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Philadelphia College of Osteopathic Medicine
Graduate Program in Biomedical Sciences
School of Health Sciences

**ASSESSING THE ROLE OF THE INEQUITABLE FOOD ENVIRONMENT IN
THE OBESITY EPIDEMIC**

A Capstone in Public Health by Samuel G. Latzsch
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Submitted in Partial Fulfillment of the Requirements for the Degree of
Master of Science in Biomedical Sciences, Population and Public Health Concentration

May 2021

ABSTRACT

The prevalence of obesity has more than doubled in the United States within the past forty years, and children that are raised obese are more likely to have health complications and a shorter lifespan. The onset of the obesity epidemic coincided with numerous factors which likely played a significant role in drastically shifting the food environment and dietary habits of Americans. The food production industry notable capitalized on industrialism and innovative technology to mass produce packaged products that are energy-dense and full of preservatives to increase shelf-life duration. These measures which aimed to secure widespread food availability have resulted in an imbalance from excess caloric intake and an imbalance in dietary composition. While outright food accessibility is still an issue for nearly one-tenth of Americans, the issue of food security has transformed from one of quantity to quality for many individuals particularly in urban settings and lower socioeconomic populations. The now trillion-dollar food processing industry is producing and strategically marketing their most profitable products which have been affiliated with obesity. To combat the obesity epidemic, concurrent interventions must be taken to address inadequate federal policy, production, distribution, and personal perceptions through education in nutritional efficacy.

BACKGROUND

I. RISING OBESITY TRENDS

Excess body weight has historically been a sign of wealth and food abundance for a small faction, but the past four decades has brought this condition to the majority. Since the 1970s, the United States has pioneered the obesity pandemic with a nearly threefold increase in prevalence and consistent record-breaking rates in obesity.^{9, 21} Recent data suggests that nearly three out of every four American adults carry a degree of excess body mass and are characterized as overweight.¹⁹ These current statistics indicate that the national obesity incidence is persistently climbing and has more than doubled since 1980.⁵ The accepted definition of obese stipulates a body-mass index (BMI) of 30 kg/m² or greater to convey a disproportionate ratio of body weight per area. 42.5% of the U.S. adult population, or over 70 million individuals, fit this description.¹⁹ An additional classification has been created to discern the 9.2% of Americans that exceed a BMI of 40 kg/m² as severely obese.⁹

While all trends attest to the crisis, disparities exist across sex and race. While men are more likely to be overweight, women are more likely to reach the threshold of obese and severely obese. Race is also a powerful determinant, as non-Hispanic black Americans have the highest rate of obesity at 49.6%. In contrast, only 17.4% of Asian Americans adults are deemed obese. Rates for Hispanic and white Americans exist near the average at 44.8% and 42.2%, respectively.¹⁹

To measure obesity in children and adolescents, the Center for Disease Control (CDC) integrates data from five historical studies spanning from 1963-1994 to generate a standard model for BMI interpretation stratified by age and sex.²³ 19.3% of Americans under the age of 18 years exceed the 95th percentile of BMI and are accordingly classified as obese. Variability in the onset of childhood growth and development are not sufficient to explain the unequivocal rise in youth BMI for the fourth straight decade.⁴² These rates substantiate the notion that the obesity epidemic is not generationally isolated and can be seen in the earliest stages of childhood.^{3, 33, 47}

In its most salient form, obesity is the consequence of energy storage in the body from a net caloric excess over time; the energy intake in the form of food and beverage is greater than the output through formal exercise and homeostatic processes. Obesity exclusively is not life-threatening, but excess body weight can exacerbate the likelihood for a plethora of noncommunicable diseases. Metabolic syndrome is the collective identity of risk factors for cardiovascular disease, stroke, and other life-threatening conditions. These factors include hyperlipidemia, hyperglycemia, hypertension, and an increased waist circumference.¹⁰ Severely obese Americans are 7.37-times more likely to develop adult-onset diabetes and 6.38-times more likely to develop hypertension.² Over thirteen types of cancers, such as pancreatic, thyroid, liver, and kidney cancers, are also shown to correlate with a higher BMI.² In summation, these conditions account for over half of all deaths in America.⁴⁵ Obesity is suggested to have an influence on at least 300,000 annual deaths in the U.S.¹⁴ Even those apart from the obese population are faced with economic tolls and healthcare saturation. The comprehensive cost of obesity-linked U.S. healthcare bills was estimated at \$147 billion in 2008.²² Nearly half of this amount

was expensed through taxpayer-subsidized Medicare and Medicaid.¹³ The toll of seeking treatment and living through these diseases has been estimated to have lost at least \$3.38 billion in productivity.²²

II. ORIGINS OF GROWING OBESITY PREVALENCE

The steep climb in obesity over such a short timespan indicates something more than an arbitrary causation. Therefore, the onset of the epidemic must be contextualized with major developments in the United States around the 1970s. One hypothesis imparts advancements in technology which lead to automation, urbanization, and mechanization dominated the cultivation of sedentary lifestyles and a substantial decline in energy output. The current recommendation for U.S. adults to engage in five hours of aerobic or strength training each week is only met consistently by approximately 23.2% of the population, yet the caloric expenditure has not depreciated significantly in recent generations.²⁷ While this claim of inactivity may carry merit as a contributable factor, evidence from the delayed globalization of the American-oriented “Western Diet” links the caloric consumption with the obesity trends in over seventy countries.⁵⁰

Food producers too capitalized on these technological advancements in the forms of mass production, food preservation, and packaging efficiency.⁴ Lower production cost and higher output led to 3,900 kilocalories of food per person every day after accounting for exports to malnourished countries by 2000.¹⁶ The abundance of calories not only reflects the innovation for efficiency but also the growth in crop production due to restructured legislation. The 1973 U.S. Farm Bill stripped production caps that previously stabilized supply and demand in the aftermath of the Great Depression. Moreover,

subsidies were offered to encourage maximum yield. While this allowed the agricultural industry to grow and increase exports, the government strategically invested subsidies only in crops such as corn, soybeans, and wheat because of their extensive shelf-life and versatility in industry.^{30, 12} These taxpayer-funded subsidies continued to grow the grain surplus and promote the utilization of these crops as raw materials for production of artificial sweeteners and oil concentrates. By 1997, the the industry was so significantly overcompensated that corn was sold for 23% below the basic production cost.⁴⁹ These savings were passed on in the value of approximately \$20 billion worth of livestock feed to the meat production industry to also proliferate this sector.⁴⁹

III. THE PROCESSED FOOD RENAISSANCE

Food processing loosely defines the process of altering food prior to sale to the consumer. This wide breadth in identity can include minimal modifications such as pre-chopped vegetables to entirely reorienting products from milk to ice cream. Minimal processing can benefit consumers by reducing prep-time or increasing accessibility and shelf-life. Alternatively, ultra-processing can utilize sophisticated techniques to manipulate the food contents or derive pure units such as carbohydrates, sugars, and oils.¹⁵ A staple of the grain refinement industry is the production of high fructose corn syrup. Corn is utilized as the starting material to derive complex carbohydrates and cleave them into simpler sugar constituents. During this process, the carbohydrates are stripped of other metabolically relevant elements such as vitamins and fiber, which provide essential metabolic functions, are abandoned to prioritize taste and versatility as an additive. These conventional carbohydrate and lipid isolates are further used in

practically all products across the typical grocery store to enhance taste and create artificial flavor.³⁷

Like all businesses, large food manufacturing organizations operate to create revenue through their products, and taste is their dominant intention. Food manufacturers employ neuroscience and psychology to create the empirically best tasting products.²⁶ Developers funnel sizable portions of their budgets toward experimental trials to find the exact proportions of added sugar, fat, and salt that create the most palatable and desirable product for their consumers.⁵² This scientifically calculated balance is coined as the “bliss point” and is used to model the final product.³⁷ The increased satisfaction will lead to greater consumption and sales, yet the unintended biological consequences of these flavorants can compound. Primarily, the added caloric density aggregates into a greater energy consumption for the same perceived volume of food. Cascading signals require around twenty minutes to communicate satiety from the digestive system to the brain, and significantly more calories can be consumed from calorie-dense foods during this period.⁶ An extreme carbohydrate consumption can cause blood glucose concentrations to spike and could eventually lead to inflammation and insulin resistance.⁴⁰

As an evolutionary mechanism, humans evolved to activate dopaminergic pleasure pathways in the brain to reward food consumption. Sugars and fats best activate these receptors and produce the greatest signals because of their high energy capacity in catabolic processes. This mechanism was beneficial when meals were not habitual, and an energy surplus was prized as storage for later use during prolonged fasting. Studies uncover a natural preference for naturally energy-dense foods such as a partiality to potatoes over cabbage.¹⁷ However, when these processed foods are engineered for

energy-density, a single bite can maximize taste receptors activity and exploit these inherent reward signals. Many ultra-processed foods show no direct correlation between caloric concentration and preference, thus suggesting that the taste receptors are completely saturated. Ongoing studies investigate the role of these reward center and the coercion of an addictive tendency. The dopamine signals in mesolimbic regions from food response is nearly identical to the pleasurable response of addictive drugs such as cocaine or opioids. When substance-dependent drug users are given visual cues for their substance, their brains reveal patterns in neural reward regions. Similarly, research indicates that obese individuals produce patterns of activity in these conserved regions in response to food cues.¹⁵

Processed foods have taken off in popularity as snacks and packaged foods have filled the niche previously held by home-prepared meals. As more women work seeking employment, cooking and preparing meals became a shared chore within the household. Since 1960, the average time spent preparing food halved to less than one hour per household per day.⁴³ However, the total calorie consumption has increased to about 3,600 kcal daily per day.⁴⁴ These extra calories are likely not from eating more food but just more dense food which dominate the realm of packaged and easily accessible foods. Intake of added sugars has climbed by 20% and added fats have risen by 38%.³⁶ Beverages with added sugars in the form of soda and fruit juice are consumed by about one in two Americans every day, and this source alone can contribute around 30 grams of added sugar and over 100 kcal for a singular eight-ounce serving.^{25, 48} These aggregated trends are ample to rationalize the rise in daily calorie intake and the subsequent weight gain.

IV. DIVERSITY AND INEQUITY IN GROCERS

Food stores are classified by their availability and diversity in options. Grocery stores and supercenters typically offer over 25,000 food and beverages options, yet convenience stores and small shops carry a smaller inventory of basic items with longer shelf-life opportunity.²⁹ On average, shelf space for processed foods is disproportionate to that available for fresh fruit and vegetable options in all stores. In convenience stores, the ratio of packaged to fresh is 1:10, yet full-scale grocery stores still only offer about half as much shelf space for fresh items as packaged.¹¹ Further, an estimated 70% of all packaged foods and beverages in a grocery store contain a form of added sugar.³⁴ The retail space in these stores is also subject to capitalistic competition, as food suppliers bid for the prime shelf spaces in the grocery store through slotting fees. Psychology is again utilized to determine consumer shopping patterns including eye movements and where to place child-targeted products within their line of sight.²⁹ The collective industry invests more than \$22 billion annually in slotting fees to grocery stores.

While the transformed food landscape may explain the nutritional imbalance, some American communities are not offered abundant choice due to geographic distance and inequities in food security. A food desert describes a community in which there is a significant deficiency in accessibility to fresh and nutritious food options from a lack of availability or affordability.²¹ Availability is a measure of healthy food vendors, such as grocery stores, produce markets, and superstores, and their physical distance from residential neighborhoods. Public transportation, climate, and the urban-rural classification of the community play vital roles in the practicality of these sources and must be assessed accordingly.³⁹

The presence of healthy food options is not enough to rule out a possible food desert, as economic barriers could ultimately determine whether these foods are truly accessible. Urban hubs undergoing rapid gentrification are particularly susceptible to the appearance of but not at a price conceivable for residents. These areas that appear to have accessibility but are financially infeasible are conceptualized as food mirages.³² Higher income communities are more likely to have personal transportation at their disposal, so a proportion of the community must be deemed as impoverished to warrant an affordability concern.⁹ The United States Department of Agriculture (USDA) formally recognizes a food desert with a population of at least 500 individuals, or one-third of the local population, living more than one urban mile, or ten rural miles, from a grocery store. This interpretation places approximately 53.6 million Americans in a food desert.³⁸

While this conventional definition can assess the general accessibility for a community, individuals that fall below the median may be discredited for their difficulties. The food desert can be a reputable measure of fresh and healthy food options, but the contribution of convenient stores and restaurants are also ignored.³⁹ A 2009 study recognized this deficit while examining the food environment of the urban regions in New Orleans. The researchers found that using various proposed parameters to identify a food desert gave inconclusive results and an unreliable perception of food access. Alternatively, the team coined the term “food swamp” to perceive areas where healthy options were simply outcompeted, or swamped, by the vast fast food and convenient alternatives. Their claim asserts that the fixation on food deserts is antiquated, and attention must shift to the growing leverage of unhealthy options. There are approximately two convenience stores for every grocery store or supercenter.¹⁸ Nutritious

food inaccessibility is still a reality for some Americans, but many regions, particularly in concentrated urban centers, now have a saturated food market supply which progresses the problem from one of quantity to one of quality.^{7, 8}

V. FOOD INSECURITY INTERVENTIONS

The U.S. government has implemented a collection of initiatives aimed to address food security. The Supplemental Nutrition Assistance Program (SNAP) is a federal program of the USDA to provide essential foods to impoverished families and individuals. Over 40 million Americans utilize this food assistance program alone. The specific benefits are scaled by income and household size, and the average benefit is \$1.39 per person per meal in 2020.¹⁸ Each state has the authority to determine eligibility from more local considerations, but the federal requirements stipulate eligibility for all Americans at or below 130% of the national poverty line.¹⁸ Over 40 million people participate at any given time including approximately 20% of all households with a child under the age of five years.⁵¹ After registration and verification, participants receive a unique EBT card with their allotted funds to be used at over 200,000 SNAP-participating stores. These funds can only be applied to a domain of eligible items such as fruits, vegetables, meat, dairy, and grain products.¹⁸

To address food insecurity to more specific demographics, other programs work in conjunction with SNAP. The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) ensures nutrition and family education for pregnant women, mothers, and children under the age of 5 years. WIC services are available to nearly half of all woman and children with 14 million receiving benefits annually.²⁸ Children over

the age of 5 years can also qualify for numerous food assistance programs through public schools such as free or reduced-price lunch in the National School Lunch Program (NSLP). While a portion of these participants are deemed chronic recipients, the aim of all of these programs is to provide relief for children and families under transient financial hardships.¹⁸

RESEARCH STRATEGIES

The obesity and general demographic statistics was collected through USDA and CDC records. The National Health and Nutritional Examination Survey (NHANES) is a subsidiary of the CDC which runs surveys and collects nutrition and public health data. Preliminary facts from these sources shaped the project to explore the underlying causes of the modern disparities in obesity.

PubMed was next utilized by integrating keywords and sifting through hundreds of reports. Most information was sought from secondary reviews and reputable fact collection agencies. TED Talks were a vital source of new literature and the contributed to the evolution of the final scope of this project.

Federal programs and initiatives were assessed through their websites, press releases, and social media. News articles with program participants delivered a more personal account and demonstrated the actions taken in pursuit of their published goals.

DISCUSSION

The U.S. obesity epidemic is a clear public health concern. Substantial prevalence and growing incidence signal that the resulting healthcare and economic strains will persist until greater interventions are implemented. Nutrition and health are multi-faceted reflections of the food environment and communities, and the obesity epidemic displays numerous shortcomings in healthy food utility. No intervention will result in an immediate resolution, but reshaping conceptions at the levels of policy, production, and perception can extend lives and stabilize the crisis.

Policy intervention must start with the issue of racial and socioeconomic disparities. The current SNAP operations must be reassessed to improve the financial efficiency and stabilize the food security of participants. The current SNAP operations are controversial to a portion of taxpayers and politicians for its suggested role in chronic program dependence and the obesity epidemic. A 2018 study found the average cost of a no-frill meal to equate to \$2.36. This exceeds even the maximum allotment of food assistance benefits and indicates that households with no additional income allotted to food spending are still not meeting the minimum requirements to constitute consistent guaranteed meals. With tight funds and a relative freedom in purchasing options, it is logical that participants will purchase the most filling foods that will provide the most calories per dollar. SNAP, formerly known as Food Stamps, has long carried a stigma of reliance and embarrassment for participants. Previous efforts to amend the program provided discretion for participants by implementing non-conspicuous EBT cards and

requiring all vendors to integrate the process with those of other store patrons. Program organizers are reluctant to introduce regulations that could combat these ill-advised purchasing tendencies because of the possible reluctance to utilize the program.

However, if benefits were provided in the form of items or food units, this could ensure adequate nutrition and eliminate the price variations across the nation. Participants could recommend foods and disclose dietary restrictions during the application process to ensure dietary restrictions and cultural appropriations are validated.

Although substantial evidence suggests that the inception of mass food processing coincided with the onset of the obesity epidemic, big food corporations are hesitant to acknowledge their accountability. These companies are not exempt from pressures for high performance and maximum returns for their investors, but their unique posit in nutrition as a universal commodity places every individual as a potential consumer. By equipping science and psychology in pursuit of the objectively best product, food manufactures are capitalizing on evolutionary loopholes and humanistic weaknesses. The hyper-palatability of their products through the strategic implementation of fat, sugar, and salt synthesizes novel yet desirable neurological consequences that are practically parallel with substance dependence in drug abusers. The sugar refinement process even resembles the cocaine manufacturing process to isolate, distill, and concentrate the desired product. This transfigures the model of one-time purchasers to lifelong patrons by drawing marketing comparisons to the societal enemy known as the tobacco industry.³⁵

Many of the largest food corporations deny accountability for the obesity pandemic that is plaguing their consumers not because of moral deficiencies but for the shareholder satisfaction consistent profits. Spokespeople for some corporations will

deflect their responsibility by shifting the issue from one of poor nutrition to inadequate exercise. This strategy, known as leanwashing, additionally allows these organizations to access the opposing market that addresses the problem in which they contribute.³⁴ Coca-Cola is the largest soft drink producer in the world and sells over 1.9 billion servings of their sugar-sweetened beverages every day. The company founded a nonprofit organization in 2014 called The Global Energy Balance Network with the mission to promote a “healthy balance” between caloric intake and expenditure. While seemingly neutral in nature, a potential conflict of interest arises with the fact that the Coca-Cola company produces products that have been linked to supporting the obesity epidemic. As a result, the Global Energy Balance Network focuses on promoting exercise as a remedy to obesity, avoiding discussions of dietary choices that could implicate the company in the epidemic and affect Coca-Cola’s profits and business model. Nestle, the largest food producer in the United States, has products that range in health rating from highly processed snacks and chocolates to the entire line of Lean Cuisine frozen meals which are marketed as dieting strategies. This company is offering remediation for their contributions to the obesity crisis through profitable intervention methods rather than removing their primary involvement.

When cheap and delicious prepackaged foods are available, the relative cost of fresh produce is a major deterrent from buying healthy foods, and consumers with no intention of buying these items may even by-pass grocery markets for convenience stores. The disproportionate pricing of produce is rooted in agricultural policies from the 1973 Farm Bill. Reallocation of the subsidy budget to support the cultivation of fresh produce could incentivize farmers to grow these admitted less-profitable crops. Only 2%

of American farmland is utilized for fruit and vegetable cultivation, yet approximately 59% grows corn, soybeans, and other commodities.²⁰ Shifting subsidies could relieve the relative cost two-fold by lowering production cost for produce and shrink profit margins on crops that are commonly used in processing. Having competitive produce options accessible does not ensure a shift in dietary habits, so the increase in supply must be complimented with an increase in grocery store demand.

Race and socioeconomic status are correlates with both food insecurity and obesity. Hispanic and black Americans make up a disproportionate amount of the total food insecure households. Nearly 20% of all black families do not have consistent food security, and over 97% of food desert residents meet the criteria for SNAP. America's Healthy Food Financing Initiative is an organization that operates to open stores with healthy food options in these areas with low security. An increase in produce vendors can connect fresh food producers to consumers, but the demand must still match the supply.

While producers and suppliers are ultimately responsible for what goes in the stores, individuals are ultimately responsible for what goes in their mouths. Delineating blame is fruitless at this stage of the obesity epidemic, but a coordinated effort to shift both the supply and demand within the food environment can restore energy balance and take the foot off the accelerator of the obesity crisis. It is an uphill, mutli-front war to reconstruct the food industry and reprioritize nutrition in food choice, but recognizing the shortcomings of the inequitable food market is an overdue step. Without intervention, the current youth could be the first recognized generation to have a shorter life expectancy than their parents, but the fate of the future Americans can be restored with prompt intervention.

RECOMMENDATIONS FOR FUTURE STUDIES

Future studies should investigate the impact of variable regulation in SNAP and other food security programs. This would require government sanctions but could reveal true tendencies of SNAP-eligible participants and their ensuing dietary habits. Additionally, more conclusive information could be collected by following chronic and transient participants to identify factors that can help families migrate above the poverty line.

Another realm of study might revisit the relationship between food deserts and their likelihood to develop into food swamps. With no supermarket presence, fast food retailers dominate the entire food market. Additionally, recognition of specific retailers' patterns of expansion such as assessing the communities into which Whole Foods opens stores and the health outcomes in a prospective cohort study.

Finally, research should dive into the education system and the nutritional competencies of school children. Childhood is when dietary patterns start, and the ability to read food labels and recognize relatively good and bad health decisions can impact their lifelong health. The current food label mandated on all packaged foods offers information about the macronutrient composition and ingredients, but perhaps additional requirements or additional resources could be easily accessible for consumers.

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