



Food Chain and Food Policies: Causes and Solutions for the Obesity Pandemic

REVIEW

NISHTHA SAREEN, MD, MPH

SHIVANI WATSON, MD

NINA E. HILL, MD

ERIC J. BRANDT, MD, MHS

KRISHNASWAMI VIJAYARAGHAVAN, MD

*Author affiliations can be found in the back matter of this article

HOUSTON
Methodist
DEBAKEY HEART &
VASCULAR CENTER

ABSTRACT

This article highlights the prevalence, epidemiology, and pathophysiology of obesity in the United States, including its increasing link to cardiovascular disease (CVD). We discuss food policies—ranging from societal to regional, state, and federal levels—and their healthcare impact. While multiple examples show some success in reducing the global obesity pandemic via the food chain, much research is still needed to demonstrate the robust impact of these multi-prong interventions and their ability to decrease the CVD burden.⁸

CORRESPONDING AUTHOR:

Krishnaswami Vijayaraghavan, MD

University of Arizona, Phoenix, Arizona, US

kvijaymd@gmail.com

KEYWORDS:

obesity; food chain; food policies; pandemic

TO CITE THIS ARTICLE:

Sareen N, Watson S, Hill NE, Brandt EJ, Vijayaraghavan K. Food Chain and Food Policies: Causes and Solutions for the Obesity Pandemic. *Methodist DeBakey Cardiovasc J*. 2025;21(2):14-22.doi:10.14797/mdcvj.1509

INTRODUCTION

Obesity is a pandemic that continues to impact people of all backgrounds, ages, and races, and the widening gap in healthcare disparities contributes to this underrecognized and suboptimally managed health condition. The obesity epidemic first appeared in the United States (US) in the late 1970s and then spread to other westernized countries.

Globally, 50 million people die every year from noncommunicable diseases compared to 24 million who die from infectious disease. Two billion people go to bed overweight and 800 million go to bed hungry.¹ About one in two people in the US have diabetes or prediabetes, and one in four of these are teenagers. A food monopoly of \$15 trillion is controlled by Big Food, Big Seed, Big Agriculture, and fertilizer companies,² with food waste accounting for 40%.

Additionally, only 2% of American farmland is used to grow fruits and vegetables for human consumption, despite the US Food & Drug Administration recommendation that 50% of our diet should come from fruits and vegetables.

Interestingly, the increase in obesity shows minimal association with changes in Americans' intake of fat and carbohydrates. Rather, obesity likely has resulted from changes in the quantity of calories consumed, the quality of the food supply, and marketing of convenient, highly processed foods from cheap agricultural inputs. In fact, the factor most closely linked to the epidemic is ultra-processed foods (UPFs), foods with a high content of calories, salt, sugar, and fat but with very low nutritional value. Consumption of sugar-sweetened beverages (SSBs) also leads to higher energy intake and more weight gain.¹

A similar pattern is seen with other low-priced UPFs that are increasingly popular at fast-food restaurants. Approximately 60% of the American diet comes from processed food, and for every 10% of a diet from processed food, the risk of death increases by 14%.¹ While many believe that one's personal sense of discipline in their eating habits is the solution to reducing the obesity pandemic (see related article on [obesity as a disease by Avenatti et al., *Methodist DeBakey Cardiovasc J.* 2025;21\[2\]](#)), there is a need to modify inadequate policies, including the Farm Bills implemented by the US Department of Agriculture. How we grow food, how we produce, distribute, and promote it, what we eat and what we waste are indeed complex labyrinthine processes. However, these types of policies are a dominant force that promote destruction across the globe, depleting human, social, economic, and natural capital. If a physician's first priority is "To first do no harm," then we all must explore the entire food chain: from seed to field to fork to landfill. A reluctance to recognize the interrelated nature of this problem will only perpetuate disease-related suffering.

This article highlights the prevalence, epidemiology, and pathophysiology of obesity in the US followed by discussion of food policies and their healthcare impact. The policies discussed range from societal to regional, state, and federal levels. While multiple examples show success in reducing the obesity pandemic across the globe, much research is still needed to demonstrate the robust impact of these multipronged interventions.

THE OBESITY PANDEMIC

DEFINITION, PREVALENCE, AND EPIDEMIOLOGY

Obesity is the plague of our era, doubling in prevalence globally since 1990 and rising to alarming levels among the young and in high-income countries. Even low- and middle-income countries have rising obesity rates despite their younger populations, and their obesity rates will soon match those of high-income countries. The World Health Organization (WHO) defines obesity as an abnormal accumulation of adipose tissue, with a body mass index (BMI) of over 30 kg/m². Asian countries have lower obesity cutoffs, with China > 28 kg/m² and Japan and Korea > 25 kg/m².³ The US Centers for Disease Control and Prevention reports that in every US state, at least one in five adults are obese, and at least one in three adults are obese in almost half of the states,⁴ with the prevalence varying by age, education level, and ethnicity.

Children with obesity are five times more likely to become adults with obesity compared to children without obesity. Targeting weight gain and preventing obesity in the young is key to cardiovascular disease (CVD) prevention.⁵ Rising socioeconomic disparities in obesity rates are mostly driven by lower education levels, especially among women.⁶ Non-Hispanic Black individuals have the highest prevalence of obesity in the US, followed by Hispanic adults.⁷ Despite the increasingly appreciated link between obesity and CVD, obesity has been underrecognized and suboptimally addressed by cardiologists. The increase in obesity is closely linked to an increase in CVD burden.⁸ Patients with obesity have an almost 2-fold risk of all-cause mortality, and two-thirds of that (67.5%) is due to CVD.⁹

Obesity directly affects the heart, independent of other CVD risk factors, and is a major target for CVD risk reduction.¹⁰ Moreover, it leads both to premature deaths and to a growing economic burden. The highest number of obese individuals live in the US, China, and India.¹¹

CAUSES AND UNDERLYING PATHOPHYSIOLOGY

While the root causes and ramifications of obesity are many, it is likely that the prevalence of obesity has

tripled in the last 50 years due to environmental factors more than genetic ones. While BMI provides the most useful population-level measure of obesity, variations in the amount, type, and distribution of fat are not reflected in the BMI.¹² Fat distribution and fat type are key: higher visceral (not subcutaneous) abdominal fat carries a greater CVD risk.¹³ This underlies the Y-Y paradox (named after the study authors, Yajnik and Yudkin), whereby similar BMIs do not carry similar adiposity or cardiometabolic risk.¹⁴

At its most basic level, obesity is an imbalance between overeating and physical inactivity, with a possible underlying genetic disorder of energy homeostasis.¹⁵ There are 74 key obesity genes on energy expenditure and homeostasis based on the genome-wide association study and the latest bioinformatics tools. Excess calories from the diet are stored within the abdominal region in different distributions.¹⁶ Yet the association between obesity and intake of fat and carbohydrates is tenuous. Rather, the obesity pandemic probably resulted from the quantity of caloric consumption and the quality of the food supply accompanied by marketing of convenient, highly processed foods from cheap agricultural inputs. UPFs with a high content of calories, salt, sugar, and fat but few whole foods along with consumption of SSBs are likely causes of the obesity pandemic.¹⁷

Obesity has a domino-like effect triggering elevated blood pressure, dyslipidemia, and impaired glucose metabolism, and the speed of this effect is accelerated by genetic predisposition, socioeconomic status, and ethnicity. Excess adipose tissue sets off a proinflammatory cascade leading to systemic insulin resistance and glucose and fatty acid dysregulation.¹⁸ The Visceral Adiposity Index (VAI) is a specific and sensitive marker of obesity's cardiometabolic risk.¹⁹

Obesity is not a stand-alone disease entity with a specific constellation of requirements; rather, it is a significant risk factor for cardiometabolic diseases.²⁰ It appears to impact the immune system by “switching on” a proinflammatory macrophage phenotype from the anti-inflammatory macrophage phenotype seen in those without obesity.²¹ In addition, the cells of adipose tissue behave differently depending on whether an individual has obesity. Individuals without obesity secrete anti-inflammatory adipokines, while those with obesity secrete pro-inflammatory cytokines.²²

The pathophysiological change from obesity leads to metabolic dysfunction on a small scale and organ dysfunction on a broad scale. Adipose tissue plays an integral role in the endocrine system, since aggregated fat composes the largest endocrine tissue and communicates with all the other tissues.²³ Leptin is a proinflammatory

cytokine secreted proportional to the person's amount of fat.²⁴ A major anti-inflammatory adipokine is adiponectin, which is reduced in those with obesity.²⁵ Adiponectin reduction in obesity induces insulin resistance and leads to diabetes mellitus.²⁶ The stimulating effect of leptin on cell proliferation and differentiation is a key link to obesity, significantly increasing the risk of cancer for an individual since these processes are also found in cancerous tissue.²⁷

SOLUTIONS AND POLICIES

UNDERSTANDING THE POLICY

PATHOPHYSIOLOGY: HOW WE GOT HERE

By World War II, it became common knowledge that ammonia mixed with fuel oil, chemically fixed as ammonium nitrate, could make either explosives for bombs or fertilizers for crops. Using the leftover ammonium nitrate from the war, the US government converted all 10 of its bomb-producing plants to fertilizer-producing plants.²⁸ The fertilizer production catapulted US farming from relying on solar energy (photosynthesis) to fossil-fuel energy by creating monocultures of livestock and crops: the fertilizer boosted productivity enough to separate livestock and its manure production from crop production and crop rotation, ending the cycle where animals replenished the fertilization (manure) that crops depleted. Crop yields exploded with this new fertilizer and flooded the market with cheap grains, since the government began paying farmers the difference between the farmers' cost to grow the crops and the market price. These subsidies also allowed livestock to be fed this cheap grain since it cost less to buy than it cost farmers to grow, which created the feedlots of meat and dairy animals.²⁹

The US Farm Bill, a multiyear law, is the main policy legislation that sets these subsidies.³⁰ While the US government sponsored grain crop subsidies, it simultaneously kept sugar prices high by limiting sugar imports with sugar quotas. This seemingly paradoxical stance has led to the use of cheaper corn subsidies—incorporating high fructose corn syrup (HFCS), sugar's less expensive substitute—in almost all processed foods. HFCS is not taxed and is supported by farm bills, leading to low retail prices for HFCS-filled foods and drinks.³¹ In fact, the latest farm bill, HR 8467, has allocated a net increase of about \$43.4 billion over 9 years for the commodity support program (subsidies).³² The policies to subsidize HFCS created the onslaught of cheap processed foods that were filled with HFCS, keeping prices low for the average US citizen. Since then, the obesity epidemic has been driven

by widely available and affordable highly processed “junk” food filled with cheap sugars, starches, and oils.

In addition, since the 1970s, the US government has promulgated low-fat diets, initially in the Dietary Guidelines for Americans federal nutrition program. This was reinforced by societies and institutions, such as the American Heart Association (AHA) and National Institute of Cancer (NCI), promoting the concept that heart disease and cancer were linked to fat consumption. This snowballed into the WHO and the US Surgeon General issuing their own documents, further perpetuating low fat a decade later in the 1980s.³³ Businesses rode this wave of low-fat enthusiasm to increase their profits in conjunction with the AHA endorsing their low-fat heart healthy products with their stamp of approval etched on every product. By the end of the 1990s, 55 companies had over 600 products certified as low fat, many of which were sugary cereals (ie, Kellogg’s Frosted Flakes). These policies paradoxically led to products low in fat but high in sugar and calories, contributing to a 50% increase in obesity within the US since the 1970s.³³ Thus, the policies that created the fast-food industry now fuel patients with chronic diseases seen in the healthcare industry. [Figure 1](#) summarizes the issues impacting the US food chain and cycle.

The meteoric rise of obesity in the US has prompted policy changes at multiple levels. Despite wide-ranging impacts of these policies, the quality of evidence informing them may be moderate to low. The US Department of Health and Human Services defines best practices as “at least preliminary evidence of effectiveness in small-scale interventions or for which there is potential for generating data that will be useful for making decisions about taking the intervention to scale and generalizing the results to diverse populations and settings.”³⁴ Additionally, these policies may focus exclusively on population health without considering equity between subgroups. Next, we explore specific policy solutions to the obesity pandemic at the system and societal levels.

LEVELS OF POLICY INTERVENTIONS

CONSUMER POLICIES

Menu Labeling

Calorie labeling on restaurant menus has been practiced with mixed results, with many people failing to notice labels³⁵ but several studies demonstrating small decreases in total calories per meal.³⁴ Since 2018, the US Food and Drug Administration has required food establishments with 20 or more locations to have calorie labels on their menus. Several large US cities have similar requirements in place. Cities and states could strengthen this policy by extending it to all food establishments regardless of size.

Sugar-Sweetened Beverage Tax

Excess sugar intake is a key driver of excess weight gain and cardiometabolic disease.³⁶ On average Americans consume more than three-times the daily recommended limit of added sugars.³⁷ Sugar-sweetened beverage taxes, which may reduce demand for SSBs due to higher prices, have been instituted in several large US cities.³⁷ Instituting state-wide or federal excise taxes on SSBs could significantly extend this policy impact.

Transparent Marketing

Food and beverage companies spend over \$14 billion yearly on marketing, most of which promotes unhealthy foods. These advertisements specifically target minoritized groups such as children and adolescents and Black and Hispanic individuals.³⁸ Though food companies have pledged to self-regulate according to the Children’s Food and Beverage Advertising Initiative, research has demonstrated failure to meet self-imposed standards.³⁹ Federal standards must be enacted to regulate food marketing to children and limit targeted marketing practices, particularly for high-calorie foods with low-nutrient density. [Figure 2](#) illustrates causes of and solutions to the obesity pandemic.

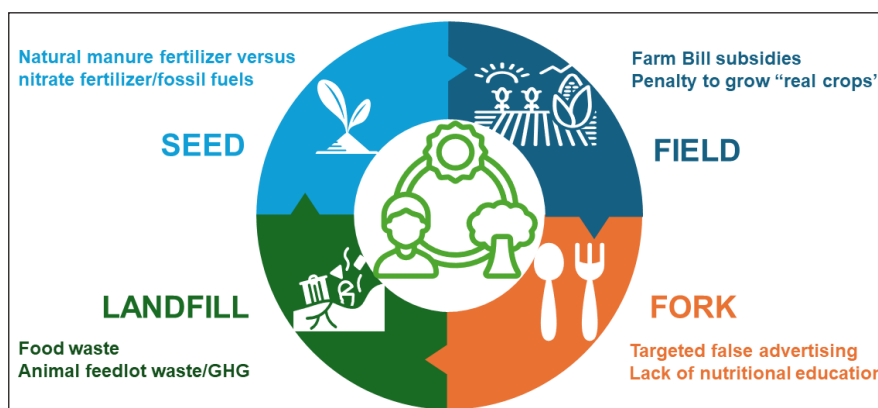


Figure 1 Issues impacting the US food chain. GHG: greenhouse gas

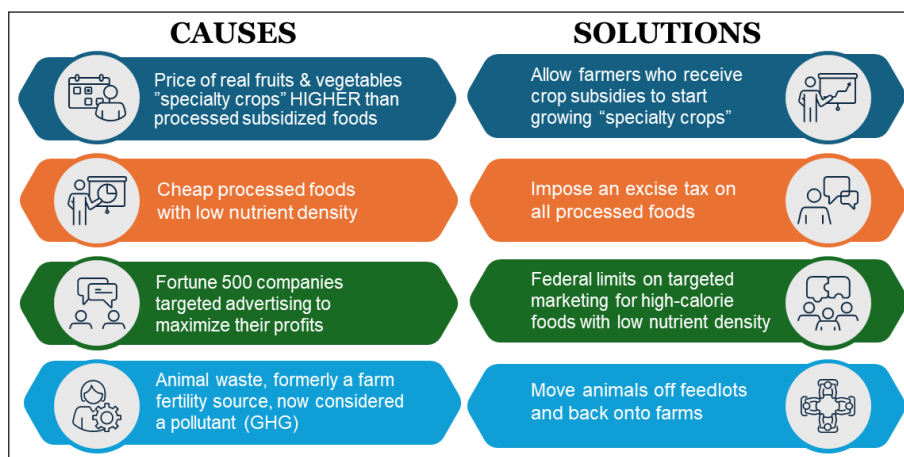


Figure 2 Food chain and food policies: causes and solutions for the obesity pandemic. GHG: greenhouse gas

SOCIAL SAFETY NET

Child Tax Credit

US households with children are more likely to be food insecure, and the paradoxical relationship between food insecurity and obesity has drawn recent attention. Food insecurity may lead to a lower-quality diet with increased consumption of energy-dense foods, which then increases obesity risk.⁴⁰ Child tax credits (CTCs) have consistently demonstrated positive impacts on family food security, including the CTC expansion in the American Rescue Plan in 2021.⁴⁰ Permanent expansion of CTCs could improve childhood food security and subsequent metabolic health outcomes.

EDUCATION SYSTEM

School Curriculum

Many children and adolescents lack basic food preparation skills and knowledge. School-based nutrition and cooking skills curricula are an effective tool to improve knowledge, skills, and self-efficacy and can ultimately improve healthy eating.⁴¹ A successful example is the Eatiquette 360 program in partnership with the Philadelphia public schools, which provides hands-on nutrition and cooking skills education for students and caregivers.⁴² Similar programs can be adapted to school needs and local food environments and sustained with community partnerships.

Early Childhood Intervention

Early life nutrition is particularly critical for long-term health outcomes. Several states have successfully instituted early childhood nutrition intervention programs to address this need. These include GO NAPSACC (Nutrition and Physical Activity Self-Assessment for Child Care), Catch Early Childhood, and Harvest for Healthy Kids, among others. Instituting a broader national strategy for early childhood nutrition interventions in care centers could provide great benefit to later childhood and adult health.

FOOD AND FOOD ASSISTANCE SYSTEM

Food Waste

One-third of all food in the US goes uneaten.⁴³ Food is wasted at multiple levels—in agricultural harvest, in retail grocery processing, in retail food establishments, and in home kitchens. Several local programs are working to address produce accessibility and food security. One such example is a partnership with the Supplemental Nutrition Assistance Program (SNAP) educators and local farmers in Maine. Local groups recover produce from fields ("field gleaning"), which is then distributed to food banks, health clinics, and other community establishments. Interestingly, overnutrition has been recognized as a form of food waste and may be mitigated through dedicated educational efforts. Obesity and food waste both challenge the sustainability of the current food system. Given the multiple levels of food waste, development of multipronged interventions are needed. Research funding to develop innovative food waste solutions may improve accessibility of high-quality nutrient-dense foods.

Food "Deserts" and "Swamps"

Food deserts are defined by the US Department of Agriculture as geographic regions where individuals have limited access to a variety of healthy and affordable foods. Individuals living in food deserts experience more barriers to healthy eating, which may contribute to obesity and chronic disease risk.⁴⁴ Food swamps are geographic areas with a higher density of food establishments selling high-calorie, low-nutrient foods such as in fast food restaurants and convenience stores. Previous research has demonstrated that residing within a food swamp is a stronger predictor of obesity propensity than residing within a food desert.⁴⁵ Thus zoning interventions limiting fast-food establishments and providing incentives for establishing grocery stores with healthier options may

improve community health. Additionally, improving community infrastructure such as public transportation routes may enhance community access to resources beyond their immediate neighborhood.

Improving Access and Quality of Food Assistance Programs

Public food assistance programs such as SNAP and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provide critical nutrition and food security support for low-income Americans. Despite this, they are underutilized by eligible individuals—with research demonstrating barriers including administrative inefficiency, lack of coverage for preferred foods, limited shopping options, and difficulties attending in-clinic WIC appointments.⁴⁶ Eligible foods are not always healthy options—although this is improving with the introduction of additional fruit/vegetable incentive programs (ie, GusNIP). To maximize the benefit to participants and achieve population health benefits of these programs, streamlining participation for individuals and families and enhancing benefit packages is critical.

HEALTHCARE SYSTEM

“Food is Medicine” Interventions

Recognizing the rise in diet-related chronic diseases and obesity, healthcare organizations and systems are increasingly incorporating “food is medicine” style interventions. This includes a recent American Heart Association (AHA) “Health Care by Food” initiative.⁴⁷ These interventions include a range of services, from medically tailored meals to fresh fruit and vegetable prescriptions, and have an emerging evidence base. Providing research funding to establish appropriate use, as well as federal regulatory policy to allow Medicare and Medicaid financing, could accelerate their impact on patient care.

Medicaid Obesity Treatment

Despite evidence supporting an array of obesity treatment services, including intensive behavioral interventions, medication, or surgical options, most Medicaid programs only cover a small portion of these treatments.^{48,49} Thus low-income Americans, many of whom have a higher risk of obesity, have fewer treatment options. State Medicaid program expansion of obesity services may improve outcomes for this vulnerable population.

Moving Forward

National and state or regional policies have unique strengths. National policies scale impact and allow integration between federal systems. State or regional interventions can engage communities, prioritize regional preferences, and enhance networking. However, both

face challenges. For example, efforts at the federal level to reduce childhood obesity such as the “Let’s Move” campaign demonstrate underwhelming results. This campaign focused on increasing children’s opportunities for physical activity, improving nutritional standards of the National School Lunch Program, and improving community access to high quality foods.⁵⁰ Despite these efforts, nationwide childhood obesity rates did not significantly decrease during the campaign period, emphasizing the need for more comprehensive policy solutions and community-based interventions. The lack of strong evidence for effective interventions is striking, despite the high prevalence of obesity. Funding nutrition and nutrition policy research is a national imperative for creation of more evidence-based policies.

CONCLUSION

The obesity pandemic and rise in chronic cardiovascular disease go hand in hand. As described in this review, policies play a critical role at local, regional, and federal levels. Interventions must start early, be multipronged, and target reduced food wastage and improved access with focus on lifestyle changes and healthy habits. More dedicated research is required to better understand the impact of the policies in place, and establish improved plans for future directions.

KEY POINTS


- Obesity results from changes in the quantity of caloric consumption as well as the quality of the food supply. Marketing plays an important role in promoting convenient, highly processed foods produced from cheap agricultural inputs.
- How we grow, produce, distribute, and promote food matters, as does how we handle waste. However, the dominant force to promote changes across the globe are policies that seem to deplete our human, social, economic, and nature capital.
- While multiple examples exist for successfully reducing the global obesity pandemic, much research is still needed to demonstrate the robust impact of these multipronged interventions.


COMPETING INTERESTS


Dr. Vijayaraghavan is a consultant for Aventyn Inc., Impact Xcelerate, Arizona Heart Foundation, Twinepidemic Inc., Life 365, Luminary Clinical Research, Project CURE, Edwards

Lifesciences, Rovicare, SC Pharma, Bayer, Learnroll, Lara Health, Bridge Bio, and Novo Nordisk; he is also on the Speakers Bureau for AstraZeneca and Kiniksa Pharmaceuticals, and has an ownership interest in Pulse Graft. The other authors have no competing interests to declare.


AUTHOR AFFILIATIONS

Nishtha Sareen, MD, MPH  orcid.org/0000-0003-0483-3838
Ascension St. Thomas Hospital, Nashville, Tennessee, US; College of Medicine, University of Tennessee Health Science Center, Nashville, Tennessee, US

Shivani Watson, MD  orcid.org/0000-0001-7726-2680
University of California Los Angeles, Los Angeles, California, US

Nina E. Hill, MD  orcid.org/0009-0004-8495-9530
Institute for Healthcare Policy and Innovation, University of Michigan, Ann Arbor, Michigan, US

Eric J. Brandt, MD, MHS  orcid.org/0000-0001-5463-4533
Institute for Healthcare Policy and Innovation, University of Michigan, Ann Arbor, Michigan, US

Krishnaswami Vijayaraghavan, MD  orcid.org/0000-0002-0919-9736
University of Arizona, Phoenix, Arizona, US

REFERENCES

1. **Chen S, Kuhn M, Prettner K, Bloom DE.** The macroeconomic burden of noncommunicable diseases in the United States: Estimates and projections. *PLoS One*. 2018 Nov 1;13(11):e0206702. doi: [10.1371/journal.pone.0206702](https://doi.org/10.1371/journal.pone.0206702)
2. **TEEB [Internet].** Geneva, Switzerland: UNEP TEEB Office; c2024. The Economics of Ecosystems & Biodiversity. Measuring what matters in Agriculture and Food systems; 2024 [cited 2024 Oct 22]. Available from: <https://teebweb.org/our-work/agrifood/>
3. **Powell-Wiley TM, Poirier P, Burke LE, et al.** American Heart Association Council on Lifestyle and Cardiometabolic Health; Council on Cardiovascular and Stroke Nursing; Council on Clinical Cardiology; Council on Epidemiology and Prevention; and Stroke Council. Obesity and Cardiovascular Disease: A Scientific Statement From the American Heart Association. *Circulation*. 2021 May 25;143(21):e984-e1010. doi: [10.1161/CIR.0000000000000973](https://doi.org/10.1161/CIR.0000000000000973)
4. **Rubino F, Batterham RL, Koch M, et al.** Lancet Diabetes & Endocrinology Commission on the Definition and Diagnosis of Clinical Obesity. *Lancet Diabetes Endocrinol*. 2023 Apr;11(4):226-228. doi: [10.1016/S2213-8587\(23\)00058-X](https://doi.org/10.1016/S2213-8587(23)00058-X)
5. **Rundle AG, Factor-Litvak P, Suglia SF, et al.** Tracking of Obesity in Childhood into Adulthood: Effects on Body Mass Index and Fat Mass Index at Age 50. *Child Obes*. 2020 Apr;16(3):226-233. doi: [10.1089/chi.2019.0185](https://doi.org/10.1089/chi.2019.0185)
6. **Diamantis DV, Karatzi K, Kantaras P, et al.** Prevalence and Socioeconomic Correlates of Adult Obesity in Europe: The Feel4Diabetes Study. *Int J Environ Res Public Health*. 2022 Oct 1;19(19):12572. doi: [10.3390/ijerph191912572](https://doi.org/10.3390/ijerph191912572)
7. **Lofton H, Ard JD, Hunt RR, Knight MG.** Obesity among African American people in the United States: A review. *Obesity (Silver Spring)*. 2023 Feb;31(2):306-315. doi: [10.1002/oby.23640](https://doi.org/10.1002/oby.23640)
8. **Koskinas KC, Van Craenenbroeck EM, Antoniadou C, et al.** ESC Scientific Document Group. Obesity and cardiovascular disease: an ESC clinical consensus statement. *Eur Heart J*. 2024 Oct 7;45(38):4063-4098. doi: [10.1093/eurheartj/ehae508](https://doi.org/10.1093/eurheartj/ehae508)
9. **GBD 2015 Obesity Collaborators; Afshin A, Forouzanfar MH, Reitsma MB, et al.** Health Effects of Overweight and Obesity in 195 Countries over 25 Years. *N Engl J Med*. 2017 Jul 6;377(1):13-27. doi: [10.1056/NEJMoa1614362](https://doi.org/10.1056/NEJMoa1614362)
10. **Valenzuela PL, Carrera-Bastos P, Castillo-García A, Lieberman DE, Santos-Lozano A, Lucia A.** Obesity and the risk of cardiometabolic diseases. *Nat Rev Cardiol*. 2023 Jul;20(7):475-494. doi: [10.1038/s41569-023-00847-5](https://doi.org/10.1038/s41569-023-00847-5)
11. **NCD Risk Factor Collaboration (NCD-RisC).** Worldwide trends in underweight and obesity from 1990 to 2022: a pooled analysis of 3663 population-representative studies with 222 million children, adolescents, and adults. *Lancet*. 2024 Mar 16;403(10431):1027-1050. doi: [10.1016/S0140-6736\(23\)02750-2](https://doi.org/10.1016/S0140-6736(23)02750-2)
12. **Blüher M.** Obesity: global epidemiology and pathogenesis. *Nat Rev Endocrinol*. 2019 May;15(5):288-298. doi: [10.1038/s41574-019-0176-8](https://doi.org/10.1038/s41574-019-0176-8)
13. **Lee JJ, Pedley A, Hoffmann U, Massaro JM, Levy D, Long MT.** Visceral and Intrahepatic Fat Are Associated with Cardiometabolic Risk Factors Above Other Ectopic Fat Depots: The Framingham Heart Study. *Am J Med*. 2018 Jun;131(6):684-692.e12. doi: [10.1016/j.amjmed.2018.02.002](https://doi.org/10.1016/j.amjmed.2018.02.002)
14. **Yajnik CS, Yudkin JS.** The Y-Y paradox. *Lancet*. 2004 Jan 10;363(9403):163. doi: [10.1016/S0140-6736\(03\)15269-5](https://doi.org/10.1016/S0140-6736(03)15269-5)
15. **Blüher M, Aras M, Aronne LJ, et al.** New insights into the treatment of obesity. *Diabetes Obes Metab*. 2023 Aug;25(8):2058-2072. doi: [10.1111/dom.15077](https://doi.org/10.1111/dom.15077)
16. **Goossens GH.** The Metabolic Phenotype in Obesity: Fat Mass, Body Fat Distribution, and Adipose Tissue Function. *Obes Facts*. 2017;10(3):207-215. doi: [10.1159/000471488](https://doi.org/10.1159/000471488)
17. **Ang MY, Takeuchi F, Kato N.** Deciphering the genetic landscape of obesity: a data-driven approach to identifying plausible causal genes and therapeutic targets. *J Hum Genet*. 2023 Dec;68(12):823-833. doi: [10.1038/s10038-023-01189-3](https://doi.org/10.1038/s10038-023-01189-3)
18. **Sakers A, De Siqueira MK, Seale P, Villanueva CJ.** Adipose-tissue plasticity in health and disease. *Cell*. 2022 Feb 3;185(3):419-446. doi: [10.1016/j.cell.2021.12.016](https://doi.org/10.1016/j.cell.2021.12.016)

19. **Ruiz-Castell M, Samouda H, Bocquet V, Fagherazzi G, Stranges S, Huiart L.** Estimated visceral adiposity is associated with risk of cardiometabolic conditions in a population based study. *Sci Rep.* 2021 Apr 27;11(1):9121. doi: [10.1038/s41598-021-88587-9](https://doi.org/10.1038/s41598-021-88587-9)
20. **Rubino F, Batterham RL, Koch M, et al.** Lancet Diabetes & Endocrinology Commission on the Definition and Diagnosis of Clinical Obesity. *Lancet Diabetes Endocrinol.* 2023 Apr;11(4):226-228. doi: [10.1016/S2213-8587\(23\)00058-X](https://doi.org/10.1016/S2213-8587(23)00058-X)
21. **Lumeng CN, Bodzin JL, Saltiel AR.** Obesity induces a phenotypic switch in adipose tissue macrophage polarization. *J Clin Invest.* 2007 Jan;117(1):175-84. doi: [10.1172/JCI29881](https://doi.org/10.1172/JCI29881)
22. **Scheja L, Heeren J.** The endocrine function of adipose tissues in health and cardiometabolic disease. *Nat Rev Endocrinol.* 2019 Sep;15(9):507-524. doi: [10.1038/s41574-019-0230-6](https://doi.org/10.1038/s41574-019-0230-6)
23. **Clemente-Suárez VJ, Redondo-Flórez L, Beltrán-Velasco AI, et al.** The Role of Adipokines in Health and Disease. *Biomedicines.* 2023 Apr 27;11(5):1290. doi: [10.3390/biomedicines11051290](https://doi.org/10.3390/biomedicines11051290)
24. **Teixeira PDS, Ramos-Lobo AM, Rosolen Tavares M, Wasinski F, Frazao R, Donato J Jr.** Characterization of the onset of leptin effects on the regulation of energy balance. *J Endocrinol.* 2021 Jun 2;249(3):239-251. doi: [10.1530/JOE-20-0076](https://doi.org/10.1530/JOE-20-0076)
25. **Khoramipour K, Chamari K, Hekmatikar AA, et al.** Adiponectin: Structure, Physiological Functions, Role in Diseases, and Effects of Nutrition. *Nutrients.* 2021 Apr 2;13(4):1180. doi: [10.3390/nu13041180](https://doi.org/10.3390/nu13041180)
26. **Hussain MK, Deli FA, Algenabi AHA, Abdul-Rudha KH.** Adiponectin gene polymorphisms as a predictor for development of type 2 diabetes mellitus in Iraqi population. *Gene.* 2018 Jul 1;662:118-122. doi: [10.1016/j.gene.2018.03.087](https://doi.org/10.1016/j.gene.2018.03.087)
27. **Caruso A, Gelsomino L, Panza S, et al.** Leptin: A Heavyweight Player in Obesity-Related Cancers. *Biomolecules.* 2023 Jul 6;13(7):1084. doi: [10.3390/biom13071084](https://doi.org/10.3390/biom13071084)
28. **Erismann JL, Sutton MA, Galloway J, Klimont Z, Winiwarter W.** How a century of ammonia synthesis changed the world. *Nature Geosci.* 2008 Sep;1(10):636-639. doi: [10.1038/ngeo325](https://doi.org/10.1038/ngeo325)
29. **NYT [Internet].** New York, NY: The New York Times Company; c2024. Pollan M. Farmer in Chief; 2008 Oct 9 [cited 2024 Dec 23]. Available from: <https://www.nytimes.com/2008/10/12/magazine/12policy-t.html>
30. **CRSreports [Internet].** Washington, DC: Congressional Research Service; c2024. The 2024 Farm Bill: H.R. 8467 Compared with Current Law; 2024 Dec 16 [cited 2024 Dec 23]. Available from: <https://crsreports.congress.gov/product/pdf/R/R48167>
31. **Dilk A, Savaiano DA.** Sugar Price Supports and Taxation: A Public Health Policy Paradox. *Nutr Today.* 2017 May;52(3):143-150. doi: [10.1097/NT.0000000000000217](https://doi.org/10.1097/NT.0000000000000217)
32. **Kay P, Michelle S, Veronica CN.** High fructose corn syrup: production, uses and public health concerns. *Biotechnol Mol Biol Rev.* 2010 Dec;5(5):71-78. doi: [10.5897/BMBR2010.0009](https://doi.org/10.5897/BMBR2010.0009)
33. **La Berge AF.** How the ideology of low fat conquered america. *J Hist Med Allied Sci.* 2008 Apr;63(2):139-77. doi: [10.1093/jhmas/jrn001](https://doi.org/10.1093/jhmas/jrn001)
34. **Kiszko KM, Martinez OD, Abrams C, Elbel B.** The influence of calorie labeling on food orders and consumption: a review of the literature. *J Community Health.* 2014 Dec;39(6):1248-69. doi: [10.1007/s10900-014-9876-0](https://doi.org/10.1007/s10900-014-9876-0)
35. **Swartz JJ, Braxton D, Viera AJ.** Calorie menu labeling on quick-service restaurant menus: an updated systematic review of the literature. *Int J Behav Nutr Phys Act.* 2011 Dec 8;8:135. doi: [10.1186/1479-5868-8-135](https://doi.org/10.1186/1479-5868-8-135)
36. **Faruque S, Tong J, Lacmanovic V, Agbonghae C, Minaya DM, Czaja K.** The Dose Makes the Poison: Sugar and Obesity in the United States - a Review. *Pol J Food Nutr Sci.* 2019;69(3):219-233. doi: [10.31883/pjfn/110735](https://doi.org/10.31883/pjfn/110735)
37. **Kaplan S, White JS, Madsen KA, Basu S, Villas-Boas SB, Schillinger D.** Evaluation of Changes in Prices and Purchases Following Implementation of Sugar-Sweetened Beverage Taxes Across the US. *JAMA Health Forum.* 2024 Jan 5;5(1):e234737. doi: [10.1001/jamahealthforum.2023.4737](https://doi.org/10.1001/jamahealthforum.2023.4737). Erratum in: *JAMA Health Forum.* 2024 Feb 2;5(2):e240017. doi: [10.1001/jamahealthforum.2024.0017](https://doi.org/10.1001/jamahealthforum.2024.0017)
38. **UConn Rudd Report [Internet].** Hartford, CT: The UConn Rudd Center for Food Policy and Health; c2024. Rudd Report: Targeted food and beverage advertising to Black and Hispanic consumers: 2022 update; 2022 Nov [cited 2024 Dec 31]. Available from: <https://uconnruddcenter.org/wp-content/uploads/sites/2909/2022/11/Rudd-Targeted-Marketing-Report-2022.pdf>
39. **Jensen ML, Fleming-Milici F, Harris JL.** Are U.S. food and beverage companies now advertising healthy products to children on television? An evaluation of improvements in industry self-regulation. *Int J Behav Nutr Phys Act* 2017-2021. 2023 Oct 4;20(1):118. doi: [10.1186/s12966-023-01517-y](https://doi.org/10.1186/s12966-023-01517-y)
40. **McCann NC, Dean LT, Bovell-Ammon A, et al.** Association between Child Tax Credit advance payments and food insufficiency in households experiencing economic shocks. *Health Aff Sch.* 2024 Jan 31;2(2):qxae011. doi: [10.1093/haschl/qxae011](https://doi.org/10.1093/haschl/qxae011)
41. **Meiklejohn S, Ryan L, Palermo C.** A Systematic Review of the Impact of Multi-Strategy Nutrition Education Programs on Health and Nutrition of Adolescents. *J Nutr Educ Behav.* 2016 Oct;48(9):631-646.e1. doi: [10.1016/j.jneb.2016.07.015](https://doi.org/10.1016/j.jneb.2016.07.015)
42. **USDA [Internet].** Washington, DC: United States Department of Agriculture; c2024. Vetri Community Partnership: Eatiquette 360; 2018 [cited 2024 Oct 22]. Available from: <https://snaped.fns.usda.gov/library/success-stories/vetri-community-partnership-eatiquette-360>

43. **USDA [Internet]**. Washington, DC: United States Department of Agriculture, Economic Research Service; c2024. Buzby JC, Hodan FW, Jeffrey H. The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States; 2014 Feb [cited 2024 Dec 31]. Available from: <https://www.ers.usda.gov/publications/pub-details/?pubid=43836>
44. **White M, Addison C, Jenkins BWC**, et al. Factors Affecting Dietary Practices in a Mississippi African American Community. *Int J Environ Res Public Health*. 2017 Jul 3;14(7):718. doi: [10.3390/ijerph14070718](https://doi.org/10.3390/ijerph14070718)
45. **Cooksey-Stowers K, Schwartz MB, Brownell KD**. Food Swamps Predict Obesity Rates Better Than Food Deserts in the United States. *Int J Environ Res Public Health*. 2017 Nov 14;14(11):1366. doi: [10.3390/ijerph14111366](https://doi.org/10.3390/ijerph14111366)
46. **Frank TL, Jabbari J, Roll S**, et al. Connecting the Dots between Barriers to W.I.C. Access and Adult and Child Food Insecurity: A Survey of Missouri Residents. *Nutrients*. 2023 May 27;15(11):2496. doi: [10.3390/nu15112496](https://doi.org/10.3390/nu15112496)
47. **American Heart Association [Internet]**. Dallas, TX: American Heart Association; c2024. Health Care by Food Initiative; 2024 [cited 2024 Dec 31]. Available from: <https://healthcarexfood.org/>
48. **Jannah N, Hild J, Gallagher C, Dietz W**. Coverage for Obesity Prevention and Treatment Services: Analysis of Medicaid and State Employee Health Insurance Programs. *Obesity (Silver Spring)*. 2018 Dec;26(12):1834-1840. doi: [10.1002/oby.22307](https://doi.org/10.1002/oby.22307)
49. **Stoops H, Dar M**. Equity and Obesity Treatment - Expanding Medicaid-Covered Interventions. *N Engl J Med*. 2023 Jun 22;388(25):2309-2311. doi: [10.1056/NEJMp2303268](https://doi.org/10.1056/NEJMp2303268)
50. **Let's Move [Internet]**. Washington, DC: White House Office of Digital Strategy; c2025. Let's Move: America's Move to Raise a Healthier Generation for Kids; 2017 [cited 2024 Dec 31]. Available from: <https://letsmove.obamawhitehouse.archives.gov/about>

TO CITE THIS ARTICLE:

Sareen N, Watson S, Hill NE, Brandt EJ, Vijayaraghavan K. Food Chain and Food Policies: Causes and Solutions for the Obesity Pandemic. *Methodist DeBakey Cardiovasc J*. 2025;21(2):14-22. doi: [10.14797/mdcvj.1509](https://doi.org/10.14797/mdcvj.1509)

Submitted: 25 October 2024 **Accepted:** 17 December 2024 **Published:** 18 February 2025

COPYRIGHT:

© 2025 The Author(s). This is an open-access article distributed under the terms of the Attribution-NonCommercial 4.0 International (CC BY-NC 4.0), which permits unrestricted use, distribution, and reproduction in any noncommercial medium, provided the original author and source are credited. See <https://creativecommons.org/licenses/by-nc/4.0/>.

Methodist DeBakey Cardiovascular Journal is a peer-reviewed open access journal published by Houston Methodist DeBakey Heart & Vascular Center.