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Somalia, Malnutrition

### **Combating Vitamin B1 Deficiency in Somalia**

The Federal Republic of Somalia is located in the Horn of Africa and is informally known as Somalia. Somalia is an Islamic country and the population estimate is to be around 15,940,309 as of August 13, 2020 according to the Worldometer. However, the exact amount of population count is unknown because of the number of nomads and refugees who are mobile due to famine and clan warfare. The average Somali living situation is a three generation household, consisting of the eldest couple, the sons and their wives and unmarried daughters, and the grandchildren and children of the married couples. It is tradition the wife moves in with the husband's family at marriage. In Somalia, gender roles play a huge role in their daily lives. The women are responsible for acquiring and preparing the food, whilst the men are generally involved in the financial and security aspects. Life expectancy for the average Somali is about 56 years old as of 2018, which is lower than the global average. The low life expectancy may be largely due to the poor health care within the country, since Somalia is among the lowest in the world. Countrywide, only about 46% of people have received immunizations, and the numbers are lower in remote areas, according to the World Health Organization, (WHO). Approximately, "1.1 million displaced people [are] living in sub-standard conditions" (WHO) meaning that outbreaks such as Measles and cholera are more likely to occur in these areas. The most impacted area is the capital of Mogadishu.

In 2011, the United Nations announced famine in Southern Somalia, which in turn affected 3.1 million Somalis, and left about half a million malnourished. The drought was one of the main causes of the famine, along with conflicts within the Transitional Federal Government and the African Union Mission in Somalia against the jihadist group, Al-Shabaab. Their goal is to expand the Islamic state, not necessarily force it onto others. These two sides were fighting over governance and the environment within Southern Somalia. The Islamic group made it difficult to access major food aid agencies. The country's internal conflict has impacted the education system by proving the lack thereof. Without a stable central government the school systems are poor in quality and numbers. Along with the poor quality, the internal conflict has also caused around 50,000 school aged children to be unable to enroll due to being displaced and 3 million children are not enrolled in total. The conflict has also impacted transportation within the country as well, causing the Somali Airlines to close in 1991. Other than that, the people use buses, minibuses and trucks. However, donkeys, camels and cattle are used in rural areas.

Agriculture is critical to the economy of Somalia. They produce things such as corn, sorghum, beans, rice, vegetables, and sesame. Somalia depends heavily on imported food to assist with food aid, despite agriculture being a major source of employment. As another consequence of COVID-19, food insecurity has heightened due to change in market supply as well as income (USAID). The UN World Food Program along with other organizations are working to assist those impacted by food insecurity with the goal to prevent the situation from becoming worse.

The climate generally consists of irregular rainfall, hot climate and drought. The dietary habits are stable throughout the country being that the country is Islamic. Therefore, they do not partake in things such as pork, improperly slaughtered meat, alcohol, blood and blood products, and lastly gelatin. However, their motto is “No meat, no meal”, so researchers can suggest that their diet is rich in meats such as goat. Even with this known though, the malnutrition rates are among the highest in the world. A report by UNICEF reported that around 1.2 million children under five years old are predicted to be acutely malnourished, while another 232,000 are thought to be diagnosed with Severe Acute Malnutrition (SAM). The numbers vary by study, due to the often inability to access accurate numbers because of the internal turmoil the country suffers from.

The literacy rate of ages 15 and over was expected to be 25.1% for men and 13.1% for women in 2005. Around 200 million children under five years old in Somalia have significantly impaired growth. These same children are often left behind in regards to education and development, mentally and physically. Due to the decades of instability, the younger generations suffer by becoming vulnerable to the aspects they lack due to the war and political confusions during their youth. The political conflict added onto natural disasters, such droughts, created a land drained with famine, lack of access and children to be raised in a society where proper education is nearly impossible. The lack of access is what is also leading to the malnutrition in Somalia, specifically among children. The children do not have access to health or access to the proper foods necessary to develop their bodies and brains alike.

Malnutrition is the lack of proper nutrition, caused by not having enough to eat, not eating enough of the right things to eat, or being unable to use the food one does eat, according to the Oxford Dictionary. There are four types of malnutrition: wasting, stunting, underweight and deficiencies in vitamins and minerals, according to The World Health Organization. There is a lack of Vitamin B1 in Somalia, which is doing nothing but making the malnutrition issue more severe. Vitamin B1, or thiamine, is what converts carbohydrates to energy within the body. The brain, skeletal muscles, kidney, heart and liver are rich in thiamine. Carbohydrates are starches, fibers and sugars found in vegetables, fruits, grains and milk products. These are critical to any diet and operate as the body’s main source of energy. There are three enzymes secreted within the intestinal cells: Sucrase, lactase and maltase.

It is important for nerve, heart and muscle function, as well as glucose metabolism. Vitamin B1 is water soluble and helps with the flow of electrolytes in and out of the nerve cells and muscles. Without a sufficient amount of Vitamin B1 in the body, a person may experience fatigue, vomiting, nausea, as well as difficulty concentrating and change in personality and memory. Long term effects are permanent nerve damage, permanent brain damage, as well as death if too fatal. Thiamine deficiency may also come from vomiting too much and also not eating as much as you should. The deficiency causes brain tissue injury.

Thiamine doesn’t store in the body for a long time, only for about 9-18 days. The daily requirement intake is 1.2 mg for men, and 1.1 mg for women. For pregnant or breast-feeding women, the requirement should be 1.4 mg a day. The minimum dosage is about 0.66 mg; for children, the recommended dosage is dependent upon age. From birth up to around six months old, the dosage is around 0.2 mg, and 0.6 mg

from six months to about 8 years old.

This deficiency adds onto the poor education conditions within Somalia discussed earlier.. To revisit, 3 million children are out of school due to the long distances and poverty, even with this, with the amount of children they are malnourished, education isn't the first priority. Malnutrition itself can also cause issues between the growing of synaptic and dendritic spires and cortical cells, according to a report by Prof. Aida Mendoza-Salonga. These are critical for cell-to-cell communication, especially in the hippocampus and cerebellum. Malnourished children specifically have a difficulty adapting to stressful situations along with impaired school performance, according to the same study. Lastly, malnutrition affects the plasticity growth of the brain and therefore, greatly impacts the brain development as a whole. The deficiency of the Vitamin B1 can accelerate the already negative effects of malnutrition and damage children's ability to develop correctly, as well as grasp academic concepts if they are given the opportunity to attend natural schooling. Side effects of the deficiency include difficulty concentrating and permanent nerve damage. Nerve injury can cause loss of motor and sensory function, causing long chronic pain to be an issue.

In 2016, Somalia was known to have about 1.75% of cultivated land. As mentioned previously, the climate of Somalia is generally dry, having irregular rainfall. Therefore, the main challenge is finding crops that have Vitamin B1 that can also be grown in the conditions of Somalia. Crops native to Somalia are sorghum, sesame, rice and beans. One of the major imports of Somalia is rice.

Having too much thiamine can inadvertently cause abdominal cramps, excessive thirst, skin conditions, diarrhea along many other conditions. But, the chances of overdosing on thiamine is a very obsolete probability due to the fact that it is water-soluble. Meaning, that it is excreted in vast amounts via urine, feces or vomit. Cholera, which is common in Somalia, is an infection that causes watery diarrhea, which leads to dehydration or death. The causes can be ingesting contaminated food or water. In January 2020, a report came out saying that 240 out of 1018 cases tested positive for *Vibrio cholerae*. *Vibrio cholerae* is the bacteria responsible for cholera.

Biofortification is the process of breeding crops with a higher concentration of vitamins and minerals. By increasing the nutritional value, it allows people to gain more vitamins and minerals, without having to overeat and cause obesity. Genetic engineering in foods would be injecting the desired vitamin into the food and therefore changing the DNA of it. Benefits of genetic engineering are reduced costs for food/drug production, a higher percentage of nutrients within the drug, increased crop yields along with a decreasing amount of food insecurity. Although these benefits are world changing, there are also some downsides to it. In the same way it is beneficial to the body, it can also damage it due to the body because of the difference in nutrition content as well as negative responses to the increase in nutrients. While some genetically engineered processes such as virus and insect resistance have been approved, vitamin enrichment is still in the works. The introduction of micronutrients through fortification is being used in Canada under certain conditions and guidelines. According to a study by NCBI, in the 1930s and 1940s deficiency diseases were being newly documented in the United States. This caused the Committee on Food and Nutrition to call for the adding of niacin, iron, thiamin and riboflavin to flour. It was referred to

as ‘enriched’ flour and had the sole purpose of improving the ‘nutritional status of the population (FDA, 1941).’ Although fortification increases the nutritional value, in the 1940s, the FDA made a decision that it is not mandatory for a food to undergo fortification, according to the same study by the NCBI. With this information, it is evident that biofortification of foods has been used before under similar circumstances. The purpose of this paper is to have Genetically Modified Organisms as a solution to fight against malnutrition in Somalia.

Sorghum is rich in Vitamin B1, having 26% of the Daily Value. Sorghum can be used in granola snacks or used as a grain in cooked dishes. It’s more beneficial to be eaten in whole grain to get the most of the nutrition. The grain also has antioxidants, promotes blood circulation and has strong dietary fibers. The dietary fibers help regulate the digestive systems. Pistachios are also rich in Vitamin B1, and are high in antioxidants as they can help prevent cell damage. The antioxidants in pistachios specifically are absorbed during digestion, meaning that during this process, the nutrients should also be distributed throughout the body.

Some foods are already fortified with thiamine. These foods are things like rice, pasta, flour and cereals. 100 grams of thiamine holds 15% of the daily value, and per cup around 30% of the daily value, specifically with brown rice. White rice holds about 73% of the Daily Value just in a half of a cup. Rice is a starch, also making it a kind of carbohydrate. Rice can be grown in varying conditions, and the fortified version of it is able to help combat micronutrients in the world. The issue with fortification however, is that there is little evidence suggesting that it actually improves our health. Dangers of fortification include adding vitamins at dangerous levels and making food less bioavailable. Bioavailability is the ability to absorb and use the proportion of nutrients. By synthetic versions being not natural, the body may respond differently.

Biofortification can be done in three ways: transgenic, conventional and through agronomic approaches. Sorghum is one of the staple crops that is mostly targeted by all three of these. Breeding has been effective when genetic diversity is present. “When genetic diversity is unavailable, genetic transformation is the better option,” according to NCBI. The transgenic approach is used when there is little to no genetic variation ‘nutrient content’. If a micronutrient is not naturally produced within the crop, the transgenic approach is the only option to fortify the crops. In this case, the best approach to fortify the sorghum is through the transgenic approach. However, the issue is sorghum is that their grains are not as digestible as other crops.

Ways to make sure these various crops are planted and distributed properly, corporations such as Scaling Up Nutrition (SUN) can help make sure it is implemented fully. SUN’s foundation is to ensure that the world is rid of malnutrition by 2030. Amidst the pandemic, SUN along with the European Union and UNICEF are working together to prevent malnutrition in children. Much like Somalia, the pandemic has affected Nepal and the developing countries are struggling to make ends meet within their country for their citizens. With the correct connections and resources, SUN should be able to redirect funds to pay for the fortification of the crops. Secondly, Relief International is working in Somalia towards providing

healthcare, education, water and sanitation. With their organization already being on the ground in Somalia, they can work to implement biofortification under their healthcare umbrella of work. By utilizing both of these organizations to Somalia's advantage, the country in due time will be on the way to combating malnutrition.

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