



REVIEW ARTICLE

Nutrition Transition in West Africa: Public Health Challenges, Socioeconomic Impacts, And Regional Policy Interventions.

Simbiat Moyomola Sanni^{1*}

¹Department of Nutrition, Wesley University, Nigeria.

*Corresponding author E-mail: sannisimbiat659@gmail.com

Article Info.	Abstract
Article history: Received: 14/09/2025 Accepted: 05/10/2025 Published: 23/10/2025	West Africa is experiencing a significant nutrition transition characterized by a shift from traditional, nutrient-rich diets to those high in fats, sugars, and processed foods. This transformation is driven by rapid urbanization, globalization, income growth, and changing lifestyles. While the region continues to grapple with undernutrition, stunting, and micronutrient deficiencies, there is a growing prevalence of overweight, obesity, and diet-related non-communicable diseases (NCDs) such as hypertension, type 2 diabetes, and cardiovascular conditions—a phenomenon referred to as the “double burden” of malnutrition. The current narrative review explores the nutritional landscapes of West Africa region and their repercussions on the aspect of public-health. Based on peer-reviewed studies published since 2005 and until 2024, the review will take up the socio-economic, environmental, and cultural factors that influence the diet shift that is occurring; these include the increased availability of ultra-processing food commodities, reduced physical activity, and a corresponding drop in the daily food practices. The inpatient literature depicts the importance of policy-level changes that would focus on nutritional education, environmental design, and frail-resiliency plans in regards to the trends. The impact on vulnerable groups, especially women, children, and urban poor populations, is emphasized, highlighting the intersection of nutrition, inequality, and health outcomes. The paper further assesses current policies and interventions across the region, such as school feeding programs, food fortification initiatives, and public health campaigns. However, fragmented efforts, limited resources, and weak enforcement mechanisms hinder meaningful progress. The study advocates for integrated, region-specific strategies that prioritize both food security and healthy dietary practices. Strengthening nutrition surveillance, promoting sustainable agriculture, and fostering multi-sectoral collaboration are critical to reversing harmful dietary trends. Ultimately, addressing the nutrition transition in West Africa requires a coordinated public health response to safeguard the future health and productivity of its population.

Keywords: Food security; urban health; double burden of malnutrition; Non-communicable diseases (NCDs); Public health; Urbanization; Nutrition policy.

2025 Center of Science. All rights reserved

INTRODUCTION

1.1 Background and Global Context

The nutrition transition concept was initially introduced by Barry Popkin in the 1990’s to capture the general dietary and physical activity changes that come along with social and economic development [1]. The stages of the nutrition transition, adapted from Popkin [1], are outlined in Table 1. These shifts typically moves societies away from traditional diets rich in fiber, legumes, and complex carbohydrates, toward energy-dense, highly processed foods containing saturated fats, added sugars, and salt [1, 2]. Although such dietary changes may occur in relation to rising availability of food and economy, they are also highly linked to

rising rates of overweight, obesity and non-communicable diseases (NCDs), particularly in low- and middle-Income Countries (LMICs) [2].

Nutrition Transition in developed countries is currently at a stage between stage four and five with increased public awareness and policy interventions to fight lifestyle related diseases [3]. However, most LMICs such as African countries are currently experiencing accelerated transitions from stage three to four, bypassing a stable nutritional-adequacy phase. West Africa presents a unique context for examining the nutrition transition due to its rapid urbanization and simultaneous burdens of under- and overnutrition, making it a bellwether for trends in other LMICs [6].

This rapid transition in LMICs has been fast-tracked by rapid urbanization, globalization of food markets, economic liberalization, as well as aggressive marketing of ultra-processed foods by multinational corporations [4]. In highly populated cities convenience and ultra-processed foods are often viewed as not only being cheaper, but also more easily accessible than their whole-food counterparts. This social vision, yet however, ignores the continuation of native, low-cost production, nutritious staple food, which is even now highly representative of typical local markets, including millet, maize, bean, leafy vegetables and seasonal fruits. Not so much the actual prices of such items, but market forces and the elimination of traditional food knowledge, emergence of the processed products on the grocery scene via marketing discourse, with more emphasis on convenience of preparation and taste preferences is what has made the processed item easy to continue purchasing at the expense of other cheaper, and healthier items. This consequently makes the urban poor populations at high risk of negative effects of this transition, thus leading to a dual burden of malnutrition in which stunting and wasting coexist with obesity and related metabolic disorders in the same communities, households, or even individuals [5].

In addition, the existing nutrition transition is closely connected to general demographic and epidemiological transitions. As infectious disease burdens continue to decrease and populations become older, the diet-related NCDs like hypertension, diabetes, and cardiovascular diseases become major causes of morbidity and mortality [6]. The currently experienced changes in nutrition, which are commonly known as the nutrition transition, pose challenging issues to the health systems in general and the West African nations, whose current healthcare-providing infrastructure is often overburdened. The clear picture of the global dynamics that are behind this shift is a necessity in the perceptions of its unique patterns in West Africa and an understanding that yields evidence-based and specific interventions. The country of Nigeria is used only as an example because of its high population, and ready availability of sufficiently extensive data, although the overall tendencies identified in this paper are of high relevance to the entire West African sub region.

Table 1: Stages of Nutrition Transition and Their Characteristics

Stage	Characteristics	Typical Diet	Health Outcomes
1. Collecting Food	Pre-agricultural societies reliant on hunting and gathering	High fiber, low fat, seasonal and natural foods	Low obesity, high physical activity, minimal NCDs
2. Famine	Early agricultural stage with limited food variety and frequent shortages	Starchy staples with minimal diversity	Undernutrition, stunting, nutrient deficiencies
3. Receding Famine	Technological advances reduce food scarcity; diets diversify slowly	Increased fruits, vegetables, and animal protein	Decline in nutrient deficiencies, rise in chronic diseases
4. Degenerative Diseases	Abundant food, highly processed and calorie-dense; urban lifestyle dominates	High fat, sugar, salt; processed foods	Increase in obesity, diabetes, cardiovascular diseases
5. Behavioral Change	Health-conscious behaviors, policy interventions, return to traditional elements	Balanced, nutrient-rich, reduced processed foods	Decrease in chronic disease risk, improved life expectancy

1.2 The Nutrition Transition in West Africa

This section outlines the key stages and regional drivers of the nutrition transition in West Africa. It builds on global trends discussed in Section 1.1 and introduces regional dietary shifts, economic factors, and health outcomes. The nutrition transition in West Africa is emerging quickly, resulting from a combination of urbanization, shifts in economic contexts, globalization, and changes to cultural norms [7]. The native feeding patterns in the west Africa are known to be nutrient rich foods which were unrefined such as millet, sorghum, cassava, yams, legumes and leafy vegetables supplemented with an intake of fruits that were locally produced. However, during the recent decades, imported products have spread, especially in the urban areas, mainly the refined foods rich in calories with insufficient amounts of essential micronutrients. As documented by the United Nations Food and Agriculture Organization (FAO) and the Economic Community of West African States (ECOWAS), the region's agricultural basket now derives a significant fraction from external suppliers; cereals represent an especially notable example, with more than 40 % of regional consumption imported. This new diversification has broken the tradition of foodways as well as increasing exposure to processed foods in Western style that contributes to high prevalence of obesity and noncommunicable diseases. The conventional dieting style, with higher dietary fiber or complex carbohydrates and vegetable proteins, is strikingly different to the recent use of added sweets and saturated fat prominent in the dietary habits of the western populations [8]. However, in the last decades there have been significant changes in dietary habit in both urban and rural settings [7].

As the rate of urbanization increases in countries such as Nigeria, Ghana, Senegal, and Côte d'Ivoire, so does exposure to Western-style diets [9]. In urban environments, people are progressively dependent on imported energy-dense, nutrient-poor food like white bread, instant noodles, sugary drinks, processed meats, deep fried snacks, fast food [9]. Such foods are also generally cheaper and more accessible and heavily promoted, compared to conventional options, particularly among low income urban populations. For example, research has demonstrated steadily increasing share of calories from ultra-processed foods in West African cities, accounting for substantial caloric excess and poor dietary quality [7].

In addition, rural areas are also not exempt from these changes. Emerging trends in the transport infrastructure; the advance in mobile technology and rural – urban linkages have helped the penetration of processed food products in remote areas [10]. In addition, remittance flows and labor migration facilitate lifestyle changes emulative of urban lifestyles. For instance, young people who migrate to cities adjust to new eating habits that they take back to their communities. Compared with diets, physical activity patterns have remained downward in most jurisdictions in the world. Mechanization, the rise of sedentary occupations, protracted screen exposure, and a concomitant reduction in traditional agricultural labor are critical drivers of this phenomenon, all of which collectively lower daily energy expenditure [11]. Such parallel of high-energy nutrition and more and more sedentary lives is a characteristic phase of the modern nutrition transition. Despite a wide range of opportunities to engage in physical activities in many West African nations (i.e. Amateur sports practised within open spaces, local football games, physical education classes in schools as well as campaigns of fitness in parks and streets), access to it is unequal. In urban settings, the availability of safe and accessible recreational facilities is frequently limited, and gym memberships or structured fitness programs often constitute unattainable expenditures for low-income populations, costing between ₦10,000–₦30,000 (USD 7–20) monthly in cities such as Lagos and Accra [51]. Long commute times, overcrowding, inadequate pedestrian infrastructure, and security concerns likewise discourage walking and other outdoor exercise, particularly among women and children [52]. It is necessary to state that nutrition transition in West Africa takes place under very unique limitations, such as continuous poverty, poor health system, and unreliable food environment. Such as compared to the slow changes in dieting in high income countries, the West African countries are experiences, which are rapid in terms of change and are manifested by simultaneous persistence of under-nutrition and appearance of over-nutrition rather than undergoing a period of nutritional adequacy first [7]. This double burden creates a situation where children are persistently affected by stunting and wasting, while adults increasingly suffer from obesity, diabetes, and hypertension. Understanding the different pathways and drivers of the nutrition transition in West Africa is important in developing region-specific interventions that enhance nutritional resilience and cultural integrity in the long run for public health [12].

1.3 Public Health Implications

The nutrition transition in West Africa has led to a variance of public health challenges, specifically through the emergence of the “double burden of malnutrition” [13]. This phenomenon is defined as the presence of under-nutrition, such as stunting, wasting, and the deficiency of micronutrients, alongside over-nutrition, i.e., overweight, obesity, and their associated NCDs in the same population, community, household, or even a person. This complex health landscape poses a great strain on an already compromised health system within the region.

Under-nutrition continues to be a significant issue in West Africa, particularly in children below the age of five years old [14]. In line with statistics put together by UNICEF and WHO, the countries of Niger, Mali, and Nigeria still portray some of the highest

incidences of malnutrition among children. In Niger, 48 % of under-fives are stunted, and 11 % are wasted; in Mali, approximately 38 % are stunted, while 13 % are wasted (both figures refer to 2018). Nigeria's 32 % stunting prevalence and 28.6 % underweight rate constitute the second-highest stunting population worldwide (both estimated values reflect 2018) [14,15]. Other micronutrient insufficiencies, such as iron deficit anemia, iodine-absence goiter and cognitive retardation, and vitamin A deficit infection susceptibility and blind-spot, are still prevalent, and impact both mother and infant adversely. These challenges are usually caused by poverty, food insecurity, poor maternal nutrition, and insufficient breastfeeding practices and lack of access to healthcare.

Modern testimony is revealed as far as an increasing number of overweight and obese people, especially at the urbanized environments, where women are more affected. This gender disparity is shaped by intersecting cultural norms, metabolic trajectories, and socioeconomic forces that mold dietary practices, physical activity patterns, and body image perceptions across numerous West African societies [16]. Recent data from the 2022 Ghana Demographic and Health Survey reveal that 50 % of women aged 20–49 are overweight or obese, comprising 28.2 % overweight and 22% obese significantly higher than the 13 % overweight reported in 1993 [16]. The national health survey of 2020 conducted in Nigeria indicates that 20.3 % of all adults aged 15 and above in the country were found to be overweight and 11.6 % were obese where women had 25.5 % of overweight and 19.8 % were obese and men with 25.2 % overweight and 12.9 % were obese. These trends are supported by a rapid increase in diet-related NCDs such as hypertension, cardiovascular diseases, type 2 diabetes, and hormone-related cancers [6]. The economic implications on the treatment of chronic NCDs are quite burdensome. A recent study in one of the tertiary hospitals in Nigeria indicated that the direct medical cost of patients with both diabetes and hypertension was about US\$37, each month and their indirect cost was US\$4.6; this was way above the 25 % of their disposable income. At the national level, annual out-of-pocket charges were US\$398, which is about 24 per cent of annual food expenditure. Moreover, the estimated total economic burden of diabetes in Sub-Saharan Africa is about US\$4 billion annually with hypertension contributing a similar burden of US\$3.7 trillion in the low- and the middle-income economies. WHO-AFRO statistics show that 0.594 Int US dollars (594/1000) are the mean economic costs of NCD per case in Nigeria, and productivity losses per DALY are about Int US dollars 6340.

It is also highly concerning that NCDs are no longer the disease of the wealthy; now they unfairly impact low-income groups who often have poor access to high-quality healthcare, healthy diets, and prevention services, further increasing the existing health disparities. Urban populations, once plagued by food insecurity, are now experiencing a surge in obesity rates due to a shift towards consuming affordable, high-calorie foods and a decline in physical activity [9]. This condition reflects the “urban poor paradox”, where poverty and overnutrition intersect resulting from change in food environments and sedentary living. Another important issue is the intergenerational cycle of malnutrition. Mothers who receive insufficient nutrition have a higher probability of bearing low birth weight children, who are themselves susceptible to under nutrition and obesity later in life [17]. This cycle worsens the health inequalities and long-term development and economic challenges.

1.4 Socioeconomic and Cultural Drivers

The nutrition transition in West Africa cannot be adequately explained without taking into account the larger socioeconomic and cultural transformation of the region. These shifts, embedded in the processes of globalization, urbanization, income shift, changing gender roles and developing social aspirations, have all together impacted food systems, dietary patterns and health behaviors in deep ways [18].

Urbanization emerges as one of the most important drivers of dietary change. Moving to cities in search of economic opportunities, rural populations become more and more subjected to modern food environments that include supermarkets, fast-food outlets, street vendors, and convenience stores. These urban foodscapes typically favor those shelf-stable, ultra-processed items over fresh, local offerings because of cost, convenience, and advertising [19]. Living in towns and cities also means time pressures and changes of lifestyle that prioritize convenience over nutritional value, especially among the working class.

Economic growth and increased household incomes have also led to changed consumption patterns. When populations increase in the middle class, there is a discernible change from subsistence level eating to aspirational consumption of meat, sugar sweetened drinks, fried foods, and packaged snacks. These choices in the diet are not only utilitarian but symbolic: the index of modernity, affluence, and upward mobility [20]. In many contexts, traditional foods are considered old fashioned or for the poor further crowding out traditional diets with western style diets.

Food choices and behaviours are also determined by cultural views on body image and health. In many West African cultures, a plump body is a symbol of beauty, fertility, prosperity and social status; especially among women [21]. While this cultural ideal is very much ingrained, it may unintentionally normalize being overweight and obese, while lessening the perceived urgency of diet change and muddling public health messaging on weight control. Gender dynamics are also very important. While women's

health is directly affected, their central role in family food choices means gendered impacts extend to entire households [22]. Women, the main caregivers and food preparers, play an important role in household dietary patterns. Lack of access to nutrition education and economic empowerment might limit their capacity to make healthier choices.

These trends have been intensified with the effects of globalization and aggressive marketing of food. Large companies tend to target African markets with high-calorie food ,branded products, using advertising that glamorizes Western lifestyles [23]. These campaigns are especially influential among youth, who often equate global brands with prestige and modernity.

1.5 Methodology and Literature Selection

The aim of the review was to clarify the trend of nutrition transition, its related impacts on public health, and relevant policy responses in West Africa with the help of literature published in 2005-2024 and evaluated by peer review. The timeframe selected is supposed to encompass 20 years of vibrant statistics not only in the world but also in region-related nutritional progress. The PubMed, Scopus, and Google Scholar databases were searched using the keywords nutrition transition, West Africa, non-communicable diseases, and public health, and micronutrient deficiency. The selection of articles took place grounded on its relevancy,geographical orientation and whether it contains quantitative/policy oriented text. The search initially returned 125 articles and after abstracts reviewing, access to full-text articles and compatibility with the theme of the study, 78 articles were used.

Aim and Objectives

In order to investigate the effects of nutrition transition on public health in West Africa, this review looks into a number of factors, including globalization and urbanization, the dual burden of malnutrition, cultural, social, and economic factors that influence diet, health risks, and evidence-based solutions.

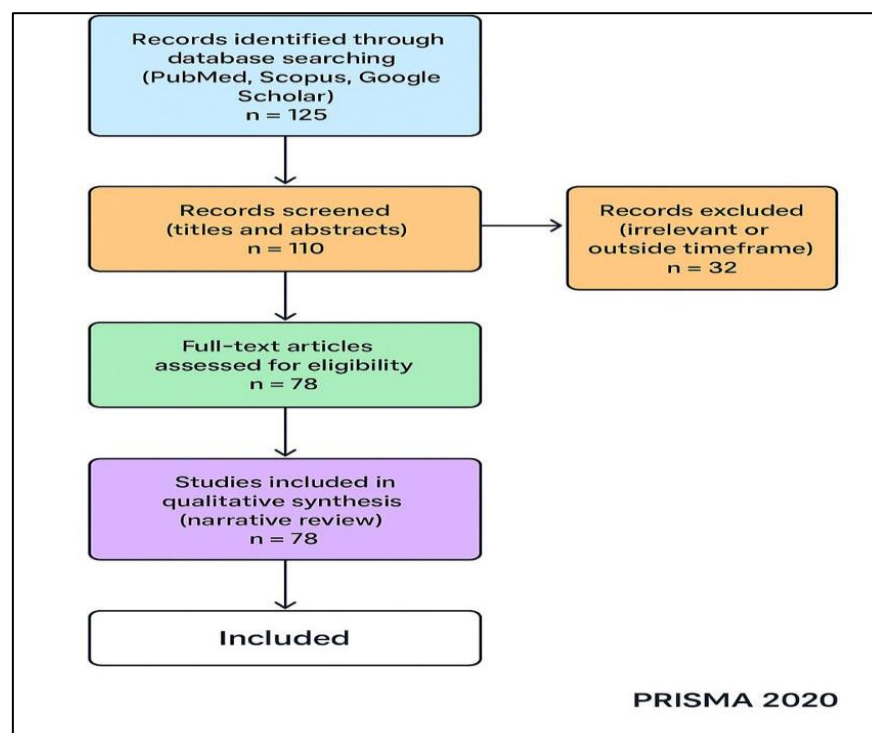


Fig. 1 : Studies about Nutrition Transition.

2. IMPACT OF THE NUTRITION TRANSITION ON PUBLIC HEALTH IN WEST AFRICA

2.1 The Dual Burden of Malnutrition

The concept of the dual burden of malnutrition indicates the coexistence of both undernutrition and overnutrition among the same population, household, or even individual [24]. In West Africa, this phenomenon has taken its toll as a major public health problem amidst a context of nutrition transition evolution. The double burden of malnutrition includes both undernutrition

(stunting, wasting, and micronutrient deficiencies) and overnutrition (overweight or obesity and related non-communicable diseases (NCDs)) [25]. Dietary shifts in Nigeria, illustrated in Table 2, exemplify broader trends across the region.

Under-nutrition and Its Consequences

Undernutrition continues to be a key issue in West Africa especially for children under five years and it is a significant cause of high mortality rates and morbidity in the region [14]. Stunting or low height-for-age is one of the most prevalent undernutrition conditions in the region [26]. Between 2 to 3 out of every 10 children are stunted with an overall percentage of 30%, according to the World Health Organization (WHO), a statistic that suggests the chronic nature of nutritional weakness during critical periods of growth and development.

Stunting is linked with various long-term effects, such as poor cognitive development, decreased academic performance and limited productivity during adulthood [26]. Children who are stunted have weakened immune responses, hence becoming more susceptible to infections and are at increased risk of developing chronic diseases such as obesity and cardiovascular diseases later in life. In addition, the problem of wasting, identified as low weight-for-height, persists, and it is of particular concern in the regions that are faced with food insecurity, climate shocks, and conflicts [27]. Low weight-for-height, a sign of acute malnutrition, increases the likelihood of infectious disease-related mortality and worsens the region's overall illness burden. Stunting, on the other hand, is a sign of chronic malnutrition and is characterized by low height for age. It is linked to long-term consequences like poor academic performance, delayed cognitive development, and decreased adult economic production. Micronutrient deficiencies are also common, especially a lack of iron, vitamin A, and iodine. Iron deficiency causes anaemia and that by itself affects maternal health, fetal development, and physical and cognitive growth of children [28]. Deficiency in Vitamin A causes night blindness and therefore increases chance of maternal and child mortality, deficiency in iodine on the other hand leads to goiter and developmental delays, and Intellectual disabilities [29]. In a number of West African countries, which have food fortification programs, existing undernourishment has failed to be eliminated. The ECOWAS member states have established obligatory fortification of staple foods like vegetable oil, wheat flour and salt. Nigeria, for example, recorded a marked increase in iron-fortified wheat flour coverage, with levels rising from 54 % in 2017 to 92 % by 2020, thereby reaching an additional 73.5 million individuals [22]. At the same time, the 95 % of salt iodization has been covered, and 96 % of the population has been reached teaches cooking oil fortification. Nevertheless, almost 50 % of West African women aged 15–49 continue to experience anemia, and 15 % of children are born with low birthweight, demonstrating that micronutrient deficiencies still compromise health and development [22]. European/North American countries have instead implemented very strong regulatory/fiscal/public-health measures to reduce obesity and non-communicable diseases, and this has allowed certain sub-groups to keep obesity rates at the same level, or even to drop. The convergent path of West Africa, which is characterized by the reduction in nutrition transition alongside high levels of undernutrition, provides a more complicated version of the developed regions.

Over-nutrition and Its Risks

At the same time, overnutrition is becoming a growing concern, especially in cities, where diets are changing towards energy-dense, nutrient-poor foods [30]. Overnutrition, which results from an imbalance between caloric intake and energy expenditure, leads to overweight and obesity. This condition is a major contributor to several non-communicable diseases (NCDs), including type 2 diabetes, hypertension, cardiovascular diseases, and some cancers. This trend is noticeable in certain countries: consumption of instant noodles and sugary drinks has sharply increased in Nigeria, according to supermarket and street food data [23], snack and fizzy drink consumption is increasing in Ghana, particularly among school-age youth [24], and up to half of weekly food items in Mali, Nigeria, and Senegal now consist of processed and ultra-processed products, which clearly deviates from traditional, nutrient-rich diets [25].

Studies show that the number of obese people is increasing especially among urban women, and this contributes to diet-related NCDs rising. For instance, in Ghana, incidences of obesity has more than doubled over the past two decades, with ~40% of adult women now being obese or overweight [31]. In Nigeria, the trend of obesity is of specific concern when the number of rural and urban dwellers now faced with a double burden experiencing undernutrition during childhood and obesity in adulthood [32]. This overlap makes public health efforts very complicated since both extremes of malnutrition have to be conquered at the same time.

The increasing incidence of NCDs due to overnutrition is putting a major economic strain on healthcare systems and society [25]. The cost of treating chronic illnesses including diabetes and hypertension continues to rise and the costs of these conditions in the long run include early death, loss of productivity and healthcare expenditure. Health systems in a number of West African nations, including Nigeria, Ghana, Senegal, Mali, and Sierra Leone, are still based on infectious diseases, which limits their ability to handle noncommunicable diseases. Primary healthcare facilities frequently lack the necessary supplies, diagnostic equipment, and skilled personnel to adequately treat chronic non-communicable diseases [33].

Table 2: Changes in Dietary Patterns – Traditional vs. Modern Diets in Nigeria

Dietary Aspect	Traditional Nigerian Diet	Modern/Westernized Nigerian Diet
Carbohydrates	Yam, cassava, millet, plantain	White bread, pasta, pastries, refined sugar
Proteins	Beans, lentils, fish, goat meat	Processed meat, sausages, fried chicken
Fats and Oils	Palm oil, groundnut oil (used in moderation)	Margarine, deep-fried fast foods, vegetable oils
Fruits/Vegetables	Seasonal, fresh, locally grown produce	Low intake, reliance on canned or fast-food substitutes
Eating Habits	Home-cooked, communal meals, low frequency of snacking	Frequent snacking, fast food culture, sedentary lifestyle

The relationships between under-nutrition and over-nutrition.

Over-nutrition and under-nutrition coexistence in West Africa is not bounded to a statistical anomaly but unveils three-legged structural inequalities namely; poverty, food insecurity, and lack of quality of health services. Such reciprocal issues establish the environment where low-income households are forced to consume mainly of foods of poor nutritional quality that is cheap in price and has high energy density, with insufficient exposure to health resources and nutrition-related education, and safe conditions that encourage participation in regular physical activities. As a result, societies are faced with the dilemma of being undernourished especially in children and simultaneously increasing prevalence of overweight and obesity among adults. Urban and rural populations in West Africa have problems with food insecurity and poverty in their health profiles. In the Republic of Mali, part of the population (18 % of the individuals in the rural population and 13 % of those in the urban environment) is underweight, in contrast to that found in the Vietnamese Republic (7.5 % of urban households and 5.6 % of their rural counterparts). There are over 31.8 million acute food insecure people in Nigeria and in the Ibadan slums, the percent of households with young children who are food insecure is 93 percent as compared to 68 percent in surrounding rural locales. In rural areas in Burkina Faso, the level of poverty is still very high over 35 % and male and female malnutrition as well as child malnutrition are alarming. Poor families, especially in urban slums, may not be able to access adequate, nutritious food and may depend on inexpensive, highly processed foods of low nutritional worth and high energy density. At the same time, these households can experience difficulties gaining access to health services, nutrition education, and safe places for physical activity, which can lead to undernutrition and obesity [35].

Moreover, the nutrition transition is usually complicated by the existence of gender roles in West Africa. Women, who are largely responsible for household food preparation, experience obstacles in obtaining nutritious foods because of financial difficulties, time shortage and lack of knowledge on healthy eating [36]. In some cases, the women might focus on the nutritional needs of their children or other family members but neglect their needs, leading to a higher prevalence of quiet hunger (micronutrients deficiencies) among adult ladies while also contributing to rising obesity in certain populations.

Shifts From Traditional to western diet.

The traditional staple diets of the West African people included millet, sorghum, cassava, yams, plantains, beans, and leafy-vegetables [38]. Such foods are nutrient-dense and they offer vital vitamins, minerals and fibre. Protein sources were majorly legumes, nuts, seeds, and animal-based products such as fish, chicken, and small ruminants [38]. Such diets were also low in fat and sugar and majority of calories were obtained from carbohydrates.

The introduction of western styles of diet (processed meats, refined grains, sugary drinks, fast food, and snacks) has brought about increased consumption of unhealthy fats, too much sugar, and added salt [39]. The availability and affordability of processed foods, which are aggressively marketed to urban populations, are the main factors for these dietary shifts. These foods have become attractive due to convenience and ease of preparation particularly in towns where lack of time coupled with busy lifestyles, and changing work patterns make it difficult for preparation of traditional meals [39].

The rising trend of fast-food outlets, supermarkets and street vendors have increased the availability and access of these processed foods. With the increasing number of people living in urban areas, the traditional sources of foods are often replaced by these new food environments [40]. Research conducted on urban centers in Lagos, Accra and Dakar has been revealing a significant increase in the consumption of highly energy- but low nutrition dense foods by both adults and children. This shift in diet has also been associated with increased rate of obesity, Diabetes, hypertension and other NCDs, induced by diet.

2.2 Dietary Transitions and Their Health Impacts in West Africa

The shift from more traditional forms of diet to more Western, highly processed diets in West Africa has grave implications on the health of the people [37]. As the countries in the region undergo rapid urbanization, globalization and socioeconomic changes, the dietary change has caused significant impact on public health. Although traditional diets in West Africa are generally high in plants, whole grains, and locally grown veggies, the increased intake of processed energy-dense foods (high in fats, sugars, and salts) has brought a range of health issues [37].

Micronutrients Deficiencies and Their Implication to Health

Together with the growing intake of processed food, a micronutrient deficiency emerges as a key public health challenge in West Africa [41]. Even with processed, packaged foods available, many of these products lack the essential vitamins and minerals. This leads to mass hidden hunger, which is a malnutrition in which people might have an appropriate number of calories consumed but do not consume enough micronutrients.

Iron deficiency causing anaemia is also among the common micronutrient deficiencies in the region affecting both women and children [28]. Anaemia may lead to fatigue, reduced immunity and impaired cognitive and physical development of children. Just the same, there is vitamin A deficiency, which is a major problem especially for children below five years, causing night blindness and making children prone to infections and even death [29]. The consumption of low micronutrient value processed foods worsens these deficits.

Another common problem in various regions of West Africa is the iodine deficiency, leading to goiter and cognitive impairments, in spite of worldwide efforts for increasing the level of iodization of salt [29]. Zinc deficiency, which leads to immune dysfunction, and increased susceptibility to infections is common, particularly among children and pregnant women. The increased dependence on highly processed foods that have minimal nutritional value exacerbates the rates of these deficiencies.

Impact on Non-Communicable Diseases (NCDs)

The health consequences of such dietary shifts are far-reaching and with the trend increasing, the burden of non-communicable diseases (NCDs), like obesity, type 2 diabetes, hypertension, cardiovascular diseases, and even cancers, is on the rise. [42]. About 6.2% of individuals in West African cities have type 2 diabetes, which is more than twice as common as the 2.5% prevalence in rural settings [29]. In Senegal, 9.7% of workers in the private sector had diabetes and 24.1% had hypertension [30]. In Nigeria, between 8% to 22% of adults are obese, while 30% of adults nationwide suffer from hypertension, with greater rates found in urban areas [31][32]. Furthermore, 43% of adults in the region had hypertension, with greater rates found in metropolitan areas [33]. These sicknesses, which at one time used to be known to be rare in the region are now among the major causes of death and disability.

Recent evidence indicates that a migration from low-calorie, traditional eating patterns toward high-calorie regimens enriched with fats and sugars has contributed to the escalating prevalence of overweight and obesity across West Africa [43]. In Ghana, the proportion of overweight and obese adult women rose from 13 % in 1993 to nearly 40 % by 2014 [31]. A 2020 national survey in Nigeria reported that 28.9 % of adult women were overweight or obese [32]. In Senegal urban obesity rates among women have steadily risen, reaching over 23 % in recent years [33]. Such trends highlight the increasing burden of over nutrition especially on the urban population. A 2024 meta-analysis of 31 studies (n = 48,809) found that high salt intake increased hypertension odds by 25 %, while junk-foods elevated risk by 41 %, compared to low consumers [34]. Urban Nigerians average 5.8 g/day of salt, exceeding WHO recommendations and face higher hypertension rates due to processed foods, bread, and condiments [35]. Additionally, excessive dietary fats and red-meat consumption in the region were associated with 76 % and 51 % increased odds of hypertension, respectively [34]. With more people becoming affected by these chronic diseases, pressures on the healthcare systems of these regions are mounting, especially where resources are scarce.

Long-Term Health consequences

The long-term effects of these dietary changes are concerning. West Africa faces a future marked by increasing incidence of chronic morbidities linked to malnutrition [45]. Such diseases are mostly preventable by changing their diet but eating of processed foods and the sedentary way of life are major impediments.

Economically disadvantaged groups in West Africa bear a disproportionate share of the burden of NCDs, which exacerbates cycles of poverty and ill health [46]. Families are forced to take money away from basic necessities like food, housing, and education in order to pay for the management of chronic illnesses, which exacerbates socioeconomic vulnerabilities. Furthermore, there are significant economic ramifications to the nutrition change. NCDs undermine economic development and productivity by lowering workforce participation through disease, incapacity, and early death. The region's already meager public health funds are under unsustainable strain due to the growing expenses of treatment.

2.3 Interventions and Policy Responses

In the context of the nutrition transition, which is gaining pace in West Africa, there is an increasing need for effective interventions and policy responses to manage the increasing burden of nutrition-related diseases [47]. Governments, health organizations, and community groups must work together to create and initiate strategies that will help to promote better diets, enhance access to nutritious foods, and promote healthier lifestyles [63]. A multifaceted strategy that integrates public health education, regulation of the food environment, and offering the requisite improvement in the healthcare infrastructure is necessary to address the complex challenges associated with nutrition-related diseases in the region.

Public Health Education and Awareness Campaigns

Public health education is one of the most important steps in addressing the health implications of nutrition transition. Teaching the population about the need to have balanced and nutritious diets and also consequences of unhealthy eating habits is vital in creating behavioral change [64]. Public health campaigns should be aimed at different demographics such as children, parents, adolescents, and adults to create awareness on the dangers of the overconsumption of processed foods, sugary drinks, unhealthy fats amongst them.

School-based nutrition education programs have been found to be very efficient in propagating healthy eating habits among the young people [65]. Such programs can educate children about the nutritional value of traditional foodstuff, the need to eat a variety of fruits, vegetables, and dangers of overindulging on junk foods and sweets. In several areas across West Africa, schools are used as the point of contact through which information reaches large numbers of the population thus making them an ideal location for nutrition education [66]. For example, school feeding programs that provide balanced meals to students can also include nutrition education, helping children learn about healthy eating habits.

Community-based measures also have an essential contribution to promoting behavior change especially in low-income and rural settings [67]. Community health workers and local leaders can play a crucial role in promoting nutrition education among the people. Such programs can target breastfeeding, appropriate complementary feeding practices, and healthy cooking practices. Furthermore, community-oriented nutrition counseling can be provided for families facing malnutrition or prone to diet-related ailments, so that realistic measures can be taken to improve their nutrition according to their particular socio-economic situations [67].

Regulation of the Food Environment

The West African food environment is crucial in determining dietary patterns. With increasing adoption of the Western-style diets, availability of processed foods, sugary drinks, and fast food has risen dramatically, especially in cities [39]. To counter adverse health effects of these foods, the governments can control food environment through policies that encourage healthier food choices and restrict advertisements on unhealthy foods.

One successful way of regulation is nutritional labeling, which can be helpful to the consumers in making a choice of purchase on their foods [68]. Concise, easy-to-read labels that accentuate important nutritional aspects e.g., calorie content, levels of sugar, fat content, and sodium can enable consumers to make better choices [69]. In several high-income nations, the implementation of traffic light labeling systems—which designate goods as green (healthy), amber (moderate), or red (unhealthy)—has improved customer choices. Its efficacy is not certain in all contexts, though, especially in areas with poor literacy rates, little nutrition education, and lax enforcement of regulations. To guarantee that labeling is both visible and meaningful to consumers in West Africa, effective adaptation would include public awareness efforts, culturally appropriate messaging, and cooperation with food producers and retailers [53]. Another essential intervention is the limitation of marketing of unhealthy foods, especially to children. In various countries, the marketing tactics greatly target the youth-promoting sugary snacks and beverages, which may

impact their likes in food and eating habits [70]. Governments can implement policies that restrict or regulate advertisements on unhealthy foods especially through television, social media and schools. Although numerous nations, like the UK, Chile, and South Korea, have banned junk food advertisements to children, with some reports of effectiveness in lowering the amount of unhealthy food marketing that children are exposed to, the system has not always worked. Children are still exposed to internet advertising through unregulated sites in many places where control is still lax. Potential advantages may be investigated in the West African environment, but in order to overcome enforcement obstacles and media saturation, any such intervention would need strong regulatory frameworks, media monitoring, and public-private collaboration [54].

Promotion of Traditional Foods and Local Agriculture

Promoting indigenous locally produced foods is an important prevention strategy for both undernutrition and overnutrition in West Africa [71]. Certain traditional diets, which are typically nutrient-rich and varied, can be adopted as healthy options for foods that have been processed. Speaking of the power of collectivity, various governmental, NGO, and community organizations could work together on enhancing the visibility and appeal of local foods via public awareness campaigns and local marketing initiatives. For instance, initiatives may focus on the health advantages of fermented foods, whole grains, and legumes – staples of most West African diets [38].

Encouraging the agriculture at a local level is also crucial to ensure better diets. As smallholder farmers are essential for food production in the West Africa region, they should receive tools and resources to produce a diverse range of nutrient-rich foods. Agricultural policies that promote sustainable agriculture, facilitate access to quality seeds, fertilizers and irrigation systems can support food security and availability of nutritious foods in the local markets [72]. Furthermore, the agro-processing programs that promote the processing and preservation of local foods in a way that does not alter its nutritional value can also generate new economic opportunities and promote public health. In addition, the government should support urban farming and community gardens, which can make fresh, cheap, and nutritious food accessible to urban populations, and promote community-based food production [73]. Such initiatives can also be used to teach people on healthy food choice and the need to adopt sustainable diets.

Healthcare System Strengthening and Integrated Nutrition Services

In order to respond to the growing trend of nutrition-related diseases, healthcare systems in West Africa need to be improved to deliver complete, integrated nutrition services [74]. This entails increasing access to primary healthcare services that are directed towards prevention and cure of nutrition related diseases. Health facilities should be able to screen for diet related diseases like obesity, diabetes and hypertension and offer management and treatment provisions to those affected.

Nutrition counselling and support training health workers is crucial towards improving outcomes. Family physicians, nurses and nutritionists should undergo training to check the nutritional status of patients, advise them on healthy food choices [75]. Furthermore, the integration of nutrition can help in combating malnutrition and promote early childhood development in maternal and child health programs.

Universal coverage of health policies is also essential in ensuring that individuals have access to required healthcare services to manage nutrition-related diseases. Governments should be able to subsidize the cost of treatment for such conditions as diabetes and hypertension, so that low-income families can access treatments [76].

Collaborations and Multi-Sectoral Approaches

The nutrition transition in West Africa can only be curbed through a multi-sectoral approach that incorporates all the stake holders such as governments, international organizations, private sector and civil society [77]. Pursuits of health and welfarism, agriculture, education, and finance sectors need to cooperate to generate policies that address the underlying reasons of both under and overnutrition.

International organizations like the World Health Organization (WHO), World Food Program (WFP), and local authorities can cooperate to harmonize nutrition-related strategies to larger development aims [66]. Collaborations with private sectors can also be very essential especially in enhancing labeling of food and enhancing healthier food products while ensuring that healthier food products are affordable and accessible.

3. BROADER HEALTH AND SOCIOECONOMIC CONSEQUENCES OF NUTRITION TRANSITION IN WEST AFRICA

3.1 The Double Burden of Malnutrition (undernutrition and overnutrition)

As earlier defined, the double burden of malnutrition remains a pressing concern, particularly in urban Nigeria and Ghana [42]. This dual challenge has become more pronounced in West Africa as countries have become fast nutritional transition due to urbanization, economic development and globalization.

Undernutrition has been the biggest nutritional issue in West African nations in the past [78]. High levels of food insecurity, poverty, substandard sanitation, and inadequate health services provision have sustained chronic malnutrition, particularly among under-five children and women of childbearing age. The Global Nutrition Report of 2022 states that stunting rates in some West African countries still surpass 30%, and micronutrient deficiency, such as vitamin A and iron deficiency, is common and associated with increased morbidity and mortality rates.

At the same time, there has been an upsurge in cases of overweight and obesity especially in urban populations of the region. Adoption of cellular lifestyles, limited physical activity, and high intake of energy dense low-nutrient foods have played a major role in this increase of obesity. Disturbingly, this trend has extended beyond affluent populations. low- and middle-income households are now equally affected mostly because of the affordability and availability of ultra-processed foods [79].

Such a double burden presents major policy and programmatic challenges. Governments will need to allocate resources and design interventions that solve both ends of malnutrition without one outdoing the other [80]. For example, school feeding programs should aim to prevent hunger while promoting dietary diversity and long-term nutrition education to reduce future obesity risk. Combining nutrition-sensitive agricultural programs with public health approaches is critical to achieving food security as well as teaching healthy eating practices.

The double burden of malnutrition requires a careful analysis of its social determinants [30]. Dietary behavior and health outcomes are all affected by poverty, education, gender inequalities and urban-rural disparities. The strategies hence have to be multisectoral, culturally sensitive, and inclusive such that both under- and over- nutrition are systematically addressed among all strata of the population [42].

3.2 Rising Prevalence of Non-Communicable Diseases (NCDs)

Prolonged nutrition transition in West Africa has contributed to unnerving increase of non- communicable diseases (NCDs) such as cardiovascular diseases, diabetes mellitus, cancers and chronic respiratory diseases. These conditions, previously regarded as diseases of affluence or aging, disproportionately affect younger economically active populations in low- and middle-income countries (LMICs) such those present in West Africa [81]. The epidemiological transition from communicable to non-communicable diseases is highly linked with change in dietary patterns, physical inactivity and wider socioeconomic changes.

The practice of consuming energy dense, nutrient poor foods –high in sugars, saturated fats and sodium – is increasingly common in urban and peri-urban areas [82]. Combined with decreased physical activity because of sedentary work places, mechanized transport, and screen-based leisure, these dietary changes have contributed greatly to the increased risks of obesity, metabolic syndrome and hypertension. According to a review by Agyemang et al. (2020), there is an increasing disease burden from hypertension and diabetes in urban people of Ghana and Nigeria. For the populations, the sedentary lifestyles lead to the development of disease risk factors.

What is most alarming is silent development of these conditions with undiagnosed or poorly managed cases, which are due to poor access to health care services, inadequate testing facilities, and the lack of public awareness [83]. In various areas across West Africa, health systems are still organized primarily to fight against Infectious diseases and maternal-child health problems with little attention to NCDs. This has created a scenario where patients keep reporting to health facilities at worst stages of disease which is contributing to increasing mortality and disability-adjusted life years (DALYs).

Apart from the personal impacts on health, the impact of NCDs on the pocket of families which are affected and the national healthcare bills is staggering [84]. Chronic illnesses require long term management, frequent checkups, and in most cases costly drugs, putting an unsustainable strain on overstretched health facilities and poor homes. The economic loss caused by NCDs in sub-Saharan Africa is expected to be predicted by the World Health Organization (WHO). This could reach hundreds of billions of dollars in the coming decades if current trends continue unchecked [81].

Social and cultural perceptions make an already complex situation even more complicated. Obesity has a variety of cultural frame in the West African societies where the ailment continues to represent well-being, prosperity, beauty, and fertility particularly to women. In Nigeria, Ghana, and Senegal, for instance, an expanded physique is periodically interpreted as evidence that an individual is well-nourished, economically secure, or otherwise shielded from disease, particularly within rural or traditional settings [55]. This cultural construction undermines the felt cultural compulsion to deal with obesity as a challenge to public-

health. As a result, individuals with the condition might not recognize the existence of their weight condition as an issue, whereas policymakers might prioritize actions to tackle other, more apparent, or established health-related conditions, including infectious diseases or undernutrition. Public-health communications that neglect these cultural assumptions tend to encounter resistance or insufficient uptake by local populations [56]. In addition, low health literacy and traditional views may ensure the inadaptability of dietary and lifestyle changes required for NCD prevention and control [85].

In line with combating the increasing burden of NCDs, integrated ways are needed fast. This entails fortifying primary healthcare systems for early diagnosis and intervention, increasing health education campaigns that are context-specific as well as introducing fiscal and regulatory measures like sugar-sweetened beverages taxes and front-of-pack nutrition labeling. Policymakers must also work inter-sectorally especially in agriculture, urban planning and education, to develop enabling environments that promote healthy choices of foods and active lifestyles [86].

3.3 The Socioeconomic Burden of Nutrition-Related Diseases

The nutrition transition in West Africa, characterized as changes from traditional to Western-style diet, has contributed to an alarming rise of nutrition-related diseases, the forms of undernutrition or overnutrition [47]. Such diseases cause a huge weight on the social-economical side of the region as it also influences the sphere of economic development. This impact will be manifested through the increase of costs of healthcare, the decrease of workforce productivity and the overall consequences for the national economies [48]. With rapid urbanization and diet change in the region, the economic implication of these diseases has become an important consideration for policymakers, healthcare providers, as well as for communities.

Economic Impact of NCDs (Non-Communicable Diseases)

Non-communicable diseases (NCDs), such as obesity, type 2 diabetes, hypertension and cardio-vascular diseases, are becoming important community health problems in West Africa [49]. The increasing incidence of these diseases is a significant economic burden to the individuals and as well the society. The care and management of NCDs are costly, and with the fast-growing number of persons affected by the diseases, the resulting pressure is piling onto already under-pressure healthcare systems in the region [50].

The cost of healthcare for NCDs includes direct (hospital admission, consultations and drugs) and indirect (missing work and effects on the economy). In most West African countries, there is inadequate healthcare systems to meet the long-term needs of the people who suffer from chronic illnesses [51]. Lack of specialised healthcare professionals and access to limited advanced medical treatment spells out the challenge for providing appropriate management of these conditions.

Furthermore, the majority of those with NCDs cannot work due to their health condition (loss of income and productivity) [52]. It does not only bear the impact on individuals and the families but has further implication at the national economy levels. In countries with a high prevalence of obesity and diabetes, expenditures towards the treatment of these diseases account for a massive proportion of the public health cost. For example, in Nigeria, the cost of treating diabetes has been estimated to be several times higher than the cost of treating infectious diseases which are obvious burdens of NCD's placed on the healthcare system [51].

Impact of Malnutrition on Productivity

Both undernutrition and overnutrition are forms of malnutrition that disproportionately affect vulnerable groups in West Africa particularly in low-income rural communities and urban slums [53]. These nutritional imbalances reduce physical capacity, increase illness-related absenteeism, and lower productivity, especially among women, children, and the working-age population in countries like Nigeria, Mali, and Burkina Faso [36, 37, 38]. Chronic undernutrition, with particular emphasis on children, has strategic effects on the labor force. Children who experience stunting and wasting in their early stages of life are more likely to develop cognitive and physical delays that could contribute to poor performance in school and poverty in terms of jobs in later years of life. Stunted children have few prospects of becoming what they can be and, therefore, have no chance of making positive contributions to the economy as adults [54].

These nutritional deficits are usually greater in low-income communities where access to a variety of nutritious foods is limited. The subsequent poor health outcomes can further become self-perpetuating avenues leading to cycles of poverty in that people cannot achieve their full economic potential because they are not well nourished during their crucial periods of growth and development [55]. Studies show iron-deficiency anemia reduces adult productivity by up to 20%, while childhood stunting can result in 22% lower adult income [55].

Obesity and associated NCDs cause absenteeism at work because of ill health and early retirement arising from disability or death [56]. The workers who are obese in nature and suffer from its associated afflictions are likely to be less productive and demand more regular medical interventions, increasing the costs to the employer and the national economy [57].

Healthcare Costs and Burden on the Health System

The rising prevalence of nutrition-related NCDs places a significant strain on healthcare systems in West Africa. In many countries, health budgets are limited, and resources are primarily allocated to combatting infectious diseases, such as malaria, HIV/AIDS, and tuberculosis, which have historically been the main health threats in the region. According to WHO (2022), treating NCDs in low-resource countries consumes 25–40% of annual health budgets [58]. However, the increasing burden of NCDs necessitates a shift in focus and resource allocation. The effective management of NCDs demands sustained care, specialized treatment, and significant investment in healthcare infrastructure including medical equipment, trained personnel, essential medicines, and robust public health campaigns. The treatment costs of NCDs are frequently shouldered disproportionately by the individual and the family, particularly in countries that are unable to provide universal healthcare [59].

For instance, in Nigeria, approximately 80–90% of healthcare spending is financed through out-of-pocket payments, only about 17–19% of the population has health insurance forcing many citizens to bear medical costs themselves and sustaining a heavy financial burden on households [52]. In addition to the direct costs there are heavy indirect costs including the economic burden of premature deaths and the disability due to NCDs. Families affected by such diseases might experience catastrophic costs associated with treatment, resulting in rising poverty levels especially in low income households [60].

Additionally, the burden of malnutrition on the healthcare remains not just for the NCDs, but also includes expenses to address infectious diseases, as those that are undernourished are prone to infections [25]. The relationships between malnutrition and infectious diseases form a vicious circle as malnutrition worsens the effects and prolongs the infections, increasing the healthcare costs and extending the recovery periods. This cycle makes healthcare systems, which are already underfunded and overwhelmed, even more stressed.

Social Inequalities and Access to Healthcare

Social inequalities also influence the socioeconomic impact of nutrition-related illnesses. High levels of disparities in wealth and unequal access to healthcare in many West African countries worsen the impact of malnutrition and chronic diseases [53]. Richer individuals are better able to afford nutritious food, healthcare services, and health education to mitigate the adverse health outcomes of undernutrition as well as overnutrition. In turn, low-income households lack access to nutritious, affordable foods and end up relying on cheap, calorie-dense processed foods, which lead to obesity and other illnesses [61].

Food insecurity is especially high among the rural populations who are less likely to have access to healthcare facilities. Furthermore, the absence of infrastructure (such as reliable transportation and communication networks) makes it further challenging to access health services [62]. Though urban areas are better provided with healthcare facilities, there is also a great disparity in healthcare access in urban areas, with otherwise marginalized groups – including migrant populations, and low income workers – left behind, in terms of health outcomes.

3.4 Influence on maternal and child health

The nutrition transition in West Africa has far reaching consequences for maternal and child health, since the two populations (maternal and child) are highly vulnerable and their nutritional status directly determines generational health outcomes [87]. Both undernutrition and overnutrition have increased as a result of the switch from traditional, nutrient-dense meals to high-energy, processed foods that are frequently deficient in vital micronutrients. This tendency is especially noticeable in young children, pregnant women, and adolescent girls, and it causes a complicated array of health issues in these susceptible populations.

Maternal malnutrition, has grown more widespread in urban and peri-urban settings throughout West Africa [88]. Underweight pregnant women have an increased likelihood of giving birth to low birthweight (LBW) infants who are likely to have stunted growth and a weakened immunity, and are at high risk of infections. On the other hand, overweight and obese mothers are at increased risk of gestational diabetes, hypertensive disorders, and birth complications (e.g., higher rates of cesarean delivery). Furthermore, the excessive weight gain during pregnancy correlates with the large-for-gestational-age new-borns that are at higher risk of childhood obesity and abnormal metabolism in adult age.

The first 1000 days from conception to a child's second birthday are especially crucial period for determining long term health. Inadequate maternal nutrition during pregnancy and lactation can result in fetal growth restriction, poor brain development, and poor immune function [89]. Moreover, the high level of the consumption of nutrient-poor complementary foods for infants

(especially in the urban), continues to lead to malnutrition in early childhood especially stunting and overweight. This dual burden can be seen in many West African countries, where children are chronically under nourished and they are also exposed to high calorie but low nutrient foods.

The nutrition transition has also affected the breastfeeding practices [90]. Although exclusive breastfeeding is still the most recommended and affordable form of infant nutrition, its practice has been gradually decreasing in certain urbanized settings because of extensive marketing of infant formula, increasing maternal employment without supporting work environments, and misconceptions about the benefits of breast milk [90]. Inadequate breastfeeding is linked to high risks of infant death and infections and long-term health problems, including obesity, and type 2 diabetes.

Intergenerational cycle of malnutrition is another great issue. Malnourished adolescent girls are likely to become malnourished mothers, thus contributing to the cycle of poor birth outcomes and underdevelopment, and risk of chronic disease. In a West African country where adolescent pregnancy is still a common phenomenon and health services are not always available, interrupting this cycle is particularly difficult.

Besides physiological outcomes, maternal and child health is also influenced by broader determinants (such as education, income, access to healthcare and food security) [91]. Women who have little educational achievement and come from low socioeconomic status are more likely to have unbalanced diet, there is low access to prenatal care and they experience environments that do not support healthy life styles. Poor healthcare structure of our society especially the rural and underserved areas compounds the disparity of maternal and child nutritional outcomes.

Targeted interventions are needed in order to address these challenges. This involves; instituting nutrition-sensitive antenatal care services, enhancing optimal breastfeeding and complementary feeding approaches and increasing access to fortified foods and micronutrient supplements for both the mothers and children. Community based public health initiatives that can educate the populations about the need for maternal and child nutrition, as well as policies that provide for maternity leave and workplace breastfeeding facilities can achieve considerable change [92].

3.5 Healthcare Systems and Economic Burden

The nutrition transition in West Africa has not only changed taste and health outcomes but has added significant pressure onto overburdened healthcare systems and national economies [79]. The increasing burden of diet-related non-communicable diseases (NCDs) in addition to long-standing issues of undernutrition, has revealed the underlying weaknesses in healthcare delivery, financing and workforce capacity for the regions. The subsequent dual burden of disease is highly inappropriate for healthcare infrastructure, public health systems, and household budgets.

Health systems in West African countries have been historically focused in containing infectious diseases, maternal and child public health threats and public health emergencies [45]. Consequently, they are not prepared to address the growing burden of chronic conditions including hypertension; diabetes; cardiovascular diseases and cancers, all which require long term care, monitoring, and management by different specialists. Nearly all primary care centers are deficient in key diagnostic equipment and drugs as well as adequately trained manpower to adequately handle NCDs, especially in rural regions where specialized services are practically inaccessible.

This shortcoming in healthcare systems has far reaching consequences regarding early detection and management of nutrition-related disease [93]. A large number of the people living with NCDs are never diagnosed until they suffer complications, which lead to hospitalization, disabilities, and premature death. The undernutrition continues to require attention, especially among children and women at low-income communities. This means that healthcare providers are usually entangled in reactive cycle as they attend to crises at the expense of preventive care and chronic disease management.

The nutrition transition also has a significant financial cost. At the national level, governmental bodies experience a rise in healthcare cost on acute and chronic care of the disease. In many West African countries with small healthcare budgets, monies devoted to treating diet-related illnesses deplete available resources for other public health programs [94]. The World Bank-aligned WHO report projects that by 2030, the economic burden of NCDs in sub-Saharan Africa stemming from lost productivity, mounting medical costs, and premature mortality could surpass Int\$1.1 trillion per year [61].

At a household level, the cost of living with chronic illnesses is devastating. Without universal health coverage, social protection schemes, families often rely on cash payments for consultations, medications, laboratory tests and hospitalizations. This cost of care can cause catastrophic health expenditure aggravating the poor further [53]. This situation is especially dire for low-income families who have to decide whether to pay for healthcare or satisfy basic needs like food, housing or education.

Further, the disease burden is exacerbated where there is a decline in workforce productivity resulting from diet-related illness and disability [56, 95]. Affected workers with NCDs themselves may suffer a loss of labor capacity, or forced early retirement; and caretakers, usually women, take time and resources away from their own pursuits to tend to sick relatives. Its ramifications extend to national economic growth, especially in countries where agriculture and the informal market within which agriculture plays a major role drive the economy. West African nations continue to rely significantly on out-of-pocket payments and underfunded primary care, in contrast to nations like the United Kingdom and Canada, where NCDs account for almost 80% of total health spending and are controlled through well-structured primary care and universal coverage. This discrepancy emphasizes how urgently LMIC systems need to be strengthened [45, 79].

4. POLICY RESPONSES AND COMMUNITY-BASED INTERVENTIONS

The complex nature of the nutrition transition in West Africa demands complex responses. Public health interventions should be integrated in national frameworks that are practical and driven by community-initiated efforts. This section analyzes the variety of responses at both the policy and grassroots initiative taken to alleviate negative effects of dietary shifts and enhance nutritional outcomes. Although things have improved, systemic issues still exist—inadequate funding, non-integrated implementation, and minimal data to inform decisions.

4.1 National Policy Frameworks and Strategic Plans

To the rising prevalence of undernutrition and NCDs of dietary origin, some West African countries have adopted national nutrition policies, as well as multisectoral strategic frameworks [96]. These policy documents corresponding in most cases with global goals such as the sustainable development goals (SDGs), are geared towards enhancing food security improvement, dietary diversification, and provision of the essential health and nutrition services.

An example is Nigeria's National Policy on Food and Nutrition and its Strategic Plan of Action (2016–2020) which highlight government's intent on battling malnutrition by using the multisectoral approach. The plan prioritizes food fortification, maternal and child health services and nutrition sensitive agriculture[97]. Ghana's National Nutrition Policy (2014–2017) describes approaches in different sectors in order to work toward reducing stunting, anemia and the increasing burden of obesity and NCDs. These national papers identify a role of nutrition in bringing about wider development objectives such as education, economic productivity, and gender equality.

Only, however, the implementation of these policies is repeatedly frustrated by lack of financial resources, weak institutional capacity, and inconsistent political will. Monitoring and evaluation mechanisms often lack, and thus it is difficult to monitor and adjust interventions, based on the trends that are evolving. Numerous programs are still too centralized, lacking community involvement and failing to adapt to local contexts [98] Improving these policies will require increased investment, and a much deeper collaboration between the sectors and levels of governance.

4.2 Food environment rules and fiscal policies

Food environment mastering plays a vital role in limiting the intake of unhealthy food and increasing the uptake of healthy foods. Policy instruments like food labeling, advertising control, and taxing on sugar-sweetened beverages (SSBs) have already been or proposed in different countries around the world – and are now gaining momentum in West Africa [99]. Fiscal measures are one of the strongest instruments for affecting consumer behaviour. South Africa's Health Promotion Levy implemented in 2018 is a tax on sugary beverages has produced measurable reductions in consumption of SSB and calories. Inspired by these examples, West African policy makers are now more and more interested in similar taxes. In Nigeria there has been calls for a tax on sugary drinks, and some states have already implemented taxes on alcohol and tobacco. Although these endeavors are in the early stages, they promise to be tools to shift dietary patterns [99].

A Nutrition Facts label is also a very important improvement. Visible labels on the front of foods make it easier for consumers to make healthy decisions and can motivate makers of foods to change their ingredients. In contrast, food labeling policies in West Africa are frequently not well made or applied [47]. Many members of the public do not fully understand what the nutritional labels on products mean. Governments are not taking advantage of marketing restrictions designed to safeguard children from too many unhealthy food promotions. Television, online ads, and school connections are being used by processed food and beverage companies to target children. Since there are few strong laws and enforcement, it is hard to stop these practices. The improvement and enforcement of these rules will depend greatly on both civil society and regional collaboration.

4.3 School- Based Nutrition and Physical activity program

Schools can help encourage kids and young people to lead healthier and more nutritious lives. With proper design, school feeding supports better brain development, helps fight instant hunger, and motivates students to attend school regularly in areas where food is scarce [100]. If combined with information on healthy eating and exercise, these programs may lead to lifelong healthy lifestyle changes.

Different school-level projects have been set up in West African countries. In 2005, Ghana started the School Feeding Programme to give one daily hot and nutritious meal of local produce to students attending basic public schools. Likewise, Nigeria's Home-Grown School Feeding Program brings together small farmers and school meal suppliers to help farmers and ensure children get healthy meals

Still, school feeding programs encounter many obstacles. The money supporting school meals is not always secure, the school buildings are not very good, and school meals often lack nutrients and variety. There is little monitoring, and occasionally, food safety can be affected [101]. Often, nutrition education is either ignored or taught in an unreliable manner. To reach their goals, school programs should work with detailed curricula, skilled teachers, and involve parents. more efforts are needed so children can play safely and get access to clean water and sanitation.

It is very important to make sure nutrition is included in both national education standards and teacher training. Students should gain knowledge about food, health, and the environment, in addition to getting their meals at school. Healthy living can be taught by organizing gardening activities, holding cooking lessons, and including physical exercise.

4.4 Community-Based Interventions and Health Promotion

At the community level, interventions make it possible to personalize national policies. They usually provide a better fit, are culturally acceptable, and work for the needs of the community. They encourage traditional leaders, groups for youth and women, and religious organizations to teach about good nutrition and call for responsible action from those in charge of health services.

Nutrition interventions in West Africa depends greatly on the work of community health workers. Since they live in the community, CHWs are able to give information on breastfeeding, feeding other types of food to infants, nutrition for women, and health care [103]. Having them involved is considered one reason for more people using healthcare services and for healthier changes in behavior. Nigeria's Community Infant and Young Child Feeding Counselling Package proves that CHWs can effectively deliver services that help many people using scarce resources.

With food prices varying a lot and supply chains being interrupted, more people have started urban agriculture and started gardening at home. They increase food and nutritional security for households and also bring the community together. Communicating health messages is increasingly done through mass media and mobile devices [104]. Educating people using radio dramas and text messages, along with social media ads, has had good results. One illustration is the Alive & Thrive initiative using mass media to make people in Burkina Faso and Nigeria aware of breastfeeding and complementary feeding [104].

However, sustainability remains a concern. Most community programs are funded by donations and usually run only for a short period. Most migrant health programs are not embedded in national health planning, and they often face staff departures, unreliable funding, and weak data collection. Long-term results are achieved by making successful models official, increasing local skills, and making the government responsible.

4.5 Multisectoral Collaboration and Capacity Building

Tackling nutritional changes needs cooperation from many areas outside of health. Food systems and people's eating habits are affected by changes within agriculture, trade, finance, education, and urban planning. Health care organizations require effective cooperation to achieve the same goals, share what they have, and avoid doing things twice. As a result of SUN Movement efforts, West African countries have created platforms that involve several stakeholders. On these platforms, the government, development groups, civil society, and businesses come together to act in a coordinated manner [105]. Effectiveness among these platforms is not consistent. In a number of cases, they face poor leadership, confusing roles, and minimal backing by politicians.

CONCLUSION AND FUTURE PERSPECTIVES

The nutrition transition in West Africa presents a complex public health challenge marked by the coexistence of undernutrition, micronutrient deficiencies, and a rising burden of diet-related non-communicable diseases. Driven by rapid urbanization, economic shifts, and changes in food systems, this transition has altered traditional dietary patterns, exposing populations to both high-calorie and nutrient-poor diet. While some improvements in food security and maternal and child health indicators have

been recorded, the overall landscape remains precarious, especially for vulnerable groups such as women, children, and low-income communities.

Efforts to address the nutrition transition have yielded mixed results. National policies and strategic frameworks reflect growing recognition of the need for multisectoral action, yet their implementation is often hindered by financial, institutional, and infrastructural constraints. Community-based programs, school interventions, and emerging food environment regulations offer promising models but require sustained investment, contextual adaptation, and rigorous evaluation to ensure impact and scalability.

Looking ahead, nutrition in West Africa hinges on a coordinated, evidence-based approach that bridges health, agriculture, education, and economic policy. Strengthening governance, enhancing data systems, and building capacity at all levels particularly within local communities will be essential. Equally important is the promotion of culturally appropriate, nutrient-rich foods and sustainable agricultural practices that prioritize both health and environmental resilience. In an era of increasing globalization, climate change, and demographic growth, West African nations cannot afford to delay. Now is the time to act decisively, to transform food systems, empower communities, and invest in bold public health strategies that secure the well-being and productivity of future generations.

REFERENCES

1. Popkin, B. M. (1993). Nutritional patterns and transitions. *Population and Development Review*, 19(1), 138–157. <https://doi.org/10.2307/2938388>.
2. Abu-Ouf NM, Jan MM. The impact of maternal iron deficiency and iron deficiency anemia on child's health. *Saudi medical journal*. 2015;36(2):146.
3. Adeomi AA. The Double Burden of Under-And Over-Nutrition Among School-Aged Children and Adolescents in Two Nigerian States (Doctoral dissertation, University of the Witwatersrand, Johannesburg (South Africa)).
4. Aderanti OT. Rural transformation and malnutrition: three essays on the influence of time use, physical activity, and diet on nutritional outcomes (Doctoral dissertation, University of Reading).
5. Adeyeye SA, Ashaolu TJ, Bolaji OT, Abegunde TA, Omoyajowo AO. Africa and the Nexus of poverty, malnutrition and diseases. *Critical Reviews in Food Science and Nutrition*. 2023 Feb 17;63(5):641-56.
6. AFRICA S. THE DOUBLE BURDEN OF MALNUTRITION. *The Routledge Handbook of African Demography*. 2022 Feb 7:436.
7. Agyepong IA, Sewankambo N, Binagwaho A, Coll-Seck AM, Corrah T, Ezeh A, Fekadu A, Kilonzo N, Lamptey P, Masiye F, Mayosi B. The path to longer and healthier lives for all Africans by 2030: the Lancet Commission on the future of health in sub-Saharan Africa. *The Lancet*. 2017 Dec 23;390(10114):2803-59.
8. Ajayi IO, Adebamowo C, Adami HO, Dalal S, Diamond MB, Bajunirwe F, Guwatudde D, Njelekela M, Nankya-Mutyoba J, Chiwanga FS, Volmink J. Urban–rural and geographic differences in overweight and obesity in four sub-Saharan African adult populations: a multi-country cross-sectional study. *BMC public health*. 2016 Dec;16:1-3.
9. Ajieroh V, Onabolu A, Ezekannagha O, Adeyemi O. Fostering an enabling environment for nutrition-sensitive agriculture and food systems in Nigeria. *Food and Nutrition Bulletin*. 2023 Sep;44(1_suppl):S3-13.
10. Akintimehin OO, Eyinla TE, Ibidapo EG, Abdulrahman MO, Oladipo DA, Akinyemi JO, Fayehun OA, Samuel FO. Interaction of Wealth, Residence and Region on Multiple Anthropometric Failure among Under-Five Children in Nigeria. *International Journal of TROPICAL DISEASE & Health*. 2025 Jan 3;46(1):21-31.
11. Akombi BJ, Agho KE, Hall JJ, Wali N, Renzaho AM, Merom D. Stunting, wasting and underweight in sub-Saharan Africa: a systematic review. *International journal of environmental research and public health*. 2017 Aug;14(8):863.
12. Ilo J, Kayode O, Jacob T, Oduntan B, Lawal R. Addressing malnutrition in Nigeria: a narrative review of causes, impacts, and pathways to nutritional resilience. *Journal of Research in Applied and Basic Medical Sciences*. 2025 Apr 10;11(2):163-75.
13. Anchang KY, Mbunwe TK. A stated preference discrete choice health literacy intervention framework for the control of non-communicable diseases (NCDs) in Africa. In *International Handbook of Health Literacy* 2019 Jul 31 (pp. 335-346). Policy Press.
14. Arena R, Guazzi M, Lianov L, Whitsel L, Berra K, Lavie CJ, Kaminsky L, Williams M, Hivert MF, Cherie Franklin N, Myers J. Healthy lifestyle interventions to combat noncommunicable disease—a novel nonhierarchical connectivity model for key stakeholders: a policy statement from the American Heart Association, European Society of Cardiology, European Association for Cardiovascular Prevention and Rehabilitation, and American College of Preventive Medicine. *European heart journal*. 2015 Aug 14;36(31):2097-109.
15. Audain K, Levy L, Ellahi B. Sugar-sweetened beverage consumption in the early years and implications for type-2 diabetes: a sub-Saharan Africa context. *Proceedings of the Nutrition Society*. 2019 Nov;78(4):547-53.

16. Aworh OC. An overview of West African traditional foods: Processing, safety and health benefits. *Nutritional and Health Aspects of Food in Western Africa*. 2024 Jan 1:1-8.
17. Azevedo MJ, Azevedo MJ. The state of health system (s) in Africa: challenges and opportunities. *Historical perspectives on the state of health and health systems in Africa, volume II: the modern era*. 2017:1-73.
18. Bailey RL, West Jr KP, Black RE. The epidemiology of global micronutrient deficiencies. *Annals of nutrition and metabolism*. 2015 Jun 1;66(Suppl. 2):22-33.
19. Baker P, Machado P, Santos T, Sievert K, Backholer K, Hadjikakou M, Russell C, Huse O, Bell C, Scrinis G, Worsley A. Ultra-processed foods and the nutrition transition: Global, regional and national trends, food systems transformations and political economy drivers. *Obesity Reviews*. 2020 Dec;21(12):e13126.
20. Balogun O. Women in Beauty Cultures and Aesthetic Rituals in Africa. In *Oxford Research Encyclopedia of African History* 2023 Aug 23.
21. Barrett CB, Bevis LE. The micronutrient deficiencies challenge in African food systems. The fight against hunger and malnutrition: The role of food, agriculture, and targeted policies. 2015 May 21:61-88.
22. Batal M, Deaconu A, Steinhouse L. The nutrition transition and the double burden of malnutrition. In *Nutritional health: strategies for disease prevention* 2023 May 11 (pp. 33-44). Cham: Springer International Publishing.
23. Batista MF, de Carvalho-Ferreira JP, Thimoteo da Cunha D, De Rosso VV. Front-of-package nutrition labeling as a driver for healthier food choices: Lessons learned and future perspectives. *Comprehensive Reviews in Food Science and Food Safety*. 2023 Jan;22(1):535-86.
24. Berkhout E, Sovová L, Sonneveld A. The Role of Urban–Rural Connections in Building Food System Resilience. *Sustainability*. 2023 Jan 18;15(3):1818.
25. Bishwajit G. Nutrition transition in South Asia: the emergence of non-communicable chronic diseases. *F1000Research*. 2015 Nov 24;4:8.
26. Bosu WK. An overview of the nutrition transition in West Africa: implications for non-communicable diseases. *Proceedings of the nutrition society*. 2015 Nov;74(4):466-77.
27. Busse H, Covic N, Aakesson A, Jogo W. What is the role of civil society in multisectoral nutrition governance systems? A multicountry review. *Food and Nutrition Bulletin*. 2020 Jun;41(2):244-60.
28. Casu L, Diatta AD, Uzhova I, Dramé M, Kaboré J, Touré F, Becquey E, Verstraeten R. Nutrition-relevant policy in West Africa: A comprehensive review.
29. Chadare FJ, Affonfere M, Aidé ES, Fassinou FK, Salako KV, Pereko K, Deme B, Failler P, Kakaï RG, Assogbadjo AE. Current state of nutrition in West Africa and projections to 2030. *Global Food Security*. 2022 Mar 1;32:100602.
30. Chaker L, Falla A, van der Lee SJ, Muka T, Imo D, Jaspers L, Colpani V, Mendis S, Chowdhury R, Bramer WM, Pazoki R. The global impact of non-communicable diseases on macro-economic productivity: a systematic review. *European journal of epidemiology*. 2015 May;30:357-95.
31. Tuoyire DA. Overweight/obesity among 15-to 24-year-old women in Ghana: 21-year trend, future projections and socio-demographic correlates. *Journal of Biosocial Science*. 2021 Nov;53(6):839-55.
32. Adeomi AA. The Double Burden of Under-And Over-Nutrition Among School-Aged Children and Adolescents in Two Nigerian States (Doctoral dissertation, University of the Witwatersrand, Johannesburg (South Africa)).
33. Hassan HK, Adigun OA, Manirambona E, Olaleke NO, Abioye MS, Lucero-Prisno III DE, Atewologun FA, Okesanya OJ. Mitigating the escalating threat of infectious diseases outbreaks in tropical Africa: a perspective examination of challenges and strategies for future preparedness. *Beni-Suef University Journal of Basic and Applied Sciences*. 2024 Jun 8;13(1):55.
34. Conrad Z, Kowalski C, Dustin D, Johnson LK, McDowell A, Saleses M, Nance J, Belury MA. Quality of popular diet patterns in the United States: evaluating the effect of substitutions for foods high in added sugar, sodium, saturated fat, and refined grains. *Current Developments in Nutrition*. 2022 Sep 1;6(9):nzac119.
35. Dall TM, Sapra T, Natale Z, Livingston T, Chen F. Assessing the economic impact of obesity and overweight on employers: identifying opportunities to improve work force health and well-being. *Nutrition & Diabetes*. 2024 Dec 4;14(1):1-8.
36. Doku DT, Neupane S. Double burden of malnutrition: increasing overweight and obesity and stall underweight trends among Ghanaian women. *BMC public health*. 2015 Dec;15:1-9.
37. Drewnowski A. Impact of nutrition interventions and dietary nutrient density on productivity in the workplace. *Nutrition reviews*. 2020 Mar 1;78(3):215-24.
38. Eckhardt GM, Bardhi F. New dynamics of social status and distinction. *Marketing Theory*. 2020 Mar;20(1):85-102.
39. Frumkin H, Haines A. Global environmental change and noncommunicable disease risks. *Annual review of public health*. 2019 Apr 1;40(1):261-82.
40. Gamos O. *Landscaping Study–Modern Foods*.
41. Garg RK. The alarming rise of lifestyle diseases and their impact on public health: A comprehensive overview and strategies for overcoming the epidemic. *Journal of Research in Medical Sciences*. 2025 Jan 1;30(1):1.
42. Glatzel K, Ameye H, Hülsen V, Qaim M. Changing food environments in Africa's urban and peri-urban areas: Implications for diets, nutrition, and policy. *ZEF Working Paper Series*; 2024.

43. Gorski MT, Roberto CA. Public health policies to encourage healthy eating habits: recent perspectives. *Journal of healthcare leadership*. 2015 Sep 23;81-90.
44. Grant M, Wilford A, Haskins L, Phakathi S, Mntambo N, Horwood CM. Trust of community health workers influences the acceptance of community-based maternal and child health services. *African Journal of Primary Health Care and Family Medicine*. 2017 Feb 22;9(1):1-8.
45. Greenberg H, Deckelbaum RJ, Eggersdorfer M, Kraemer K, Cordaro JB. Diet and non-communicable diseases: an urgent need for new paradigms. *Good nutrition: perspectives for the 21st century* Karger. 2016.
46. Guldán GS. Undernutrition and overnutrition: the challenging double burden of malnutrition. *Good Health and Well-Being*. 2020;747-59.
47. Gyasi RM, Phillips DR. Aging and the rising burden of noncommunicable diseases in sub-Saharan Africa and other low-and middle-income countries: a call for holistic action. *The Gerontologist*. 2020 Jul 15;60(5):806-11.
48. Haggblade S, Duodu KG, Kabasa JD, Minnaar A, Ojijo NK, Taylor JR. Emerging early actions to bend the curve in sub-Saharan Africa's nutrition transition. *Food and Nutrition Bulletin*. 2016 Jun;37(2):219-41.
49. Haque M, Islam T, Rahman NA, McKimm J, Abdullah A, Dhingra S. Strengthening primary health-care services to help prevent and control long-term (chronic) non-communicable diseases in low-and middle-income countries. *Risk management and healthcare policy*. 2020 May 18:409-26.
50. Health G. Expanding access to newer medicines for people with type 2 diabetes in low-income and middle-income countries: a cost-effectiveness and price target analysis. *The Lancet Diabetes & Endocrinology*. 2021 Dec 1;9(12):825-36.
51. Higgins A. Socioeconomic Disparities in Ultra-Processed Food Consumption: Incorporating Political Ecology in Nutrition and Toxicological Policies (Master's thesis, Indiana University).
52. Higgs ES, Goldberg AB, Labrique AB, Cook SH, Schmid C, Cole CF, Obregón RA. Understanding the role of mHealth and other media interventions for behavior change to enhance child survival and development in low-and middle-income countries: an evidence review. *Journal of health communication*. 2014 May 6;19(sup1):164-89.
53. Jakovljevic MB, Milovanovic O. Growing burden of non-communicable diseases in the emerging health markets: the case of BRICS. *Frontiers in public health*. 2015 Apr 23;3:65.
54. Jones AD, Acharya Y, Galway LP. Urbanicity gradients are associated with the household-and individual-level double burden of malnutrition in sub-Saharan Africa. *The Journal of Nutrition*. 2016 Jun 1;146(6):1257-67.
55. Khan MN, Rahman MM, Shariff AA, Rahman MM, Rahman MS, Rahman MA. Maternal undernutrition and excessive body weight and risk of birth and health outcomes. *Archives of Public Health*. 2017 Dec;75:1-0.
56. Kavle JA, Mehanna S, Khan G, Hassan M, Saleh G, Engmann C. Program considerations for integration of nutrition and family planning: Beliefs around maternal diet and breastfeeding within the context of the nutrition transition in Egypt. *Maternal & Child Nutrition*. 2018 Jan;14(1):e12469.
57. Kiely ME, McCarthy EK, Hennessy Á. Iron, iodine and vitamin D deficiencies during pregnancy: epidemiology, risk factors and developmental impacts. *Proceedings of the Nutrition Society*. 2021 Aug;80(3):290-302.
58. Kiosia A, Dagbasi A, Berkley JA, Wilding JP, Prendergast AJ, Li JV, Swann J, Mathers JC, Kerac M, Morrison D, Drake L. The double burden of malnutrition in individuals: Identifying key challenges and re-thinking research focus. *Nutrition bulletin*. 2024 Jun;49(2):132-45.
59. Lumbwe MM. An assessment of the social and academic benefits of the school feeding programme in selected primary schools of Mwinilunga district in North Western province of Zambia (Doctoral dissertation, The University of Zambia).
60. Manderson L, Jewett S. Risk, lifestyle and non-communicable diseases of poverty. *Globalization and Health*. 2023 Mar 2;19(1):13.
61. Marshall AP, Takefala T, Williams LT, Spencer A, Grealish L, Roberts S. Health practitioner practices and their influence on nutritional intake of hospitalised patients. *International journal of nursing sciences*. 2019 Apr 10;6(2):162-8.
62. Marshall NE, Abrams B, Barbour LA, Catalano P, Christian P, Friedman JE, Hay Jr WW, Hernandez TL, Krebs NF, Oken E, Purnell JQ. The importance of nutrition in pregnancy and lactation: lifelong consequences. *American journal of obstetrics and gynecology*. 2022 May 1;226(5):607-32.

63. Mbata AO, Soyeye OS, Nwokedi CN, Tomoh BO, Mustapha AY, Balogun OD, Forkuo AY, Iguma DR. Preventative Medicine and Chronic Disease Management: Reducing Healthcare Costs and Improving Long-Term Public Health. *International Journal of Multidisciplinary Research and Growth Evaluation*. 2024 Nov;5(06):1584-600.
64. Mbogori T, Mucherah W. Westernization of traditional african diets and the development of chronic diseases in Africa. In 9th annual AISA international interdisciplinary conference in collaboration with multimedia. University of Kenya 2019.
65. McKenzie S. *Getting physical: The rise of fitness culture in America*. University Press of Kansas; 2016 Feb 29.
66. Micah AE, Su Y, Bachmeier SD, Chapin A, Cogswell IE, Crosby SW, Cunningham B, Harle AC, Maddison ER, Moitra M, Sahu M. Health sector spending and spending on HIV/AIDS, tuberculosis, and malaria, and development assistance for health: progress towards Sustainable Development Goal 3. *The Lancet*. 2020 Sep 5;396(10252):693-724.
67. Min J, Zhao Y, Slivka L, Wang Y. Double burden of diseases worldwide: Coexistence of undernutrition and overnutrition-related non-communicable chronic diseases. *Obesity reviews*. 2018 Jan;19(1):49-61.
68. Mishra R, Bera S. Geospatial and environmental determinants of stunting, wasting, and underweight: Empirical evidence from rural South and Southeast Asia. *Nutrition*. 2024 Apr 1;120:112346.
69. Moodie R, Bennett E, Kwong EJ, Santos TM, Pratiwi L, Williams J, Baker P. Ultra-processed profits: the political economy of countering the global spread of ultra-processed foods—a synthesis review on the market and political practices of transnational food corporations and strategic public health responses. *International Journal of Health Policy and Management*. 2021 May 24;10(12):968.
70. Moser SC, Pike C. Community engagement on adaptation: Meeting a growing capacity need. *Urban Climate*. 2015 Dec 1;14:111-5.
71. Muka T, Imo D, Jaspers L, Colpani V, Chaker L, van der Lee SJ, Mendis S, Chowdhury R, Bramer WM, Falla A, Pazoki R. The global impact of non-communicable diseases on healthcare spending and national income: a systematic review. *European journal of epidemiology*. 2015 Apr;30:251-77.
72. Muonde M, Olorunsogo TO, Ogugua JO, Maduka CP, Omotayo O. Global nutrition challenges: A public health review of dietary risks and interventions. *World Journal of Advanced Research and Reviews*. 2024;21(1):1467-78.
73. Nichols CE. Spaces for women: Rethinking behavior change communication in the context of women's groups and nutrition-sensitive agriculture. *Social Science & Medicine*. 2021 Sep 1;285:114282.
74. Nickel S, von dem Knesebeck O. Effectiveness of community-based health promotion interventions in urban areas: a systematic review. *Journal of community health*. 2020 Apr;45(2):419-34.
75. Nicolétis É, Caron P, El Solh M, Cole M, Fresco LO, Godoy-Faúndez A, Kadleciková M, Kennedy E, Khan M, Li X, Mapfumo P. Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security.
76. Nogueira-McRae T, Ryan EP, Jablonski BB, Carolan M, Arathi HS, Brown CS, Saki HH, McKeen S, Lapansky E, Schipanski ME. The role of urban agriculture in a secure, healthy, and sustainable food system. *BioScience*. 2018 Oct 1;68(10):748-59.
77. Oni T, Unwin N. Why the communicable/non-communicable disease dichotomy is problematic for public health control strategies: implications of multimorbidity for health systems in an era of health transition. *International health*. 2015 Nov 1;7(6):390-9.
78. Onyango AW, Nikiema L, Kimokoti RW. Nutrition in health promotion policies and programs at the community level. *Handbook of Global Health*. 2020 Nov 25:1-36.
79. Peeters A. Obesity and the future of food policies that promote healthy diets. *Nature Reviews Endocrinology*. 2018 Jul;14(7):430-7.

80. Pingali P, Aiyar A, Abraham M, Rahman A, Pingali P, Aiyar A, Abraham M, Rahman A. The nutrition transformation: from undernutrition to obesity. *Transforming food systems for a rising India*. 2019;93-133.
81. Piperata BA, Dufour DL. Food insecurity, nutritional inequality, and maternal–child health: A role for biocultural scholarship in filling knowledge gaps. *Annual Review of Anthropology*. 2021 Oct 21;50(1):75-92.
82. Priya KM, Babu K. Discovering Consumer Behavior Towards Back-of-Pack Nutrition Labels: A Systematic Literature Review. *Current Research in Nutrition and Food Science Journal*. 2024 Aug 30;12(2):502-26.
83. Raj S. Influences of the nutrition transition on chronic disease. *Integrative and Functional Medical Nutrition Therapy: Principles and Practices*. 2020:17-29.
84. Ramesh MR. Maternal and Child Health: A Comprehensive Review.
85. Ruel MT, Leroy JL, Ecker O, Hernandez M, Resnick D, Thurlow J. Urban food systems and diets, nutrition, and health of the poor: Challenges, opportunities, and research gaps. *Handbook on Urban Food Security in the Global South*. 2020 Dec 18:380-96.
86. Russo L. The impact of slow productivity on healthcare costs in a no-growth: An empirical analysis. *Journal of Policy Options*. 2022 Dec 1;5(4):22-8.
87. Sadeghirad B, Duhaney T, Motaghipisheh S, Campbell NR, Johnston BC. Influence of unhealthy food and beverage marketing on children's dietary intake and preference: a systematic review and meta-analysis of randomized trials. *Obesity reviews*. 2016 Oct;17(10):945-59.
88. Sarfo J, Pawelzik E, Keding GB. Dietary patterns as characterized by food processing levels and their association with the health outcomes of rural women in East Africa. *Nutrients*. 2021 Aug 20;13(8):2866.
89. Shah HD, Nazli Khatib M, Syed ZQ, Gaidhane AM, Yasobant S, Narkhede K, Bhavsar P, Patel J, Sinha A, Puwar T, Saha S. Gaps and interventions across the diagnostic care cascade of TB patients at the level of patient, community and health system: a qualitative review of the literature. *Tropical Medicine and Infectious Disease*. 2022 Jul 15;7(7):136.
90. Shrimpton R, du Plessis LM, Delisle H, Blaney S, Atwood SJ, Sanders D, Margetts B, Hughes R. Public health nutrition capacity: assuring the quality of workforce preparation for scaling up nutrition programmes. *Public health nutrition*. 2016 Aug;19(11):2090-100.
91. Skinner K, Pratley E, Burnett K. Eating in the city: A review of the literature on food insecurity and Indigenous people living in urban spaces. *Societies*. 2016 Mar 24;6(2):7.
92. Ssentongo P, Ssentongo AE, Ba DM, Ericson JE, Na M, Gao X, Fronterre C, Chinchilli VM, Schiff SJ. Global, regional and national epidemiology and prevalence of child stunting, wasting and underweight in low-and middle-income countries, 2006–2018. *Scientific reports*. 2021 Mar 4;11(1):5204.
93. Stanhope KL, Goran MI, Bosy-Westphal A, King JC, Schmidt LA, Schwarz JM, Stice E, Sylvetsky AC, Turnbaugh PJ, Bray GA, Gardner CD. Pathways and mechanisms linking dietary components to cardiometabolic disease: thinking beyond calories. *Obesity reviews*. 2018 Sep;19(9):1205-35.
94. Suvedi M. Global need for revitalization of agricultural extension training. *Journal of Extension Education*. 2019;31(3).
95. Thow AM, Abdool Karim S, Mukanu MM, Ahaibwe G, Wanjohi M, Gaogane L, Amukugo HJ, Ruhara CM, Ngoma T, Asiki G, Erzse A. The political economy of sugar-sweetened beverage taxation: an analysis from seven countries in sub-Saharan Africa. *Global Health Action*. 2021 Jan 1;14(1):1909267.
96. Vermeulen SJ, Park T, Khoury CK, Béné C. Changing diets and the transformation of the global food system. *Annals of the New York Academy of Sciences*. 2020 Oct;1478(1):3-17.
97. Vilar-Compte M, Pérez-Escamilla R, Ruano AL. Interventions and policy approaches to promote equity in breastfeeding. *International journal for equity in health*. 2022 May 10;21(1):63.

98. Vollmer S, Harttgen K, Subramanyam MA, Finlay J, Klasen S, Subramanian SV. Association between economic growth and early childhood undernutrition: evidence from 121 Demographic and Health Surveys from 36 low-income and middle-income countries. *The lancet global health*. 2014 Apr 1;2(4):e225-34.
99. Wehrmann D. Incentivising and regulating multi-actor partnerships and private-sector engagement in development cooperation. Discussion Paper; 2018.
100. Wells JC, Marphatia AA, Amable G, Siervo M, Friis H, Miranda JJ, Haisma HH, Raubenheimer D. The future of human malnutrition: rebalancing agency for better nutritional health. *Globalization and health*. 2021 Dec;17:1-25.
101. Wolfson JA, Ramsing R, Richardson CR, Palmer A. Barriers to healthy food access: Associations with household income and cooking behavior. *Preventive medicine reports*. 2019 Mar 1;13:298-305.
102. Xia Q, Zhou C, Wu Z, Pan D, Cao J. Proposing processomics as the methodology of food quality monitoring: reconceptualization, opportunities, and challenges. *Current Opinion in Food Science*. 2022 Jun 1;45:100823.
103. Xu YY, Sawadogo-Lewis T, King SE, Mitchell A, Robertson T. Integrating nutrition into the education sector in low- and middle-income countries: A framework for a win-win collaboration. *Maternal & child nutrition*. 2021 Jul;17(3):e13156.
104. Ziso D, Chun OK, Puglisi MJ. Increasing access to healthy foods through improving food environment: A review of mixed methods intervention studies with residents of low-income communities. *Nutrients*. 2022 May 29;14(11):2278.