

Challenges and Solutions to Increase Fresh Food Consumption in Food Desert and College Campus

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Abstract

Food deserts are regions where low-income households do not have access to the affordable fresh foods. Many socially conscious grocers, NGOs and government programs have tried to address the problem. However, the problem persists.

Busy college students also consume far less fruit and vegetables than the FDA's recommendations on many college campuses. Georgia Tech students only consume half of the recommended portion. This may be due to limited on campus dining options, stress, or simply preference for flavorful foods. In addition, 78% of GT students have their eating habits get worse during busy weeks. The low consumption of fresh food leads to poor nutrition, poor health and poor performance. Our study identifies four factors that can affect people's choice of food, which are affordability, accessibility, convenience, and palatability. The combination of these four characteristics hinders simple market solutions.

In the food desert, the assistance programs are needed. We have identified current programs, such as SNAP or food stamp, and potential programs such as shuttle services, subsidized food delivery services, farmer's markets, etc.

Each assistance program has its cost structure. We need to find the best allocation of funds among assistance programs in order to offer a more fresh and diverse food supply in the food desert.

On campus, nutrition education, community refrigerator, community garden, nutrition focused food supply in dining halls can be potential solutions.

Keywords:

Food desert, processed food, fruit, vegetables, supply chain

1. Introduction

USDA 2020-2025 Dietary Guidelines for Americans recommends 1 – 4 cups/day of vegetables and 1 – 2.5 cups/day of fruit for the population [1] For the college age students, the ranges are 2.5 – 4 for vegetables and 1.5 - 2.5 cups of fruit. The exact number of cups depends on the gender and total calorie intake. The problem with low consumption of fruit and vegetables becomes more prevalent among children and adolescents [2,3]. Our survey from 149 Georgia Tech students shows alarming signs. For vegetables, the respondents only consume 57% of what they desire and 53% of FDA's recommended amount. For fruit, they only consume 54% of what they desire and 65% of FDA's recommendations. The initial 15 responses from food desert show stronger concern on affordability and taste than convenience and accessibility. Their vegetable consumption is much lower than their fruit consumption. In this paper, we aim to study the reasons for the low consumption of fruit and vegetables on campus and in food deserts.

2. Problem Description

It is well established that fresh fruit and vegetables are essential parts of a healthy diet, but low consumption among children through college students and the existence of food deserts are long-lasting problems. People lacking balanced nutrition are more likely to have poor health, low productivity, and higher healthcare costs. More importantly, children who grow up in such an environment are accustomed to fatty, salty, sweet, strong flavored, and processed food. They will continue to have problems with health, productivity, high healthcare costs, and economic wellbeing, leading to many other social issues in underserved communities. Government, Non-

governmental organizations (NGOs), and activists spend billions of dollars each year to assist low-income households; however, the problems persist [4].

3. Related Research

Many researchers have studied the problem from different perspectives. In terms of cost, Rao et al (2013) concluded that a healthy diet cost \$1.50 extra than unhealthy counterparts. Kern et al (2017) found that the average price ratio of healthy to unhealthy food is 1.97 with a standard deviation of 0.14. In terms of convenience, Hamrick (2014) found in the 2014 Eating & Health Module (EHM), a supplement to the Bureau of Labor Statistics’ American Time Use Survey (ATUS), the average time Supplemental Nutrition Assistance Program (SNAP) recipients spend in meal preparation is 50 minutes per day [5]. This is quite significant. Buying fast food can save 31 minutes per day; using packaged food can also save time. Psychologists have also studied this issue. Scaglioni et al (2018) showed that the human brain often favors short-term rewards rather than long-term benefits, such as taste, comfort, and convenience [6].

4. Methodology

First, we apply the supply chain principles and supply and demand of fresh fruit and vegetables to identify the major factors that lead to the problem. The second method is to develop and conduct surveys to identify how these factors contribute to the low consumption of fruit and vegetables. We initially target two communities. The first is the college campus, where our student group has good knowledge. The second is in the food desert. The design of the two surveys shares some similarities but also has some differences.

4.1 Fruit and vegetable supply chains

Figure 1 shows the simplified supply of processed food as opposed to the supply of fresh fruit and vegetables. Human beings have always been challenged by food supply for the population until recently in developed countries. Food supplies are seasonal, low yield, and subject to local weather and many other challenging conditions. Fresh fruits and vegetables have a limited shelf life. They are fragile and irregular in shape and weight which cost more to handle. People have developed many technologies to overcome these challenges. Modern farms and logistics systems can transport large quantities of fresh foods to the processing plant at a low cost. Fresh foods are cooked, salted, fermented, sealed, and packaged at these plants. The processed and packaged foods are homogeneous in shape and weight, easy to handle, and have a much longer shelf life. As a result, their prices can be lower than their fresh counterparts.

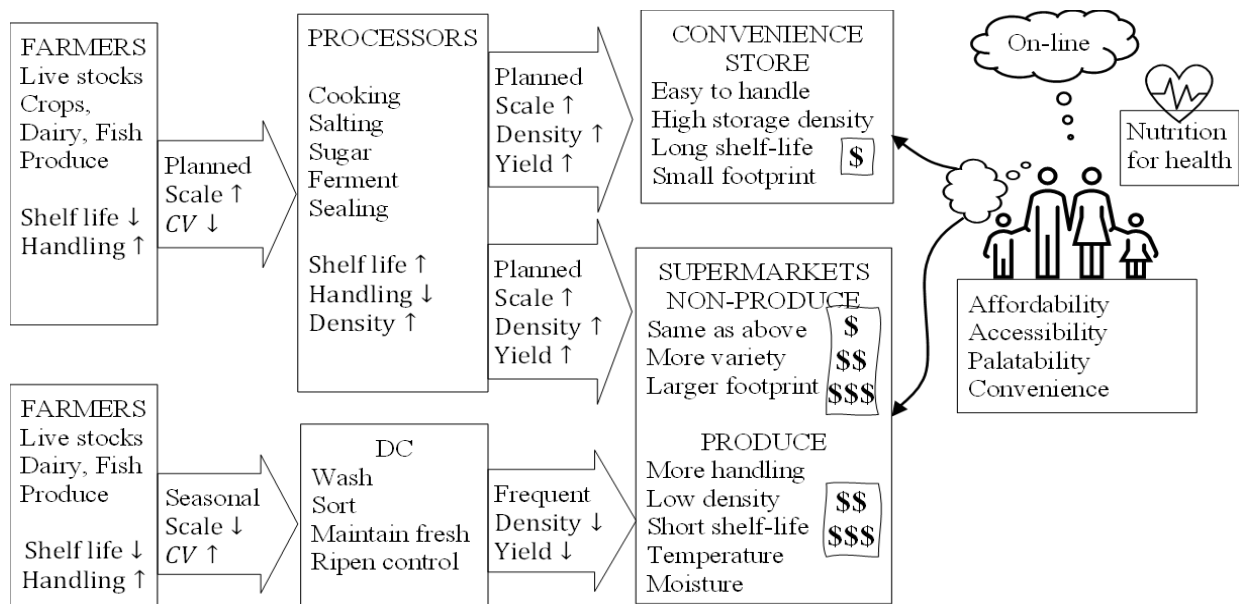


Figure 1: Supply chains for processed food and fresh food

The supply chain for fresh fruit and vegetables is significantly different from processed food. In Figure 1, the fresh food chain is in the lower box. The process is shorter but more challenging and with higher costs. At the end of the chain, the consumers purchase their food mostly from convenience stores or supermarkets. In this study, we focus on groceries and did not include restaurants or fast food. The factors we chose to focus on are influenced by the four factors in the box on the right.

4.2 Affordability and accessibility

We will first address affordability and accessibility since their influences are connected in the food desert. FDA defines food desert as whether consumers without cars can access a major food outlet within 1 mile. Major food outlet refers to supermarkets or major grocery stores with at least \$2 million in annual sales and containing all the major food departments. For areas with low-income or less dense population, large-scale grocery stores with fresh food do not have sufficient market to justify its operational cost.

On the other hand, convenience stores, such as drug stores and discount food stores, have smaller footprints and require minimum infrastructure and personnel. They can make sufficient profit with the low cost processed food and other merchandise they carry.

4.3 The economic influence of affordability and accessibility

Demand and supply for fruit and vegetables take place in local communities. As price increases, demand decreases and supply increases. The supply and demand at the local market will reach the equilibrium and determine transaction price. The relationship between the price and supply quantity can be modeled as a reverse demand model shown in Figure 2. The price at a supermarket p decreases with an increase in supply q . The cost to supply is c . Most people in the US live in low density communities. They depend on cars to get to where they need to go. With the car, they can reach major supermarkets in miles away. Therefore, a major supermarket can serve a large community with high demand, shown in the solid green line. The maximum possible price any person would pay to the supermarket is P_{sup} . The maximum market size is Q_{sup} . The supermarket can sell at some price above c and respective quantity to make a profit shown in the green rectangle.

Food deserts is different. The reverse demand curve for a convenient store is the blue line connecting P_{conv} and Q_{conv} . The reason for the lower maximum price is due to lower income. The reason for smaller market size is that the walking distance will only include a small customer base. The population in the region with cars can drive to the other supermarkets. Therefore, the maximum price is lower than the cost, and there is no market solution.

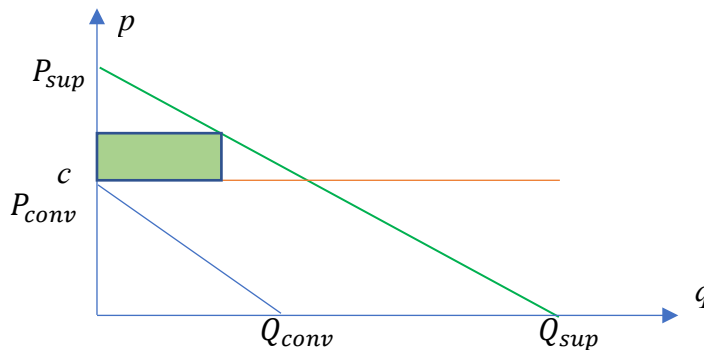


Figure 2: The reverse demand curve, cost, and profit

4.4 Palatability or food preference

Food choice, preference, or palatability for an individual depends on many factors. One of the factors is the types of food offered during a person’s childhood. Research also shows that the human brain often favors short term rewards, such as taste, comfort, and convenience, rather than long term benefits. Food processing offers a chance for suppliers to use low-cost seasonings and appealing package design to attract consumers. Suppliers also apply modern psychology and artificial intelligence to study what works and what does not. These already have a strong impact on the consumption of fresh food.

4.5 Convenience

Fresh vegetables are inconvenient to consume. The washing, cutting, mixing, and cooking take time. They also require running water, electricity, cookware, stove, and other kitchen utensils or equipment. Most fresh vegetables are subtle in flavor, good cooking requires significant skill. Preparing vegetables for consumption also takes a large amount of time as the study shows. However, processed vegetables in frozen food, canned food, and other prepackaged foods, are much easier to consume.

Fresh fruit is not hard to prepare. The cold chain and the use of containers have helped the fresh fruit supply chain tremendously, and the availability of refrigeration and coolers help the consumption of fruit a lot. However, they can be quite costly.

The ripening technology extends shelf life significantly. It also increases the availability of fresh fruit far away from the farm. However, artificially ripened fruits tend to be less tasty, less appetizing, and less nutritious.

5. Results and Potential Solutions

Our initial survey received 243 responses from students. Among them 149 completed all the questions. The selections of first and second out of the four priority choices from the completed surveys among the four factors are shown in Table 1.

Table 1: The priority selections in the descending order of priority

	Palatability/taste	Convenience	Affordability	Accessibility
First choice	50	42	39	18
Second choice	38	50	44	17

Taste, convenience, and affordability dominated the responses. It is interesting that the unfinished responses are very similar in percentage in this regard.

Table 2: The vegetable consumption in cups per day

	Average desired amount μ_D	Standard deviation σ	Average consumed μ_C	Standard deviation σ	Gap	Standard deviation σ
Vegetables	2.8	1.01	1.6	1.04	1.2	0.77
Fruits	2.4	0.97	1.3	0.90	1.1	0.86

Note that we found what students desire is already lower than the average amount recommended by FDA. The actual consumption of vegetables is only 57% of the cups they desire. The actual consumption of fruit is only 52% of the cups they desire. The respondents also provided the challenges in achieving the desirable number of cups through a series of questions.

In addition, we found that for students, the most impactful factor that makes healthy choices challenging is lack of time, followed by price, limited transportation, and distance to grocery stores. These needs to be addressed when we develop our potential solutions.

5.1 Potential Solutions for Palatability and Convenience

For students who prioritized palatability, 78.4% reported their eating habits got worse during busy weeks. Increasing the palatability of fresh food is challenging - consider the taste of fresh kale versus canned southern-style kale. Palatability can be nurtured through exposure and weighing the short-term satisfaction against long-term health benefits. Cosmi et al (2017) showed that early taste experiences impact food choices in the future [7]. Johnson (2016) studied the developmental and environmental influences on young children’s vegetable preferences [8]. Palatability to fresh food can also be gained through preparing food from fresh ingredients. Chu et al (2013) show that help with preparing and cooking food was associated with higher fruit and vegetable preference [9].

One potential solution is to provide students with the knowledge of how to cook fresh ingredients in an easy, healthy, and palatable way. It can be incorporated into the general health education. The cooking methods can be passed around in the form of recipe, and the school can provide more tools that facilitate cooking. For instance, we can set up a community fridge for students on campus to temporarily store their fresh ingredients or self-made meals. Although there is currently one community fridge on campus, the impact was insignificant due to its affiliated program and the lack of outreach. We are proposing placing a new community fridge in the Industrial and Systems Engineering Main Building, to create a more accessible fridge for ISyE majors. We felt that starting with a fridge in a smaller department building would help us a “test run” to determine its feasibility. We will promote this concept and find its impact through a longitudinal survey.

5.2 Potential Solutions for Affordability and Accessibility

More than a quarter of the students who participated in the survey prioritize affordability. Cost has prevented 84% of them from purchasing fruits, vegetables, and lean proteins for at least half of the time or more. Meanwhile, about 11% of the students prioritize accessibility. Although 73% of them believe that cars have a medium to strong influence in increasing their frequency of going to groceries, what stood out from the result is that 44% of the students prioritizing accessibility walk to the groceries. If making groceries closer is not realistic, then establishing an environment around campus that is safe for walking can be helpful.

While USDA spent over 73 billion dollars through SNAP (food stamp), NSLP (school lunch), SBP (school breakfast), CACFP (child-adult program), SFSP (summer), NSLP (after school) programs, the consumption of fruit and vegetables continues to be low. For the community in society, most US cities are built for cars with a low population density. Public transportation lacks a wide coverage area and a high-frequency schedule. As a result, they are not helpful for people without a car. For the community on campus, we also need to look for ways to bring fresh food on campus with a lower cost. The modern economy offers many additional solutions such as delivery, rideshare, crowd-based transportation services. From the survey, the biggest reason preventing students from using delivery service are the economic concerns (such as delivery price, membership fee, etc.), personal preference, and issue with receiving. We have just started the exploration of these solutions.

6. Next Steps

The next step of our research is to get more responses to understand food desert problems in American households. The current results from the survey targeting community food desert areas indicate that most households prioritize affordability and palatability. There is also a significant increase of the percentage of frozen ingredients and frozen meals in their groceries compared to college students. It was interesting to find people also eat fruit more than the amount they desire, but less vegetables than they desire. This reflects that people are more likely to eat based on their preference because fruits are more enjoyable compared to vegetables. We are planning to gather more results to have a better picture of fresh food consumption at a broader level and develop concrete solutions to help people with food insecurity.

7. Conclusions

This research identified the key factors that hinder the healthy consumption level of fruit and vegetables. The initial survey results revealed that these factors significantly contributed to low consumption. The problem is very challenging and would take much more effort to achieve practical and verifiable solutions.

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