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Review Article

Global nutrition challenges and sustainable food system as a strategy for a healthier future

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Establishing sustainable food systems along with solving worldwide nutrition problems represents vital steps toward a secure future. The worldwide population of three billion people experiences malnutrition while eating low-quality food. Substandard diets stand as the number one reason for worldwide health problems which generate both non-communicable diseases and childhood stunting and micronutrient deficiencies, while causing twenty percent of total health issues. The solution involves both reducing harmful dietary behaviors and enhancing medical facility availability. Sustainable food systems protect natural biodiversity while delivering nutritional safety and resolving environmental problems in local areas. The transformation of the food system into sustainable, healthful diets requires efforts that surpass what individual consumers can do. To accomplish this goal, it requires tackling sociocultural and economic factors while implementing international agreements on healthy diet standards and sustainable food production systems as well as creating production incentives for sustainable practices.

Keywords: *nutrition, NCDs, strategies & challenges, future health, sustainable agriculture*

Introduction

The globe faces serious nutrition-related issues in the twenty-first century, such as food poverty, malnutrition, and illnesses linked to diet. To properly address these difficulties, a multifaceted strategy is necessary due to their complexity (Fanzo et al., 2021). Food system that ensures social and economic fairness minimizes its negative effects on the environment and provides wholesome food for everyone. UN Sustainable Development Goals, especially Goal Zero Hunger and Good Health and Well-Being, depend on the implementation of such a system. Providing food and nutrition, supporting the lives of millions of farmers, and maintaining environmental sustainability provide a triple challenge for food systems (*The Triple Challenge - OECD*, n.d.). Food systems have changed significantly during the last 50 years, making it possible to grow enough food to feed the world's fast-growing population. But these changes have also brought forth trade-offs and new difficulties, especially in climate change, ecological resilience, and growing inequality. Overnutrition is more prevalent in high-income countries and people, whereas undernutrition is more common in low-income countries. Malnutrition may result from both undernutrition and overnutrition, and it is a serious worldwide health concern (*Global Nutrition*, n.d.). The Comprehensive Plan of Action on Female, Infant, and Little Child Nutrition was endorsed by the United Nations Health Assembly in 2012 and aims to achieve six global nutrition targets by 2025 (*Global Nutrition Targets 2025*, n.d.). These goals include lowering the proportion of stunted children under five, lowering the anemia rate among fertile mothers, lowering low birth weight, and making sure that childhood obesity does not rise. To achieve global nutrition objectives and build a healthy future, sustainable food systems are imperative. Micronutrients are essential for tissue function maintenance and metabolism. They are required for the

synthesis of energy, immunological response, blood coagulation, and other critical processes. Serious health problems, such as anemia, reduced immune systems, and poor cognitive development, can result from a shortage of micronutrients. The immune system is maintained in part by five micronutrients: zinc, magnesium, vitamin B6, vitamin C, and vitamin E. Supplements containing these micronutrients are frequently marketed as immunity boosters and come in dosages far higher than the recommended daily intake. Nevertheless, there is no proof that taking these supplements offers any advantages beyond maintaining a healthy diet alone. It makes more sense to consume a variety of meals to strengthen your immune system rather than consuming tablets to obtain these micronutrients (*Micronutrients Have Major Impact on Health*, 2016). Food security is "the state of everybody at all ages having financial, physical, and social availability of enough, nutritious, and secure food that fulfills their nutritional requirements and dietary tastes for a healthy and active lifestyle." This definition requires a good diet. Dieting is influenced by every aspect of the nutritional system, and meals in turn influence nutrients and general health. The diet of children should be diverse from day one and include starchy food items, legumes, as well veggies, and meats including animal products, eggs, and milk. It balances the intake of calories and expenses by limiting sugar, additional sugar, fats that are bad for you, salt, and highly industrialized foods and beverages (*Food Systems Dashboard*, n.d.). Hundreds of millions of people rely on the food system as one of their primary sources of employment worldwide. Nevertheless, many of the people employed in food systems are among the world's poorest and most marginalized individuals, and earnings inside these systems frequently fall short of a livable wage. Poverty impacts workers throughout food systems, across the whole value chain, in both rural and urban locations, even though many of the world's poorest are employed in agriculture. Food-related livelihoods are also entangled in labor rights abuses such as child labor, harassment, and hazardous working conditions. Migrants and women are particularly susceptible to exploitation. Low agricultural yields, a reliance on staple crops, and smallholder farming are characteristics of traditional and rural food systems. Because fewer people live in cities, there is a low proportion of food imports relative to local consumption, and supply chains are short. Some crops suffer significant food losses due to a lack of refrigeration and storage facilities, which discourages farmers from expanding into perishable food production. There are significant seasonal variations in pricing as well as in the availability of food. Rural non-farm job options, including small-scale commerce, basic food processing, agricultural input sales, and storage, are expanding quickly in many nations. The majority of food is sold in unofficial marketplaces, such as central and district markets, independently run small businesses, and street vendors. A supermarket is a rare sight outside of major cities (*Food Systems Dashboard*, n.d.). To lower the risk of NCDs, BP, body mass index (BMI), and Blood Glucose must be maintained at healthy levels. This can only be achieved with a diet that offers the proper mix of macronutrients (carbohydrates, proteins, and fats) and micronutrients (vitamins and minerals) (*Non-Communicable Diseases | DSM*, n.d.). Optimizing nutrition, with a focus on customization, is necessary for improving the inhibition and handling of major chronic illnesses. Encouraging better diets for everyone within planetary bounds is vital because everyone has the right to eat healthily and benefit from excellent nutrition (*Non-Communicable Diseases | DSM*, n.d.). Eating a healthy, balanced diet rich in a range of foods from the key food categories, such as fruits, vegetables, starchy foods, dairy products and milk (or non-dairy substitutes), and sources of protein, is the best method to prevent malnutrition (*Malnutrition*, 2017). For long-term advantages, it is important to optimize nutrition from an early age, including the 1000 days between commencement and a child's next birthdate (*Malnutrition*, 2017). A healthcare expert, such as a dietician, may be consulted if malnutrition is detected to go over the best course of action. Nutrition may be injected directly into a vein, supplemented with nutrients, or dietary adjustments may be part of the treatment (*Malnutrition*, 2017).

Understanding the complexities of nutrition

Socioeconomic factors and nutrition disparities

It is well recognized that dietary differences caused by economic status account for a portion of the societal wellness differences that are seen. People with higher socioeconomic class (SES) tend to eat healthier; on the other hand, people with lower SES tend to have eating habits that are less in line with dietary guidelines or healthy suggestions which deteriorates the condition of their bodies (Alkerwi et al., 2015). Therefore, topics of active municipal health concern include socioeconomic differences as well as food superiority, as shown by fit eating. It is not logically persuasive to use a single "best" indicator method to categorize societies since it may highlight a particular component of social stratification that may only be pertinent to certain health outcomes and at various times of a person's life course. The capacity of the most often used SES indicators (education, occupation, and income) to represent the complex multidimensional processes that shape social structure is constrained. Income is a better indicator of a present level of living than education or career, which are indicators of social connections and mastery of lifelong skills. High socioeconomic level (SES) people are more likely to have recovering intake behaviors, whereas low SES people have unnatural nutritional profiles (Alkerwi et al., 2015).

People in the US who were Black, White, had low incomes, had low educational attainment, lived in rural regions, or were in food deserts were more likely to have an unhealthy diet overall (*Association of Socioeconomic and Geographic Factors With Diet Quality in US Adults | Nutrition, Obesity, Exercise | JAMA Network Open | JAMA Network*, n.d.). With origins in systemic racism, historically marginalized groups' diets—such as Black, American Indian, and Alaska Native communities—tend to be of inferior quality, as do rural and economically underprivileged areas, where access to healthful food may be more restricted. Due in part to the correlation between the incidence of obesity and food quality, these same regions have often seen disproportionately higher mortality rates from chronic illnesses linked to obesity. To address health inequalities and advance health equality, a greater comprehension of how social, economic, and environmental variables impact food quality may be useful (Desbouys et al., 2020). Consuming a nutritious diet is correlated with income and education, although this correlation varies between racial, cultural, and geographic groupings. Understanding the intricacies of nutrition necessitates taking into account a variety of variables, such as socioeconomic position and culture, which can influence eating patterns and nutrition inequalities. Interventions may be created to address nutrition inequities and promote healthy eating habits by considering these variables.

Cultural influence on dietary patterns

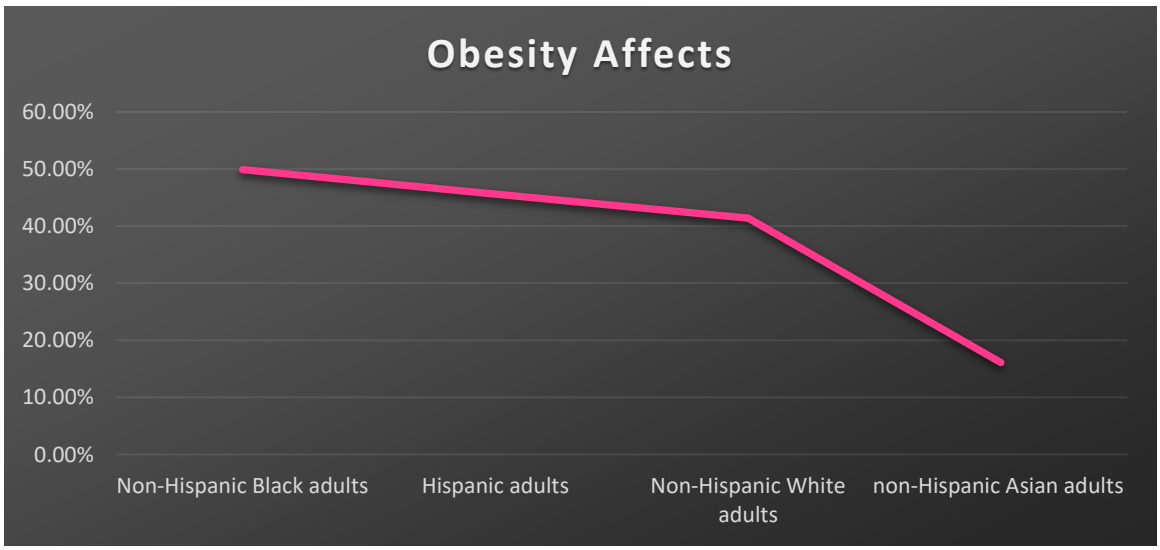
A multitude of cultural factors, such as those affecting the formation of one's body image, dietary choices, and chances for physical exercise, can lead to differences in juvenile obesity. Like with eating, children imitate the kinds of exercise that their guardians perform. As a result, a parent in a society where resting after a hard day at work is seen as more healthy than exercise is less likely to produce kids who appreciate the value of exercise for overall wellness and health(*Module 2: Understanding Culture & Nutrition - Around the Table | NCEMCH*, n.d.). African-American teenagers have higher reductions in physical activity with age and are less likely to play organized sports than their white peers. A kid's weight may not worry Hispanic parents since they may not see any negative effects from an active, "chubby" youngster. Within the Hispanic population, there are cultural variances, with women from Mexican and Caribbean backgrounds favoring a slimmer figure.

The global obesity epidemic

The body mass index (BMI), a simple weight-to-height ratio, is widely used to classify obese adults as overweight. It is calculated as follows: kg/m2, which is the weight of a person divided by the area in meters of their height in meters. Adult obesity and overweight are defined by the WHO as: A BMI of 30 or above is considered obese, whereas a BMI of 25 or higher is considered overweight.

Prevalence and trends in obesity

For many years, the prevalence of obesity has been a major cause for worry in the arena of worldwide strength, and it still is today. The broad definition of obesity is having an excessive amount of body fat, which can cause some health issues and raise the risk of developing chronic diseases. Both industrialized and developing nations are affected by the worldwide epidemic of obesity. It is not exclusive to any one area or demography. Obesity has been listed by the (WHO) as one of the biggest worldwide health issues of the twenty-first period.



Graph No.1 (Obesity Affects some Groups more than others)

Different populations have varying rates of obesity; non-Hispanic Black people have the greatest frequency, afterward non-Hispanic White, non-Hispanic Asian, and Hispanic individuals. Obese people have a greater probability of being middle-aged. The obesity and educational patterns of non-Hispanic White, non-Hispanic Black, and Hispanic women and men are all comparable. Even though the variance was not economically significant with non-Hispanic Black men, the number of obese people increased with educational attainment. However, some changes were significantly different (Bryan et al., 2021). Over the previous few eras, obesity has become more prevalent both domestically and internationally. Obesity is a leading cause of growing healthcare expenses and is connected with significant health hazards.

Consequences of obesity on health and healthcare systems

Healthcare systems and individual health are both significantly impacted by obesity. Obese individuals are more likely to develop some major illnesses and medical illnesses, such as high BP, high saturated fatty acid, type 2 diabetes, respiratory issues, joint issues, gallstones, and gallbladder disease (CDC, 2022c). Additionally, corpulence increases the chance of various fatal and disabling conditions, such as heart disease and several malignancies. In addition to its negative effects on health, obesity has a big financial burden on healthcare systems. The US healthcare system spends around $173 billion a year on handling obesity (CDC, 2022b).

Figure 1. The effects of obesity on healthcare systems and individual health

A multifaceted strategy encompassing people, healthcare institutions, laws, and the food sector is needed to combat obesity and its effects. To lessen the impact of obesity on the health and healthcare systems, preventative actions are crucial. These include encouraging healthy lifestyles and providing accessible healthcare. Obese people frequently have a worse quality of life overall, which affects both their well-being and the well-being of their families. Since some communities are more susceptible to the effects of obesity, it can worsen health inequalities.

NCDs and global burden

Chronic illnesses with a partiality for extended length known as non-communicable diseases (NCDs) are brought on by a confluence of inherited, bodily, ecological, and behavioral variables. The main factor in death and disability globally is a condition (NCD), commonly referred to as chronic illness. The four main types of NCDs are Cardiovascular diseases (CVDs), Cancers, Chronic respiratory diseases (CRDs), and Diabetes (*Non Communicable Diseases*, n.d.). Air pollution and pollutants are one of the major environmental risk factors for NCDs. It is liable for 6.7 million fatalities universally, of which 5.7 million are attributable to NCDs such as blow, ischemic heart disease, chronic obstructive pulmonary disease, and lung cancer (*Non Communicable Diseases*, n.d.). WHO response regarding NCDs, NCDs are acknowledged as a key impediment to sustainable development in the 2030 Agenda for Sustainable Development. Government leaders pledge vigorous national measures to cut the early mortality rate from NCDs by one-third by 2030.

To speed up prevention and control and reach nine global goals, the WHO Global Action Plan for Prevention and Control of NCDs was extended to 2030. An implementation roadmap was also developed. NCDs have a major negative impact on economies, society, and public health globally. Effectively addressing NCDs necessitates a multipronged strategy that involves public health measures, education, healthcare access, and way-of-life modifications. For the 21st century, one of the greatest important municipal health trials is lowering the worldwide burden of NCDs.

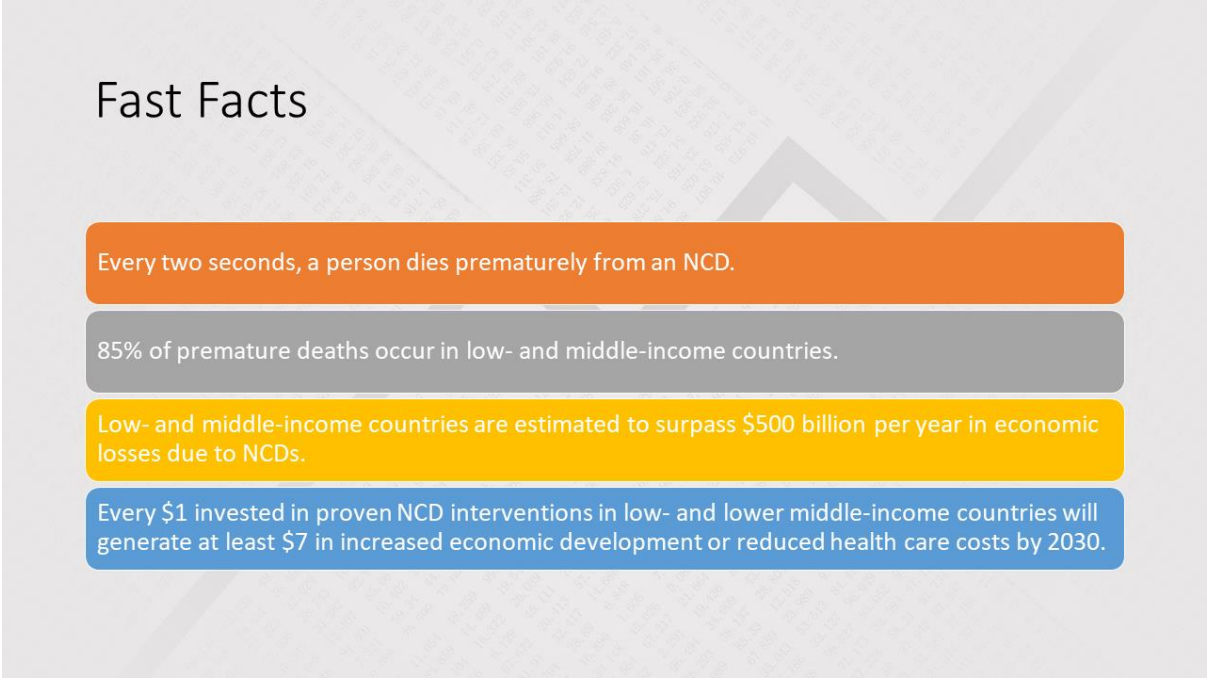


Figure 2. About Global NCDs | Division of Global Health Protection | Global Health | CDC, 2022

The majority of NCD fatalities are caused by cardiovascular illnesses, followed by malignancies, respiratory conditions, and diabetes. There are Two Diseases discussed in detail Cancer and Diabetes.

Cancer

Cardiovascular disease, diabetes, and cancer key classes of non-communicable diseases. Cancer is the unconstrained cell development that can subvert and spread to isolated areas of the form. There are nearly 100 different varieties of cancer that can either be benign or spiteful. A benevolent tumor is often not toxic and does not insinuate the skin around it. Spiteful tumors can encroach on adjacent tissue and disseminate to other bodily regions (NCDs, n.d.). A significant worldwide health issue, cancer claims the lives of 10 million people annually. It is one of the top four main causes of mortality worldwide and a significant factor in NCD-related premature death (*Cancer*, 2015). The biggest cancer risk factors that may be avoided include smoking, being overweight or obese, eating poorly, and not exercising enough (Wild, 2012). There are several distinct forms of cancer, and each type is distinguished by a particular set of symptoms and therapies. The following are a few of the most prevalent cancer types: Chest cancer, mammary cancer, stomach cancer, Male sexual cancer, Skin cancer of the melanoma variety, and one kind of blood cancer is leukemia (Lee & Lee, 2003). Cancer is brought on by DNA changes in cells, which are brought on by things like smoking, exposure to the sun, carcinogens in the environment, viral infections, and a family history of the disease. Cancer symptoms vary according to the kind and stage of the disease, but common warning indications include unexplained weight loss, fever, exhaustion, and discomfort, changes in bowel or skin patterns, and sudden bleeding or discharge. Depending on the kind, stage, and health of the patient, several cancer therapies may be used, such as surgery, radiation, chemotherapy, targeted therapy, and immunotherapy (NCDs, n.d.) (*Cancer*, 2015). A complex and difficult condition, cancer affects millions of individuals globally. Many cancer patients now have better outcomes thanks to early identification and medical advancements, but the disease still poses a serious threat to world health. It's crucial to seek the advice of medical specialists if you or someone you know is struggling with cancer so that you may receive individualized information and assistance.

Diabetes

Diabetes is a chronic illness brought on by insufficient insulin production, which results in increased blood sugar levels that, if not effectively controlled, can affect multiple bodily systems. Type 1 diabetes, which is characterized by an insulin deficit, needs daily insulin injections and manifests as severe thirst, famine, weight loss, and unclear image,

whereas type 2 diabetes, which affects 90% of patients with the condition, is brought on by inefficient insulin utilization (Administrator, n.d.). Diabetic consequences might include heart disease, stroke, blindness, renal failure, and amputation. Diabetes is a dangerous condition that can cause a wide range of problems. However, the majority of diabetics may live long, healthy lives with adequate treatment. Diabetes is a chronic condition that cannot be passed down and has a protracted progression due to genetic and environmental factors. Genetics increases the risk, while environmental factors like obesity, sedentary lifestyles, and unhealthy diets increase the risk. Due to hereditary and environmental variables, diabetes is a chronic disorder that cannot be passed on and has a slow progression. Environmental variables, including obesity, sedentary behavior, and unhealthy meals, can raise risk, in addition to genetic factors (*Diabetes Non Communicable Disease | NCD Alliance*, n.d.). To treat diabetes as an NCD and lessen the accompanying health and financial consequences, preventive strategies, early identification, and appropriate management are essential. To assist people in better managing and preventing diabetes, public health initiatives concentrate on spreading awareness, encouraging healthy lifestyles, and providing access to medical treatment and education.

Malnutrition: a persistent problem

Malnutrition encompasses undernutrition, lack of vitamins and raw materials, obesity, and non-communicable illnesses linked to food. In 2020, 149 million children under five were stunted, 45 million were wasted, and 38.9 million were overweight or obese. Undernutrition is a contributing factor in 45% of fatalities in children under five, primarily in low- and middle-income countries. Young obesity and heavy weight are also increasing in these countries. The worldwide load of malnutrition has significant and eternal properties on development, the economy, society, and medicine (*Fact Sheets - Malnutrition*, n.d.). Malnutrition is a serious health problem that results in decreased food intake, low nutrient absorption, and infections that prevent nutrient absorption. It can result in malnutrition caused by a lack of certain micronutrients, undernutrition, obesity, and non-communicable diseases linked to food. Optimizing nutrition early on is essential for a good start in life and long-term advantages. The prevention of malnutrition is crucial for general health.

Undernutrition and stunting in developing countries

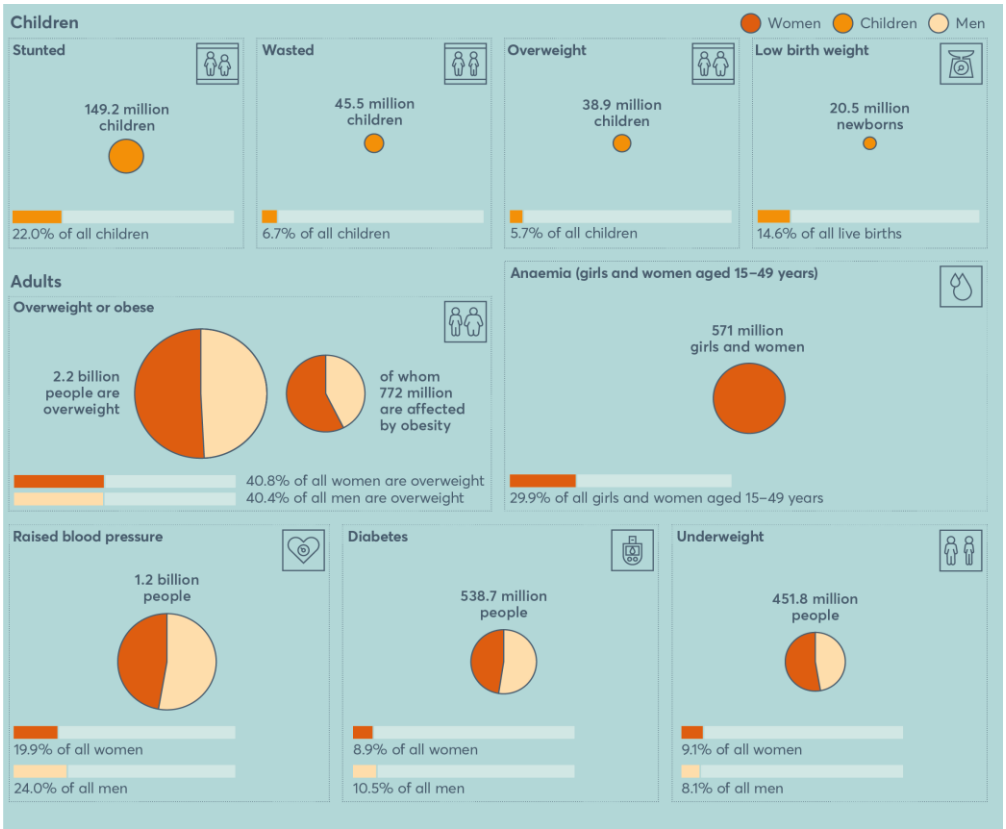


Figure 3. **Source: NCD Risk Factor Collaboration (last available year projections: 2019),** UNICEF/WHO/World Bank Group: Joint child malnutrition estimates (last available year 2020), UNICEF global databases Infant and Young Child Feeding (last available year 2019 at the time of writing), and WHO Global Health Observatory (last available year 2015).

Note: Adults 18 an inordinate length of time and older are included in the statistics on adult overweight, obesity, diabetes, and elevated blood pressure. Overweight is a subset of obesity.
(*GNR | Country Nutrition Profiles Methodology - Global Nutrition Report*, n.d.)

Stunting syndrome, another name for linear growth failure, is the most widespread kind of malnutrition in the world, affecting 165 million children under the age of five. The syndrome, which causes pathological alterations in the developing brain, is linked with higher injury and death, impaired physical and neurodevelopmental capacity, decreased financial capacity, and a higher chance of developing metabolic illness as an adult. Between 2010 and 2025, the prevalence of stunting is to be reduced by 40% (Prendergast & Humphrey, 2014). Childhood linear growth failure is the most common kind of undernutrition in the world. Parental nutrition and socioeconomic level are important risk factors for undernutrition and stunting, which are serious problems in developing countries. Further efforts are required to enhance children's health, education, and future earnings to prevent malnutrition and meet global nutrition targets. Many people suffer from malnutrition worldwide. Stunting and wasting are frequently described as two distinct types of malnutrition that need various preventative and/or therapeutic measures. However, there is evidence indicating that many of the underlying causes for these two kinds of malnutrition are the same, and they frequently coexist in the same groups and children (Soliman et al., 2021). Both short- and long-term effects of child stunting include a rise in mortality and morbidity, impaired learning and development, increased susceptibility to infections and non-communicable illnesses, decreased fat oxidation, decreased calorie spending, resistant to insulin, and a higher risk for acquiring obesity, hypertension, lipid disorders, lowered earnings, and unfavorable female fertility results in maturity. Additionally, stunted children who gain weight quickly after the age of two are more likely to gain weight or become fat in the future (Dewey & Begum, 2011). Government investments, correct knowledge of the nutritional needs of mothers, best practices for feeding children and families, and adequate care and cleanliness may all help avoid malnutrition. Senegal saw a decrease in stunting in children under five years old following the implementation of a community-based program that increased access to social services linked to nutrition and enriched food with vitamins. To ensure that more children have access to nutritious food and lead healthy, productive lives, governments, donors, partners, and international organizations must keep collaborating to develop and expand nutrition programs (*Stunting Limits Learning and Future Earnings of Children*, n.d.).

Micronutrient deficiencies: hidden hunger

A person's micronutrient insufficiency, or hidden hunger, occurs when their diet fails to meet their dietary requirements, resulting in a lack of essential vitamins and minerals (*VIDEO: What Is Hidden Hunger? | FAO*, n.d.). Since the ensuing health effects may not always be immediately apparent, hunger associated with energy deficiencies frequently eclipses or is disregarded in favor of this form of hunger (*Micronutrient Malnutrition*, n.d.). Even though the human body only needs trace amounts of micronutrients, these vitamins and minerals are essential for basic physiological processes including growth, development, and metabolism. Chronic illnesses and other harmful health effects may result from deficiencies in one or more of these micronutrients. Health organizations have been documenting micronutrient malnutrition deficits in zinc, iodine, iron, folate, vitamin A, and other elements for decades. These deficiencies continue to have catastrophic effects on billions of people globally. Furthermore, undernutrition is not just a problem in impoverished countries (Allen, 2006). Numerous physiological deficits, including metabolic problems, lowered immunological, endocrine, and cognitive function, and insufficient or delayed physical development, have been linked to micronutrient deficiency (*Micronutrient Malnutrition*, n.d.). The most common micronutrient deficiencies worldwide include: More than two billion individuals worldwide suffer from iron insufficiency, the most prevalent micronutrient deficit (Han et al., 2022). Vitamin A: Eye damage, blindness, and an increased risk of death for women and children can result from a vitamin A deficiency, which is common in many impoverished nations (Nutrient Deficiencies That Are Incredibly Common, 2023). Zinc insufficiency is common, especially in low- and middle-income nations and it can cause delayed sexual development, growth retardation, and compromised immune system performance (Kiani et al., 2022). The body needs nutrition to produce energy, and a balanced diet should include both macro- and micronutrients. A lower intake of nutrients than the norm is referred to as nutritional insufficiency, but a significant drop in one or more nutrients is known as nutritional deficiency, which increases the risk of illnesses including diabetes, heart disease, and cancer. Environmental causes such as food shortages or medical diseases such as anorexia nervosa, fasting, and intestinal malabsorption can lead to malnutrition.

Strategies for a heathier future

A comprehensive plan that leverages the resources of all sectors is required to address global health concerns. This strategy should prioritize global health security, preventative measures, health promotion, multispectral collaboration, equity, social justice, and healthcare systems for a better future. Global health issues are intricate and diverse, disproportionately impacting groups who are already at risk. These comprise social factors, mental health,

environmental dangers, and infectious illnesses. To tackle these issues, a coordinated endeavor and a diverse strategy are needed, utilizing the advantages of several industries, players, and technological advancements. A healthy future depends on the advancement of the labor force, the infrastructure, and the healthcare systems. Building capacity, offering resources, and providing training may all help solve the issue of overworked healthcare workers and inadequate resources. New developments in healthcare delivery, such as telemedicine and e-health, can improve care efficiency (*Addressing Global Health Challenges*, n.d.).

Basic strategies

Ensuring that medical education is current and effective is critical since it is a vital part of healthcare systems. The following are some methods to improve medical education, Employ active learning techniques, Put health education first, Make use of instructional technologies, evaluate the health literacy of the patient, and Determine and promote creative, practical, and empirically supported solutions. These tactics can be used to improve medical education and guarantee that future medical professionals have the information and abilities necessary to deliver high-quality treatment(*5 Strategies for Patient Education as a Nurse | Wolters Kluwer*, n.d.) (Singh, 1996). Develop strategic strategies to increase their contribution and innovate for a healthier future. Academic institutions such as the Royal College of Surgeons in Ireland (RCSI) are leading the way in this regard (*Innovating for a Healthier Future – RCSI Strategy 2023-2027*, n.d.). Academic medicine and health care are undergoing rapid systemic transformation. The AAMC has to become an even stronger, more productive organization to guide and support its members through the significant changes they encounter. The AAMC is reexamining its membership structure and community involvement with this action plan. To fulfill our purpose, we will accomplish this by extending and strengthening our relationships with individuals in academic medicine and beyond (*A Healthier Future for All*, n.d.).

*"**A healthier future starts here and now.** From gaping health disparities to uneven access to care, the challenges ahead are daunting. But amid the novel coronavirus pandemic and growing public outrage over systemic racism, a renewed sense of urgency offers an unprecedented opportunity for change. In partnership with medical schools, teaching hospitals and health systems, academic medical societies, and the people of academic medicine, the AAMC is poised to lead the change that will improve the health of people everywhere."* (*A Healthier Future for All*, n.d.).
— David J. Skorton, MD, AAMC President and CEO

The role of food technology

The lifespan of the food we consume, from cultivating crops to processing components to creating delectable meals, depends heavily on food technology (Farming, 2023). It is applying the knowledge of nutritional science to several facets of the food chain, such as the distribution, packing, processing, safeguarding, and use of food. Throughout history, technology for food has proved essential to human expansion and well-being, and it still plays a critical part in our contemporary food systems.

Food's technological significance is demonstrated by what it brings

Food technologists are in charge of making sure that food items are manufactured legally, securely, and to the stated quality while adhering to a stringent regulatory structure that is revised regularly. Additionally, they create and execute procedures and technology to guarantee a stable food supply and avoid foodborne diseases (Dorey, 2023). Food technologists do research and development on novel foods, enhance food systems, and come up with creative answers to problems facing the sector. In addition to creating new recipes and ideas, they could work with previously known or undiscovered ingredients and technology to alter food to satisfy certain dietary needs (*The importance of food science and technology*, n.d.).

Fortification and food processing for nutrition

Food preparation and enrichment are two distinct methods for raising the nutritional content of food. To increase a meal or condiment's quality of nutrition, supplementation is the purposeful addition of any number of micronutrients, such as mineral and vitamin content. It is an evidence-based strategy that helps to prevent, lessen, and manage deficits in certain micronutrients. For the overall population (the weight or massive operations fortification) or certain demographic groups (aimed fortification), such as children, pregnant women, and recipients of social security programs, enrichment can be utilized to address a proven micronutrient shortage. As a potent, financially viable, and scientifically supported strategy to combat vitamin and mineral deficiencies—which include, but are not limited to, iodine-related diseases, anemia, and iron deficiency—the World Health Organization advocates for widespread supplementation of foods (*Food Fortification*, n.d.). Contrarily, food processing encompasses any technique that modifies a food's original condition. Among other things, it may entail canning, freezing, drying, cooking, or adding preservatives. Food processing nearly invariably results in changes to the food's nutritional value. Certain vitamins are less impacted by processing and hence more stable than others. When food is processed and stored, water-soluble vitamins (B-group and C) tend to be more hazardous than the fat-soluble vitamins (K, A, D, and E). Thiamin, or riboflavin, and the antioxidant vitamin C are the most erratic vitamins. Highly processed foods can cause an increase in energy consumption that leads to weight gain since they are often heavy in calories, sugar, salt, and harmful fats. In addition, a high intake of ultra-processed meals has been connected to sadness, tumors, gastrointestinal issues, weight gain, metabolism, and cardiovascular diseases (Services, n.d.). Food processing and fortification are two distinct methods for raising the nutritional content of food. A food is said to be fortified if it contains one or more micronutrients that are added on purpose, whereas food processing is any action that modifies a food's natural form. While food processing can change the nutritional content of food and raise the risk of consuming unhealthy, highly processed foods, fortification is an evidence-based strategy that helps prevent, reduce, and regulate micronutrient deficiencies.

GMOs and the future of food

In the years to come, GMOs, or genetically modified organisms, may be very important to the agriculture process. Here are some important details regarding GMOs and their future. With the ability to produce their fertilizer, withstand pests and illnesses, and use less water, genetically modified crops can withstand the effects of climate change. For instance, the Alliance for Agriculture at Cornell University is developing drought- and insect-resistant maize for use in Africa, which might minimize farmers' costs associated with using pesticides and fertilizers (*The Future of Eating*, n.d.). The forthcoming generations of genetically modified crops will concentrate on enhancing and modifying the crop plants' qualitative attributes, such as the nutrition that the crop that is harvested plant provides. This signifies a change in emphasis from the biotechnology industry's original objectives, which mostly focused on important crops for financial gains (Stearns, 2017). A growing number of scientists are using genome-editing techniques, such as CRISPR-Cas9, which allow them to modify individual DNA base pairs more subtly or add new genes to plants or animals. Because this technology is frequently quicker and less expensive than more traditional genetic editing methods, it may make it possible for smaller players to compete. Some nations, including the US and Argentina, believe that genome-edited plants won't be subject to the same regulations as genetically modified organisms (GMOs), which might lead to the faster and less expensive introduction of novel crops to the market. Compared to non-modified crops, GMOs provide advantages including increased yields, lower costs, fewer herbicides and pesticides, and less soil erosion. Additionally, they are employed in medicine to create insulin, illness therapies, and vaccinations that can save lives. The general population is still opposed to genetically modified organisms (GMOs) regardless of the possible advantages. However, several studies have demonstrated that GMOs are just as healthy as normal crops and do not pose any dangers to the health of consumers.

Success stories and case studies

This is a compilation of case studies that look at the forces and mechanisms behind dietary change. The individual case studies include several nations from Asia, Europe, and Africa. These examples and instances of achievement can inspire future interventions and programs and offer insightful information about the factors that influence and lead to changes in nutrition. There is a compilation of nutrition-related success stories available from the WHO's Eastern Mediterranean Region Office. A variety of subjects are covered in the stories, such as diabetes, child development norms, food security, and food systems. An illustration of this may be seen in Egypt, where teens' eating habits were improved by the implementation of a school-based nutrition education program (Nutrition, n.d.). There is a compilation of nutrition improvement success stories from the Centers for Disease Control and Prevention (CDC). These articles feature initiatives at the state and municipal levels that support breastfeeding, healthy living, and the promotion of physical exercise and a balanced diet. The stories touch on a variety of subjects, such as expanding access to healthy food options, fostering connections between farmers and businesses, and enhancing retail availability of fruits and vegetables

(CDC, 2022a). This collection of work addresses the rising need for experiential learning on undernutrition by presenting successful case studies. A variety of subjects are covered in the tales, such as community-based initiatives, food fortification, and maternal and child nutrition (Kim et al., 2017) (Kohli et al., 2020) (Kohli et al., 2017).

Countries making strides in nutrition improvement

It is noteworthy that several nations are not on course to meet the global nutrition objectives by 2025, and advancement towards them is sluggish. These illustrations do, however, demonstrate that several nations are making notable progress in enhancing nutrition.

Guatemala: Known for its strong commitment to eradicating undernourishment and famine.

Peru: Rated highly committed to ending hunger and undernutrition.

Malawi: Rated highly committed to ending hunger and undernutrition.

Brazil: The first country to make specific commitments in the UN Decade of Action on Nutrition, with three commitments to be achieved by 2019: stop the growth in the adult obesity rate, reduce by at least 30% consumption of sugar-sweetened beverages among adults, and increase by at least 17.8% the proportion of adults who regularly eat fruit and vegetables.

Senegal: Making strides towards reducing malnutrition by improving the nutrition status and healthy development of children under the age of five living in poor urban or rural areas of Senegal. They have also led the way in developing bio-fortified varieties of millet, beans, and sweet potatoes that address various(*Senegal Makes Strides in Fighting Malnutrition – DW – 10/16/2018*, n.d.).

Kenya: One of only seven countries on track to meet four of the six maternal, infant, and young child nutrition targets by 2025(*Global Nutrition Report | Country Nutrition Profiles - Global Nutrition Report*, n.d.).

Eswatini: One of only seven countries on track to meet four of the six maternal, infant, and young child nutrition targets by 2025 (*Global Nutrition Targets 2025*, n.d.).

Armenia: One of only seven countries on track to meet four of the six maternal, infant, and young child nutrition targets by 2025(*Global Nutrition Targets 2025*, n.d.).

El Salvador: One of only seven countries on track to meet four of the six maternal, infant, and young child nutrition targets by 2025(*Global Nutrition Targets 2025*, n.d.).

Promising initiatives and outcomes

Several recent international nutrition projects have suggested ways to enhance food surroundings and food choices by transforming food systems. To guarantee that diets are both healthful and sustainable for the environment, policy actions to change food systems, boost consumption of foods that promote health, and decrease consumption of foods derived from animals are desperately needed. Promising outcomes have been obtained by reorienting agriculture systems in countries like Ethiopia, China, and Bangladesh to encourage improved nutrition (*How Countries around the World Are Leveraging Agriculture to Improve Nutrition | IFPRI*, n.d.). Communities as well as governments have implemented strategies to reduce the intake of calories and enhance nutrition (Shahid & Bishop, 2019). The impact of available resources on malnutrition can be increased by increasing the efficacy and efficiency of current nutrition interventions. There are strategies that nations may employ to maximize the distribution of available funding to save more lives and lower the number of instances of malnutrition for the same amount of money (*2021 Global Nutrition Report | Executive Summary - Global Nutrition Report*, n.d.). The most effective approach to improving nutrition is seen to be community-centered food-based methods for reducing and preventing malnutrition, in which communities are given the capacity to act via a process of social mobilization to put the nutrition improvement strategies into practice.

Future directions and recommendations

Targeting vulnerable groups like expectant mothers and young children under 24 months of age, nutrition-sensitive social protection programmers also involve nutrition education and counseling. It lessens the financial effects of external shocks and incorporates nutrition services into Social Protection (SP) measures. With an emphasis on

undernutrition among women and children in emerging economies, the World Bank and other programming personnel work to maximize the nutrition consequences of health investments and policies. Over 100 partners globally have accepted the scaling-up nutrition framework, and 30 developing nations have made commitments to do the same. These nations' leaders place a high priority on nutrition as an investment in the economic, social, and physical development of their citizens (Bank, 2013). Multispectral interventions aimed at addressing the root causes of malnutrition are referred to as multispectral approaches to nutrition. To guarantee gains in nutrition, these strategies are necessary (Reinhardt & Fanzo, 2014). To combat malnutrition holistically, a comprehensive strategy that involves all sectors and addresses underlying causes such as poverty, illiteracy, access to clean water, inadequate healthcare, and poor sanitation is essential. This will promote a more effective and complete strategy. A multispectral approach, which emphasizes the promotion of good eating habits and physical exercise above merely providing access to nutritious food, aids in the identification of the most effective therapies for many kinds of malnutrition, including undernutrition, overweight, and deficiencies in certain micronutrients. Working together across several industries increases productivity and results by combining resources, skills, and knowledge. Leveraging their capabilities for greater effect, the health sector may offer nutrition education and counseling, while the agriculture sector can increase food production. Long-term solutions are necessary for the complicated problem of malnutrition. A multispectral strategy emphasizes long-term behavior change, capacity building, healthy eating habits, sustainable interventions, and tackling core causes across a variety of sectors. A multispectral strategy combining the health, water, and sanitation sectors is necessary to address the obstacles and problems in eradicating malnutrition. Malnutrition and diarrheal illnesses can be caused by a lack of access to clean water and proper sanitation, which can also hinder the body's ability to absorb nutrients (*A Multispectral Approach to Fighting Malnutrition*, n.d.). Multispectral approaches to nutrition can play a critical role in the eradication of all types of malnutrition by putting these future directions and suggestions into practice. These strategies bring several sectors together to carry out thorough and focused interventions, establish synergies, develop long-term solutions, and get beyond obstacles and hurdles.

Conclusion

A secure future demands both global nutrition solutions together with an environmentally friendly food system. Global statistics show that over three billion people face malnutrition which leads to non-communicable diseases that stem from inadequate nutrition and include childhood stunting and micronutrient deficiencies as well as obesity and overweight conditions. These problems need two main approaches: cutting down on unhealthy food intake and improving healthcare availability. Food and nutrition security together with biodiversity protection and ecosystem conservation and environmental protection are accomplished through sustainable food systems. Sustainable diet promotion requires action beyond individual consumer choices because it needs to tackle sociocultural and economic variables while setting worldwide standards for sustainable food production and healthy diets and providing rewards for sustainable practices.

Author contributions

All authors contributed to the study's conception and design. The study was created and the protocol was written by author Iffat Tahira. Material preparation, data collection, and analysis were performed by Iffat Tahira and Haris Maqsood. The first draft of the manuscript was written by Iffat Tahira and Haris Maqsood commented on previous versions of the manuscript. Author kehkashan Akhter, Kiran Shahzadi, Eman Zahira the literature searches and contributed a lot in Strategies Portion. The final part of the manuscript is Hinder Hunger written by Muqadas Rukhsana and Nimra Tahir. References and citations were managed by Iffat Tahira. All authors read and approved the final manuscript.

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