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Chapter

Review of Food Access in the Shade of Critical Times

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Abstract

Food security is a condition where people at all times have physical, economic, and social access to sufficient, safe, and nutritious food. Even though the world produces enough food for all humans, we have people with low access to food due to several socioeconomic variables, and this lack of food access affects their lives and health in return. On regular days, physical access to food outlets is limited by several variables and that creates categories in food access areas. In extreme weather events, the accessibility becomes more limited due to the impact on mobility, and interruption to electricity or transportation systems. These weather events increase due to climate change, and the future is highly unpredictable. The cumulative effect of climate change and pandemics increases the risk of complicated circumstances for food security. COVID-19 pandemic is considered the largest epidemic, and the onset of these large-scale future epidemics is predicted to be inevitable. This chapter will describe the extent of food access categories in Guilford county of North Carolina pre-COVID-19, and the influence of climate change and the COVID-19 pandemic on the food-access distribution.

Keywords: food security, food access, health issues, chronic diseases, climate change, natural disasters, pandemic, COVID-19

1. Introduction

It is ongoing research on how the food system influences safe and healthy diets and in turn helps toward maintaining a sustainable and resilient environment. The food system includes production, processing, packaging, distribution, marketing, purchasing, consumption, and waste food [1]. The food system addresses food security, food safety, and food quality. Food safety is food protection from food-borne illnesses, covers, handling, preparation, and storage of food. The quality of food provides nutritional benefits to the people. Food security includes food access during all times and under any condition. Food access becomes critical under severe climate events, natural disasters, pandemics, and political stress. These events influence access negatively which results in food insecurity.

2. Food security

According to The United Nation Food and Agriculture Organization (FAO), the definition of food security includes four dimensions: (i) the availability of sufficient quantity and quality food; (ii) the access by people to nutritious food; (iii) supporting well-being systems with freshwater and health care; and (iv) stable food sources [2]. Stability is the ability to access food and the availability of food at all times. Food security is a current global concern for the next 50 years and more. Food security is unequally distributed and areas such as sub-Saharan Africa and South Asia are suffering the most from food insecurity. Food securities also include food availability, affordability, food quality, and food access. Food availability also is dependent on the production, distribution, amount, and types available for purchase at stores. Food affordability is the economic cost affordability of an item. Food quality is acceptable nutrition. People's food access is influenced by their income levels, access to resources, physical environment, social environment, cost of food, their government, and trade policies.

Food security is affected by policy, environment, socioeconomic, and culture. The socioeconomic factors mean low-income neighborhoods, low access to public transportation, and a low number of food sources. Increasing the food security in a region or a county would need a collaboration of policies, investments, human resources development, agriculture research, rural infrastructure, water resources, farm infrastructure, and natural resources management. Over the 7 billion population, we have 2 billion in food-insecure because they meet one or more of the FAO's definitions of food security [3]. The population would reach between 8.3 and 10.9 billion people by 2050 and that makes food security challenges due to the current starving and undernourished rates. This hunger and lack of access to food vary in different tier-level countries, such as developed countries it is 5%, the developing countries reached 13%, African countries reached 20%, and 13% in Asian countries. Concerning the increasing population, the world will need to double or increase by 70% of the food production by the year 2050. Ten percent of the world is undernourished, i.e. 821 million in 2018. This 10% is distributed in three continents, where Asia is ranked as the highest with 514 million, Africa with 256 million, and South America and the Caribbean with 42.5 million.

Vulnerable areas to food security are also defined as "Hot Spots" [4]:

1. Vulnerable areas affected by war are facing difficulties in logistics and distribution during pandemics and normal conditions.
2. Vulnerable areas are affected by extreme weather events and pests that affect crop yield.
3. Vulnerable poor communities were 821 million people already facing food insecurity before the pandemic of COVID-19.
4. Vulnerability to food cost. These countries face major currency depreciation and that decreases their ability to import food items.

3. Food access

People's ability to access food physically and financially has an important impact on their lives. Measuring food access can be done by several methods and on several

levels. At the individual level in the United States, the National Food Stamp Survey in 1996–1997 documents people's answers about their food outlets' distance to their homes [5]. More surveys were developed in 2011 as a food security supplement survey asking if they had enough food in their homes [5]. Another measure that investigates the indirect impact is the distance to food outlets by the Economic Research Service (ERS) 2012 [5]. Further measure at the individual level is the Retail Food Environment Index (RFEI). It is a survey method about people's access to food outlets and their options [5]. Another method of measuring access to food is by the area category location of food outlets and related variables in a neighborhood [5]. In the area category location method, the access to food can be measured by the distance to food outlets, income, poverty rates, and transportation access [5]. These factors categorize tracts or districts from the poorest in healthy options to the most nutritious area. These areas are as follows:

Food desert: This phrase was firstly used in Scotland in the 1990s to define low access to food outlets due to low income [6]. After that, researchers around the world adopted the definition and applied more classifications. It is defined as areas with more than one mile to grocery stores. People living in food desert areas or tracts have limited healthy options with higher prices and limited access to public transportation [7]. The area's residents rely on small stores more than supermarkets because of location availability [7]. These small stores tend to have smaller quantities and higher prices, and fewer fresh options [7].

Food swamp: These areas or tracts have more unhealthy food outlets than healthy food options [8]. These neighborhoods are more likely to be minority and low-income [9]. Several studies proved that fast-food restaurants are concentrated in racial-ethnic minorities' neighborhoods [10].

Food oases: These areas have people with high socioeconomic status and an abundance of healthy food outlets such as supermarkets, grocery stores, farmers' markets, and community gardens [11]. This food access condition is the ideal goal for food access development where people have more options for healthy food.

The influence of food access on people's health and behavior is investigated, and it varies based on income, urbanism, population density, and people's ethnicity. Furthermore, low access to food causes several negative effects on people's health such as delayed childhood development, diet-related diseases, and malnutrition or hypernutrition. These food access areas show different records and impacts on people's lives and health [12]. Factors such as car access and income are the most critical variables in people's access to food [13]. A study in Australia found that financial aid or allowance improved people's access to food [14]. For that, government financial aid and food credits can support people's access to healthy food. People's access to transportation such as busses stations or personal cars improves their nutritional choices. In addition, walking to food outlets is not feasible in different seasons, summer limits food access due to the heat during the day, and winter limits food access due to the extremely cold climate [15]. Lack of access to adequate food is a key factor in some diseases such as obesity, diabetes, hypertension, cancer, and high mortality rates [6]. A study conducted in the United States proved that food swamps can predict obesity more than food deserts, and its prediction becomes more accurate when it is combined with income inequality and low transportation access [9]. Moreover, a study conducted in Australia proved the same hypothesis that access to transportation is more affected by people's access to food than their location in food desert areas [16].

Inadequate distribution of food outlets in urban areas influences people's well-being negatively. People's health and wellness are proven to show a negative impact

on food access in several studies in the United States and around the world. Several studies found that people with more access to fast food also indicate having higher body mass [17]. A study conducted in Philadelphia, a city ranked as the highest in food scarcity, in the surrounding area by 2 miles of fast-food restaurants, found out that the low access to fresh food sources is associated with a higher rate of health issues such as diabetes, heart diseases, and cancer [18]. A study in California illustrates obesity variation to correlate with food access, but the variation in obesity could be because of people's characteristics and diets [19]. A study compared people in the food desert and found out that people in the food desert showed more chronic kidney disease and hypertension [20]. Moreover, a recent study is conducted by our team in Guilford County in North Carolina on the correlation between accessing food and health issues [12]. Their results illustrate that food deserts show higher mortality rates and higher rates of health issues such as obesity, high cholesterol, and high blood pressure [12]. More studies on the correlation between food distribution and people's health proved a strong correlation with illnesses such as tuberculosis [21].

Furthermore, it is documented that there is a connection between food deserts, low income, low access to transportation, and diabetes [22]. Food and physical activity have a significant impact on predicting children's obesity [23].

More variables or factors influence food access such as ethnicity. In the United States, low access to food areas is in low-income and colored communities [24]. A study illustrated the investigation of people's ethnicity and their food access and choices [24]. The survey results show variation in food access based on ethnicity [24]: less healthy food was consumed more by African Americans; Latino communities have better access to healthy food; and immigrants consumed more fruit, rice, and beans [25].

3.1 Food access and climate change

The earth's climate is changing, and this change has influenced people and the environment. Influences such as population growth, migration, need for water, shelter, and livelihood have a major influence on changing the earth's equilibrium. That leads to changes in the environment such as deforestation, biodiversity loss, habitat loss, desertification, and scarcity [1]. Most of these changes are made by humans to urbanize their cities. Regarding man-made activities, there is evidence that burning fossil fuels and land use changes made cumulative effects on these events. As defined by Paul Crutzen and Eugene Stoermer, the era when human activities affect the earth, and the environment is the Anthropocene Epoch [1]. The most obvious sign of this era is climate change. These climate changes are caused by human activities on natural elements such as the increase of greenhouse gas (GHG) emissions, carbon dioxide, and methane. Carbon dioxide has been increasing from 284 ppm in 1832 to 397 ppm in 2013 [3]. Methane is a strong gas and increased from 340 ppm in 1980 to more than 420 ppm in 2022. It is about the changes in the atmospheric temperature that influences more changes. This greenhouse gas (GHG) emission increases and changes to land use are the main cause of climate change [15]. Earth temperature has been increasing since the nineteenth century. Since the 1850s, the temperature increased by 0.8°C according to documented temperature increases in oceans and lands [3]. The temperature is expected to increase by 1.8°C which is higher than in previous centuries. More recently, a report by the National Center For Environmental Information, NOAA, illustrated the temperature for more than 143 years from 1880 to 2022 [26]. The monitoring of temperature in

March over the years found that this year's temperature is 0.95°C (1.71°F) above the twenty-first century average (March 2022).

Climate change effects are direct and indirect and could affect some places more severely than others [27]. Climate change influences food security in six aspects [3]: 1—The impact is greater in high hunger countries; 2—it will increase undernutrition and malnutrition; 3—it will increase food inequalities on all scales global and local; 4—people in vulnerable conditions to extreme weather events will suffer more because of the severity of climate change; 5—the climate change effects will continue affecting the earth in the next 20–30 years because of the past carbon emissions; and 6—severe weather events will increase in severity and its future is unpredictable.

As climate change is becoming more severe sources such as clean water, air quality, low pathogen exposure, and the ability to raise, gather, harvest, and gather crops, animals, seafood, and wild food will be threatened [28]. These threats to food availability will negatively affect all human nutritional status [28]. Climate change affects food security by affecting crop production, storage, and transportation [1]. It influences the food supply chain, demand, and access on a local scale.

Since the 1990s, decreases in food security, commodity prices increase, and the decrease in per capita cultivated are documented [29]. Climate changes affect the availability of food items specifically fruit and vegetables, and it is predicted to be between 5 million to 175 million by 2080 [2]. For instance, 30% of farmers in developing countries are food-insecure [30]. In tropical and warming environments, climate change would severely increase rainfall, and it will cause pests and disease to the crops and livestock [31]. Regions such as African Sahara are influenced by biophysical, political, and socioeconomic variables, which make them more vulnerable to climate change [32]. One of the climate change impacts is the loss of cropland, and the sub-Sahara in Africa is expected to lose more than 10–20% of its crop and West Africa by 20–50% by 2050 [32]. These changes and droughts influence rain pattern changes, which has been estimated that East Africa is likely to become wetter and Southeast Africa to become drier [32]. The complexity of environmental tension with lack of food access raises the stress on vulnerable communities.

Based on climate forecasting models for the next 100 years, the land temperature will be increasing and result in lowering the crop yield in dry regions and increasing the short-term yield in high-latitude regions. These changes have a consequence on providing food, water, and shelter for humans. These affect climate changes such as temperature increases and changes in rainfall. Climate changes may influence hunger, but they could be controlled by feeding people during crises and investigations into new agricultural techniques that increase yields. Moreover, monitoring and predicting systems can be used by the government for early warning [30]. Insurance cover crops depend on remote sensing to cover the needed crops in case of drought years [30]. Investment in modified seed has more ability to survive [30]. More local policies protect local production [30]. The temperature increases are likely to impact crops negatively in the next two decades and affect corn wheat, rice, and other primary crops [30]. One of the expected effects of climate change in Mali is a hunger increase from 34% to 44% [33].

3.1.1 Food access and natural disasters

Climate change influences severe events such as natural disasters, scarcity, low air quality, unequal food distribution, and conflict over natural sources. Natural disasters hit the world differently and in some regions the effects are severe. Each natural disaster impacts several environmental elements.

Drought: It is the decrease of rainfall rates more than usual per season or year. Drought can be in several forms such as meteorology drought known as precipitation shortage, agriculture drought as soil moisture, and socioeconomic drought as influenced by other drought types [34]. The increases in drought events influence food security negatively because of water scarcity and lower agriculture yield, which affects their availability in food outlets and results in a lack of food access. Moreover, it influences the availability of food, which increases its prices because of scarcity [34]. The drought in 2007–2008 combined with increased energy prices caused a food crisis, where food prices increased more than double [35]. In the Middle East, the hydrological drought peak was in 2009 as 50% of the area faced extreme drought. Meteorological drought was documented in the early 1970s, and 2000s, and 60% drought in the period between 2008 and 2012. These drought events affected food security, especially in 2010.

Hurricane: During severe rain and hurricane events, life sectors got affected at different levels. The hurricane may affect electricity and streets. The electricity damage stops all activities dependent on it such as food refrigeration. Damages to trees and falling on roads may stop people from accessing essential needs such as food outlets. Regardless of the effect on all stores, large food outlets such as supermarkets seem to be more resilient. Natural disasters such as hurricanes can affect food sources and that results in low food availability. For instance, in Puerto Rico, 69% of farmers were experiencing food insecurity after hurricane Maria in 2017, and 38% of them were experiencing food insecurity for 3 months or more [36].

Flooding: It is when water overflows or soaks in an area that is not a river or a lake. A natural disaster like flooding has several impacts on the food system. Floods impact agriculture negatively and that affects the food available for purchase. Crops were damaged by the water overflow. In Bangladesh, the flood damaged 12% of their rice yield in 2007 [37]. In Pakistan, the flood of 2010 resulted in a crop loss of approximately 19% [37]. Some countries' experiences with floods and other natural disasters encouraged them to make an impact such as what governments of the Philippines, Malaysia, and ideas planned [36]. In the United States, severe events such as floods and hurricanes are documented between 2004 and 2014, and the country recorded 24 natural disasters with effect on 1.90 million people. These events affect people's access by damaging infrastructure which limits people's access to food [38].

3.1.2 Adapting to climate change in the food sector

Despite the fact that climate change effects are expected to increase in the next 40 years, food production needs to be increased by 50% to face the land shrinking and to provide necessary food [26]. Although we are adopting the current changes, preparedness for unexpected future changes is also highly critical. Some countries started adapting to climate change effects. For instance, Ghana adapted to the drought and rainfall changes by planning and installing early-maturing, drought-resistant crops, and applying agrochemicals [32]. In Burkina Faso, West Africa, they planned dry season crops and installed micro water harvesting systems. Several considerations are to be taken in dealing with climate change to protect food [32].

Several recommendations related to policies are identified as follows [4]:

1. Merging food security and sustainable agriculture into global and national policies.

2. Increasing the global investment in sustainable agriculture and food system in the next decade.
3. Reducing the greenhouse gas emission and negative impacts while shifting agriculture production to more sustainable productions.
4. Programs and policies targeting vulnerable communities to climate change and food insecurity.
5. Reshaping people's access to food and their consumption patterns for better nutrition, healthier, and sustainable eating pattern.
6. Reducing waste in all food systems: infrastructure, farming practice, processing, distribution, and household habits.
7. Establish a system including human and ecological sectors that share, integrate, and comprehensively all information.

3.2 Food access during pandemic

Throughout history, mankind has been exposed to several pandemics and epidemics that affected their health and life. In history, humanity faced several epidemics such as the Spanish Flu, Asian Flu, Hong Kong Flu, HIV/AIDS, SARS, Ebola, and Swine Flu [4]. In the last centuries, humans faced Bubonic Plague in the 1300s, smallpox in the 1500s, Spanish Influenza in 1918, and HIV/AIDS in the 1980s. Recently, humans faced SARS in 2002, Bird Flu in 2003, Swine Flu in 2009, MERS in 2012, Ebola in 2012, and Zika in 2015 [39].

A pandemic affects all human activities, and one of them is agriculture and farming production. Limiting people working in these production areas results in food shortages in stores. The limited quantities in food stores and outlets will increase food scarcity. The food items scarcity would increase their prices and add more burden to access. Furthermore, the pandemic spread would require people to be quarantined to protect themselves and that would limit their visits to stores.

A recent pandemic is COVID-19 which is caused by a respiratory disease [18]. The first COVID-19 cases were discovered in Wuhan, China, on January 18, 2020 [40]. After the spread of cases in several countries, the World Health Organization declared COVID-19 as a global pandemic on March 11, 2020 [41]. Based on sequencing technology on the COVID-19 virus, it was found 96.2% of bats as a possible source of SARA-CoV2 [42]. When the pandemic started, the United Nations World Food Program warned the world that by the end of 2020 approximately 265 million people would suffer food insecurity, which is more than 135 million people in food insecurity conditions before the pandemic.

Countries such as the United States announced restrictions on traveling and interactions [43]. Firstly, face masks were mandated mostly in every country and social distancing was highly encouraged [43]. Moreover, negative COVID-19 tests were required in emergencies, 24 hours before travel, to limit the spread in destination countries [43]. Schools were shut down and students adapted to online education for the first time in history. Some countries enforced curfews to limit people's interactions and the spread of the virus. The goal of these restrictions was to contain the pandemic spread, but they had a negative psychological influence on communities.

At the beginning of the pandemic, India had only 36 COVID-19 cases and 7 death cases. On April 5, 2020, the cases were 3577 and 83 deaths but rose rapidly to 508,953 cases and 15,685 deaths by Jun 28, 2020. The government took actions to control the spread by restricting traveling and imposing a lockdown effectively from March 24, 2020, to May 24, 2020, at different levels. In the United States, the first case was documented on January 20, 2020 [44].

In India, the pandemic changed people's consumption patterns [45]. In rural areas, people's income was affected by the lockdown, and people in villages consumed lower-quality food during the pandemic [45]. In Australia, according to a survey study, households' food security decreased because of the pandemic, and that affected people's habits and cooking.

In the beginning phase of the pandemic, people panicked and started buying excess food and household goods. That led to limitations on people's access to sufficient food and changed their food habits and cooking. The lockdown restriction impacted the supply chain through a labor shortage and that affected food availability and access. The pandemic reduced 25% of labor. Moreover, the pandemic affected food availability in poor countries and with low national security. Consumer shopping patterns have changed due to the pandemic increases. The pandemic encouraged businesses and farmers to change their business models and use online ordering, pickup, and delivery.

The FAO admitted the huge loss of food and agriculture by the pandemic. Dealing with the pandemic influence, the FAO advised countries to focus on food requirements for vulnerable communities, supporting social safety programs and supporting small local farmers. The food index documents food prices monthly and during the pandemic in 2020 prices of cereals, oilseeds, dairy products, meat, and sugar had the lowest point since December 2018. For example, palm oil production in Indonesia and Malaysia was affected by the pandemic labor shortage which resulted in restrictions on exporting palm oil from January 2022 through March of the same year [46]. Moreover, according to the FAO, the pandemic affected small farmers and fishermen, who had declined in their supplies and that declined their ability to cover their finances.

The COVID-19 pandemic affected the supply chain strongly and affected food security, especially for vulnerable communities, and they have less food storage to last during the pandemic. There are 10 countries with 103.3 million people suffering from a food crisis [47]. In countries like India, the demand increased for long shelf life vegetables such as onion and potato but decreased for short shelf life vegetables such as fruits and grapes. Developed countries were affected, but their dependence on technologies helped them subsidize the labor work, and developing countries were affected severely because of their independence from human labor. The fear of contracting the disease is strong on people's mental health as a secondary effect of the pandemic, and it was proven that mental disorders are higher in communities with food insecurity [48]. The restricted lockdown affected people's mental health which increased depression and that increased people's food consumption and panic buying [48]. Furthermore, vulnerable people to contract the virus are people facing chronic health conditions such as cardiovascular disease, diabetes, chronic respiratory disease, hypertension, and cancer.

This pandemic caused an international food emergency. In Europe, the pandemic increased the food demand by more than 50% with the lockdown [49]. In Europe, food supply stores were banned from exporting without warning to deal with the pandemic uncertainty [49]. In Europe, food consumption increased due to the

lockdowns and remote working [17]. Spain took similar restrictions with the world and declared a state of emergency on March 14, 2020 [17]. In Spain and Italy, the pandemic restrictions encouraged people to adopt healthier diets [17]. In Spain, people were experiencing food shortages in stores by 64%. Then pandemic people started stockpiling nonperishable food items and buying extra items every trip to avoid the shortage [17]. In turn, it caused a change to buy food from local farms and organic sources [17]. In Spain, younger people less than 40 years of age increased their food consumption more than people over 40 and 50 years old during the pandemic [17]. In Germany, Denmark, and Slovenia, people consumed longer shelf life food and less fresh food. In the United States, because of the pandemic, people changed their food source and where they eat. Since the beginning of the pandemic to January 2021, the United States had more than 21 million infection cases and 350,000 deaths, which count as 20% of the global total cases. Since the pandemic onset, the unemployment rate increased to 7.9% in September 2020, a level not seen since the Great Depression. By December, 14% of adults were not having enough food across the United States.

Before the pandemic in 2017, three Arab countries were importing 100% of their cereals, namely Qatar, Kuwait, and Bahrain, and the United Arab Emirates at 99% [50]. Moreover, seven Arab countries import approximately 90% of their grains, namely Jordan, Amman, Palestine, Yemen, Saudi Arabia, Libya, and Lebanon [50]. Algeria is also at high risk of food crisis depending on importing 79% of its grains [50]. Countries like Tunisia, Mauritania, and Iraq import more than 55% of their grains. Egypt imports 44% of its [50]. The least dependent Arab countries are importing 40–33% of their grain in Morocco and Sudan [50]. In Algeria, products like semolina, flour, dry grains, and pasta became unavailable because of the demand increase and that led to prices increase, and the government took the lead to secure food sources and control monopoly and speculation [50].

The responses to the current pandemic may change the environment, and it is an opportunity to create a multidisciplinary solution for human livelihood and future generations. The Avian Influenza (H5N1) pandemic in 1997 in Hong Kong led them to create “One Health” to predict, control, and minimize future outbreaks [51]. The One Health is a multidisciplinary work in local, national, and global stakeholders [51]. Some considerations to lower the pandemic effect on different regions such as Africa: 1—develop the health system capacity by the public fund in Africa; 2—financial aid needs to be distributed among individuals, entrepreneurs, and corporations, so they contribute to lowering the negative impact of the pandemic; 3—during the pandemic and lockdowns, employees should be given incentives and; 4—central banks in African countries need to support domestic banks to save credit and liquidity. One of the consequences of COVID-19 in Africa is putting approximately 29 million people under the extreme poverty line as expected by the United Nations Economic Commission for Africa (ECA).

Because of the land use change and more human interaction with animals and the environment, more transmittable diseases are emerging. Changes in climate and people activities and land use changes cause habitat disruption and lead to pathogen movement [47]. Emerging infectious diseases (MIDs) are increasing with climate change and make a dangerous nexus. These diseases are increasing the food cost and lowering production which limits access to food. By 2030, poor counties are expected to import their food by 2%. Support from the framework is needed for these accruing matters. A framework called Document Assess Monitor Act (DAMA) is applied to deal with these issues.

1. Document: by identifying pathogens based on the current information available and their occurrence location before. Then, document the pathogen and its incident by time and place and consequences.
2. Assess: to detect related microbes, place them under the monitor. This phase includes two steps: A) phylogenetic triage and studying the pathogen. When it discovers a chance of disease spread, it will be reported to the authorities, and B) analyzing these concerning pathogens and connecting them to old diseases to estimate a prediction of spread location.
3. Monitoring: by resampling these potential threats regularly and investigating vulnerable areas to the spread.
4. Act: after the invention of the current situation, the management plan forms to formulate an action plan to act on a specific situation.

Following are the important issues recommended in the pandemic era:

1. Consumers are changing their food habits to a healthier diet. Foods rich in vitamins and nutrition support the immune system such as vitamin C. Foods rich in vitamins such as carrot and spinach are known for their ability to fight susceptibility to infections.
2. Safety from the virus spread on products. Food items can carry the SARS-CoV-1 virus and people after touching it and touching their face can catch the virus. For that, carrying bags of food items needs to be followed by intensive hand washing. Studies documented that the COVID-19 virus can live up to 2 years in a frozen state.
3. Food security due to the lockdown. Food shortages during a pandemic affect people's health and increase hunger. For that, the government should maintain emergency plans to keep all food supplies going.
4. Food sustainability. Fighting hunger by supporting food security is in the United Nation for sustainable development. Sustainable food sources contribute to healthy lives and well-being.

Future recommended actions to deal with future pandemics are given as follows [52]:

1. Additional support to the sustainable development goals, and assistance to local and small producer communities and backyard gardens in low middle-income countries.
2. More engagement and understanding between consumers and producers to support the food system's resilience to pandemics.
3. Identifying sequences and legislation to deal with it.
4. Identifying future risks and setting up risk management plans.

5. More support and funding for scientists to do research development and training in food systems.
6. Support the perspective of “One Health” to encourage all countries to work together on mitigating pandemics’ effects on people’s health around the world.

3.3 Food access during war

Food access becomes extremely critical when a country is under political stress. War is one of the events that create ripple effects on different countries outside the war scene. It demoralizes humanity that it could happen to any ordinary person in this situation. When a war happens in a country, its residents and business lose their ability to export and import food, which leads to low access to food for people in the war country, its neighbors, and importers. However, a war in one country can affect the whole world by affecting its food production as is the current case with Ukraine and the Russian war.

According to the world health organization, the Syria war that started on March 15, 2011, is the worst humanitarian crisis in the twenty-first century [53]. However, even before the war, people of Syria were having difficulties accessing freshwater 93% in urban areas and 86% in rural areas [53]. This war impacted people’s lives, education, and health. The war complicated the access to food and water. It is documented that 90% of people of Syrians were having difficulties accessing food [53]. Moreover, one in seven children is not fed regularly [53]. Documented studies illustrate that 32% of children had signs of malnutrition [53]. Furthermore, approximately 62% of infants did not have access to the best substitute feeding [53].

The war between Eritrea and Ethiopia from 1998 to 2000 caused a food crisis in both countries [54]. These two countries are among the vulnerable countries to food security [54]. Before the war started, the world health organization warned that more than 16 million people are starving because of the drought, 50% in Ethiopia and the rest in Kenya, Somalia, and Uganda [54]. Moreover, 40% of Ethiopian farm households were in chronic food insecurity [54]. After the war started, food items prices increased, and that affected people’s access [54]. Moreover, food was weaponized by soldiers, and farmers were stopped from harvesting their crops which led to food unavailability for people to access [55].

The recent food crisis is going on in the whole world in 2022. Because Russia invaded Ukraine on February 24, 2022, the country was not able to export its yield to its regular customers [56]. This limitation on exporting affected food security, fertilizer prices, and energy globally [57]. The FAO report on food crises because of the war in 2022. In March 2022, food prices were higher than average by 29.8% compared to the previous year in 2021. Countries started hoarding food in fear of inflation and food crises. The effect of the war on food is greater in countries facing food insecurity, especially with the rise of people suffering insecurity from 768 million in 2020 to 869 million in 2022. Countries that export most of their wheat from Russia and Ukraine such as Egypt, Lebanon, and Yemen are affected severely by the food shortage [34]. Moreover, countries were facing food insecurity and drought such as Ethiopia, Kenya, and Somalia [34]. Even before the war started, Ukraine and other countries were having high prices. Ukraine wheat prices were historically high because of energy and oil prices, drought, and the effect of the COVID-19 pandemic.

During the Russian and Ukraine war, both countries announced they are unable to export grains. Their announcement led to some panic buying and country hoarding.

Countries started to ban exporting their crops to protect their markets and make them available to their residents at controlled prices [58, 59]. For instance, India limited its wheat to deal with the loss of 15–20% of its crop because of the heat wave [34]. India is the second largest wheat producer, and Indonesia which produces 60% of the world's palm oil restricted limitations on these food goods [56]. Argentina banned beef, soybean, and soybean meal [57]. Russia banned sunflower seeds, wheat flour, and pasta [57]. Ghana banned the exportation of maize, rice, and soybean [56]. Algeria banned pasta, wheat, and vegetable oil [56]. Egypt banned vegetable oil, corn, wheat, wheat flour, and pasta [57]. Serbia banned wheat, corn, and wheat flour [57]. Kuwait banned grains and vegetable oil [57]. Other countries followed suit such as India, and they stopped their grain imports. Countries like Kazakhstan announced their limitation on flour and wheat on April 1, 2022, for 6 months [57]. Wheat producer countries in the black sea region have 30% of the wheat in storage to feed the world [34]. The loss of wheat from Ukraine could be filled by countries including India, Argentina, Australia, and Canada, but shipping prices are high due to energy prices [34].

4. Conclusion

Food security and equality are about the availability and safe access to nutritional food. These characteristics of food security influence people's health and their chronic conditions. Unequal access to healthy food impacts people's health negatively. People's access to food may be limited by their lack of transportation access and low income. Improving these conditions would improve people's access to health and fresh food. Food insecurity is influenced by several conditions such as environmental changes, pandemics, and wars. These conditions show a severe impact on vulnerable countries' food security. The combination of more than one condition increases the risk of food insecurity. The combination of the COVID-19 pandemic with the Russian invasion of Ukraine increased the food crisis globally and food importation. The impact of these food access areas can be improved over time. Several considerations can be applied in future to improve the food access conditions, and they are government support by adding more public transportation stops, supporting low-income communities through policies and financial aid, increase young people's nutritional awareness in schools, increasing the percentage of fresh fruit and vegetables in convenient stores, improving the healthy food options in food swamps.

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Conflict of interest

The authors declare no conflict of interest.

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