Obesity Research & Clinical Practice 18 (2024) 465–468

Contents lists available at ScienceDirect

Obesity Research & Clinical Practice

journal homepage: www.elsevier.com/locate/orcp

Obesity in the US: Exploring the paradox of increasing obesity rates alongside growing physical activity

Yoshiyasu Takefuji [1]

Faculty of Data Science, Musashino University, 3-3-3 Ariake Koto-ku, Tokyo 135-8181, Japan

ARTICLE INFO

Keywords:
Obesity
Obesity paradox
CDC dataset

ABSTRACT

The study analyzes a CDC dataset on US adult obesity and physical activity from 2011 to 2022. Despite rising obesity rates and insufficient fruit consumption, physical activity levels are increasing and overweight rates are slightly declining. The role of ultra-processed food intake, price sensitivity, early eating habits, and stress in obesity is highlighted. The findings suggest a complex obesity epidemic, indicating the need for multifaceted solutions such as regulating ultra-processed foods, improving access to healthy foods, and promoting healthy eating habits from childhood.

Introduction

This research leverages one of the largest datasets available, covering the period from 2011 to 2022 and comprising 93,249 instances from over 152 million participants. Notably, this study represents the first effort to quantify and visualize trends in obesity and physical activity over this extended timeframe.

Using a CDC dataset released on December 8, 2023, this paper offers a comprehensive visualization of obesity prevalence in the U.S. Our analysis, powered by generative AI, reveals a consistent rise in U.S. obesity rates, even as adult physical activity levels increase and overweight classification rates show a gradual decline.

Our study also highlights US dietary patterns, noting a steady increase in adults reporting less than daily fruit consumption, and a stable rate of less than daily vegetable consumption, despite federal health campaigns.

To understand obesity trends and causes, we conducted a literature review using peer-reviewed publications from the National Library of Medicine. Our review suggests that obesity prevalence is influenced by factors such as ultra-processed food (UPF) intake, consumer price sensitivity, early development of eating habits, oxidative stress, maladaptive eating behaviors, and chronic stress. This paper contributes to the discourse on obesity and its complex causes.

While existing literature has explored the causes of obesity, this paper not only reinforces that understanding but also delivers a groundbreaking quantitative analysis of the trends and their complexities. It reveals the persistent rise in obesity rates despite increased physical activity among adults. This data-driven approach provides critical insights into the multifaceted nature of the obesity epidemic, highlighting the need for further exploration and discussion.

Methods

The CDC dataset, comprising 33 columns and 93249 instances, was downloaded [1] and subsequently renamed to `data.csv`. We utilized Generative AI, specifically Microsoft's Copilot, to create a trend graph based on a survey consisting of nine questions. The nine questions are shown in APPENIX.

Queries are instrumental in crafting the appropriate Python code for visualizing the obesity survey, which consists of nine questions. These queries aid in identifying both the independent and dependent variables. The initial query is presented below. To achieve the desired outcome, multiple interactions with the generative AI are necessary. This paper showcases a trend graph composed of nine lines. Each line represents the number of survey participants over the years, plotted against the question number. Query is attached to APPENDIX.

The generated Python code is available at the GitHub site [2].

Results

To generate the obesity trend graph, download the `obesity.py` file from the GitHub site [2] and the dataset file from the CDC site [1]. After downloading, rename the dataset file to `data.csv`. Then, execute the following command where ($) indicates the prompt from the system on

E-mail address: takefuji@keio.jp.
[1] **ORCID:** 0000–0002-1826–742X

https://doi.org/10.1016/j.orcp.2024.12.004
Received 11 July 2024; Received in revised form 4 December 2024; Accepted 18 December 2024
Available online 31 December 2024

the terminal:

$ python obesity.py

Fig. 1 presents an obesity trend graph composed of nine distinct lines. The thick solid line, labeled as #2, signifies the percentage of adults aged 18 years and older who have obesity. This line, which represents a participant count of 29,535,862 on left number and 2 on question number, exhibits a monotonically increasing trend. Conversely, the line labeled as #1, which represents the percentage of adults aged 18 years and older with an overweight classification, is slowly declining.

In Fig. 1, the lines labeled from #3 to #6 represent various physical activities over the years, all of which display an increasing trend. The line labeled as #7 in Fig. 1 represents the percentage of adults who do not engage in any leisure-time physical activity. This line shows a hovering trend until the onset of the COVID-19 pandemic. Interestingly, during the pandemic, the trend remained low.

In Fig. 1, the line labeled as #8, which represents the percentage of adults who report consuming fruit less than once daily, exhibits a steady increase. Conversely, the line labeled as #9, which represents the percentage of adults who report consuming vegetables less than once daily, shows an interesting trend. It increased before the onset of the pandemic but remained low thereafter.

Discussion

A comprehensive literature review was undertaken, focusing on the interplay between obesity, food consumption, diet, and nutrition. The aim was to explore potential causal links between obesity and evidence-based facts. Koliaki et al. addressed that the global obesity epidemic, a major public health concern, seems to have stabilized in high-income countries since 2000, possibly due to healthier diets and increased physical activity [3]. However, obesity rates continue to rise in low-income nations, with severe obesity becoming an epidemic in many high- and middle-income countries. Despite a possible plateau, the prevalence of obesity remains high globally, necessitating immediate actions to halt its escalation and associated health risks [3]. This corroborates the visualized trend of obesity in the US.

Banas et al. reported that obesity rates have been rising in the US since the 1950s across all age groups, posing a significant public health challenge [4]. A study analyzing BMI trends from 1959 to 2018 revealed a consistent increase across all groups, regardless of income or education among high school graduates. However, those with less than a high school education showed a slower BMI increase. Racial disparities were also observed, with Black adults having higher BMI growth rates than White adults. These findings highlighted the need for systemic interventions to combat the obesity epidemic [4].

Valicente et al. found a link between ultra-processed food (UPF) consumption and increased body mass index, leading to recommendations to avoid UPFs despite limited causal evidence [5]. However, data do not support UPFs' unique contribution to appetite, food intake, and adiposity. Given potential adverse effects of UPF avoidance, it's imprudent to recommend their avoidance without verifying causality and mechanisms [5]. Dicken et al. associated obesity with increased UPF intake [6]. Despite disagreements on the UPF concept, observational studies and clinical data associate UPF intake with weight gain and obesity. The need to alter the obesogenic environment to reduce UPF intake is clear. The UPF concept offers a novel approach not explained by existing frameworks. Future research will strengthen these findings [6].

A study linking individual food purchases to health data found that individuals with higher BMI are more sensitive to price changes in vice food categories [7], defined as tempting and impulsively purchased items. A hypothetical 10 % price increase on these foods, akin to a fat or sugar tax, could significantly reduce their consumption, particularly among individuals with higher BMI [7]. Economic factors, coupled with the consumption of ultra-processed foods (UPF), can potentially accelerate the trends in obesity. This study supports the observed trend of increasing obesity rates.

Almoraie et al. reported that obesity, a global health concern linked to various health complications, is influenced by genetic, environmental, and lifestyle factors [8]. Oxidative stress has been identified as a

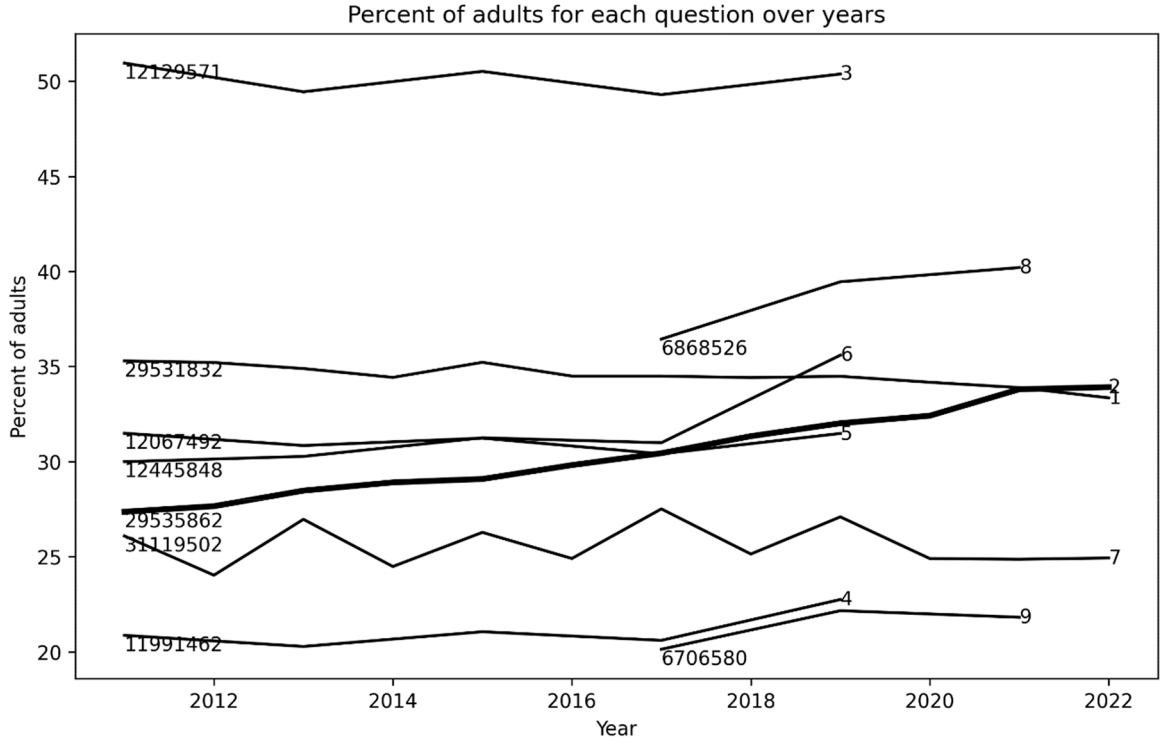

Fig. 1. Percent of adults for each question over years. Thick solid line labeled as #2 indicates obesity rates. Please note that the number on the left of each line represents the count of survey participants, while the number on the right indicates the question number.

potential contributor to obesity and related metabolic disorders. Dietary antioxidants, which can counteract oxidative stress, were being studied for their potential role in obesity prevention and management. Their review explored the impact of dietary antioxidants on obesity and its associated metabolic dysregulations [8]. This may also reduce the obesity rates.

Oh et al. concluded that environmental interventions like eliminating food deserts and improving park access are crucial to combat obesity and diabetes [9]. However, U.S. studies examining these factors' relationship with these diseases were scarce. Their study applied spatial regression to 3108 U.S. counties, revealing that park access inversely associates with both diseases, while food desert exposure and fast-food restaurant density show no significant association. However, regional analysis identified opportunities to improve park access in Alabama and Mississippi, states with high obesity and diabetes prevalence. Their findings can guide public health interventions and policy decisions [9]. This approach can provide the different perspectives for obesity.

Segal et al. reported that obesity, a condition resulting from an imbalance between calorie intake and energy expenditure, has reached pandemic proportions, with 1 in 8 people worldwide affected in 2022 [10]. Despite its prevalence, individuals with obesity often face societal stigma and discrimination, leading to psychological challenges, maladaptive eating behaviors, and chronic stress. This stigma permeates various aspects of life, compromising mental well-being and quality of life. It's crucial to address these issues alongside the physical health risks associated with obesity [10]. Psychological therapies should be incorporated for obesity.

The existing dietary guidelines in the U.S. suggest that both children and adults strive to eat five total servings of fruits and vegetables each day [11]. The American Heart Association recommends consuming four to five portions of fruits and vegetables each day [12]. This not only provides additional fiber and micronutrients, but occasionally also contributes to your intake of protein and healthy fats. The guidelines should be strengthened to reduce obesity rates.

This literature review explores the relationship between obesity, diet, and nutrition. Despite stabilization in high-income countries, obesity rates continue to rise globally, particularly in low-income nations. The review highlights the consistent increase in obesity rates in the US, regardless of income or education. It underscores the link between ultra-processed food (UPF) consumption and increased body mass index. The review reveals that individuals with higher BMI are more sensitive to price changes in vice food categories, suggesting that economic factors, coupled with UPF consumption, can potentially accelerate obesity trends. The review also discusses the role of healthy eating habits in preventing childhood obesity, the potential contribution of oxidative stress to obesity, the need for environmental interventions, sustainable diet models, and addressing societal stigma associated with obesity.

Although existing literature has examined the causes of obesity, this study goes beyond merely reinforcing those insights. It offers a pioneering quantitative analysis that unpacks the intricate trends associated with obesity. Notably, our findings reveal a troubling upward trajectory in obesity rates, even in the face of increased physical activity among adults. This data-driven approach sheds light on the complex and multifaceted nature of the obesity epidemic, underscoring the imperative for further exploration and discussion in this critical area of public health.

Ethics

Not applicable.

Program availability

The Python code is available from the GitHub site [2].

Funding

This research has no fund.

CRediT authorship contribution statement

Yoshiyasu Takefuji: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

APPENDIX. : Nine questions

1. Percent of adults aged 18 years and older who have an overweight classification
2. Percent of adults aged 18 years and older who have obesity
3. Percent of adults who achieve at least 150 minutes a week of moderate-intensity aerobic physical activity or 75 minutes a week of vigorous-intensity aerobic activity (or an equivalent combination)
4. Percent of adults who achieve at least 150 minutes a week of moderate-intensity aerobic physical activity or 75 minutes a week of vigorous-intensity aerobic physical activity and engage in muscle-strengthening activities on 2 or more days a week
5. Percent of adults who achieve at least 300 minutes a week of moderate-intensity aerobic physical activity or 150 minutes a week of vigorous-intensity aerobic activity (or an equivalent combination)
6. Percent of adults who engage in muscle-strengthening activities on 2 or more days a week
7. Percent of adults who engage in no leisure-time physical activity
8. Percent of adults who report consuming fruit less than one time daily
9. Percent of adults who report consuming vegetables less than one time daily

Query: show python code using data.csv to plot percent of adults graph with multiple black lines. Independent variable 'LocationAbbr' must be "US". Dependent variable 'Data_Value' indicates the percent of adults as Y-axis. The independent variable, 'Question' contains string values. The number of lines in a graph is equal to the number of unique question values in 'Question'. 'YearStart' indicates X-axis. plot lines and the unique number on every end of individual lines without overlapping number images. no legend is plotted in a graph. Save the result as result. png. On the terminal, print unique numbers with the unique questions by separate lines and total number of participants from independent variable 'Sample_Size' values.

Data Availability statement

Not applicable

References

[1] C.D.C.G.O.V.. Nutrition, Physical Activity, and Obesity - Behavioral Risk Factor Surveillance System. Accessed on July 3, 2024. ⟨https://data.cdc.gov/Nutrition-Physical-Activity-and-Obesity/Nutrition-Physical-Activity-and-Obesity-Behavioral/hn4x-zwk7/about_data⟩.
[2] GitHub. Obesity trends in the US. Accessed on July 3, 2024. ⟨https://github.com/y-takefuji/obesity⟩.
[3] Koliaki C., Dalamaga M., Liatis S. Update on the Obesity Epidemic: After the Sudden Rise, Is the Upward Trajectory Beginning to Flatten? [published correction appears in Curr Obes Rep. 2023 Dec;12(4):528. doi: 10.1007/s13679-023-00533-0]. Curr Obes Rep. 2023;12(4):514-527. doi:10.1007/s13679-023-00527-y.
[4] Banas J, McDowell Cook A, Raygoza-Cortez K, et al. United States Long-Term Trends in Adult BMI (1959-2018): unraveling the roots of the obesity epidemic.

Published 2024 Jan 9. Int J Environ Res Public Health 2024;21(1):73. https://doi.org/10.3390/ijerph21010073.
[5] Valicente VM, Peng CH, Pacheco KN, et al. Ultraprocessed foods and obesity risk: a critical review of reported mechanisms. Adv Nutr 2023;14(4):718–38. https://doi.org/10.1016/j.advnut.2023.04.006.
[6] Dicken SJ, Batterham RL. Ultra-processed food and obesity: what is the evidence? Curr Nutr Rep 2024;13(1):23–38. https://doi.org/10.1007/s13668-024-00517-z.
[7] Bao Y, Osborne M, Wang E, Jaenicke EC. BMI/Obesity and consumers' price sensitivity: implications for food tax policies. Published 2024 Jun 11. PNAS Nexus 2024;3(6):pgae190. https://doi.org/10.1093/pnasnexus/pgae190.
[8] Almoraie NM, Shatwan IM. The potential effects of dietary antioxidants in obesity: a comprehensive review of the literature. Published 2024 Feb 6. Healthc (Basel) 2024;12(4):416. https://doi.org/10.3390/healthcare12040416.
[9] Oh JI, Lee KJ, Hipp A. Food deserts exposure, density of fast-food restaurants, and park access: Exploring the association of food and recreation environments with obesity and diabetes using global and local regression models. Published 2024 Apr 18. PLoS One 2024;19(4):e0301121. https://doi.org/10.1371/journal.pone.0301121.
[10] Segal Y, Gunturu S. Psychological Issues Associated With Obesity. Treasure Island (FL): StatPearls Publishing; 2024. ⟨https://www.ncbi.nlm.nih.gov/books/NBK603747/⟩ (Available from:).
[11] ⟨https://www.dietaryguidelines.gov/sites/default/files/2021-03/Dietary_Guidelines_for_Americans-2020-2025.pdf⟩.
[12] ⟨https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/nutrition-basics/suggested-servings-from-each-food-group⟩.