major driving factor of the nutrition transition. In this study, however, that divide was not as apparent. In contrast to the existing literature, there were not many responses indicating wild foods and indigenous vegetables as foods associated with poverty. Rather, most people when asked, "what foods do you consider the healthiest?" picked a traditional food, or even answered more generally that they believed all local foods were healthy. Additionally, the relationship between fish and meat consumption and wealth is well-documented and was expected. Notably, the significance of yam in the Igbo community is present throughout the data and is reflective of yam's long held reputation as wealth indicators, in part due to the difficulty of its cultivation.

Overall, the results of the data analysis clearly demonstrate the nutrition transition in Nigeria through both the primary and secondary data analysis. Obesity is rising, noncommunicable disease burdens are increasing, and some food preferences are changing. However, concurrently the interviews conducted around Enugu suggest pride and esteem in indigenous food systems, as well as their health-promoting effects with its emphasis on fresh, whole foods and extensive use of local vegetables and legumes, even though there was a consensus that Igbo food culture is changing because of the younger generation's altered tastes for processed foods and convenience.

The role of indigenous knowledge and foodways promoting health is a narrative left out of most governmental, non-governmental organization (NGO), and corporation-driven initiatives in not only Nigeria, but throughout the developing world. To make lasting and impactful progress, these narrative needs to be empowered throughout local and national governments and communities where this knowledge still exists and is cherished. Further research is needed in the field to analyze the effectiveness of implementing specific changes on a grander scale, but nonetheless the potential embedded in this knowledge is invaluable in the magnitude of resourcefulness alone.

As the participants made clear in their responses, illuminating the findings of the literature review, there needs to be something said about the status of investment currently in African foodways. Currently, the landscape of investment in cash crops, genetically, and biofortification in African foodways from organizations that directly threaten these peoples' livelihoods, their food traditions, and their risk for chronic disease and their economic exclusion. The billions of dollars going towards the Westernized expansion of industrial agriculture in Africa are in direct contradiction to indigenous African ways of growing and consuming healthy foods that have developed over millennia.

The indigenous people around the world already have the answers of how to live a life free from the burden of chronic diseases through their health-promoting diets and lifestyles. It is time for policy, investors, and academics to acknowledge, celebrate, and support these people in protecting their immense indigenous nutritional knowledge bases, natural resources, and food sources, to protect and promote human health, environmental sustainability, and economic independence.

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