

# Obesity and Its Growing Impact on Future Mortality: A Collection of Essays

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# Obesity and Its Growing Impact on Future Mortality

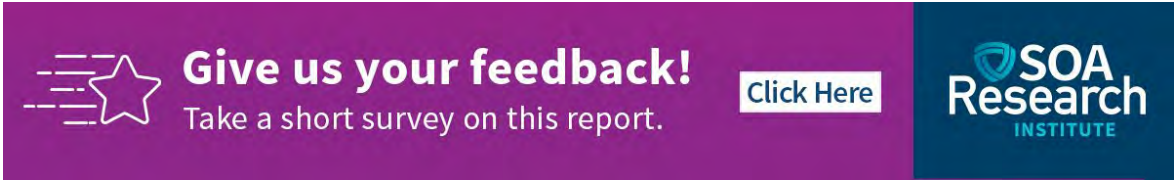
## A Collection of Essays


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# Obesity and Its Growing Impact on Future Mortality

## A Collection of Essays

### Introduction and Acknowledgments

#### INTRODUCTION

The Society of Actuaries (SOA) Research Institute’s Mortality and Longevity Strategic Research Program Steering Committee established a call for essays to gather a variety of perspectives on the impact of obesity on mortality. The result of this effort is intended to provide a valuable resource for readers to become well-grounded on current trends in obesity and obesity management as these issues relate to mortality and mortality projections.

The collection includes fourteen essays that were accepted for publication from all submissions. Six essays were chosen for prizes based on their creativity, originality, and likelihood of further thought on the subject matter.

Award Winner	<b>Weight Loss Drugs and Insurance: Actuarial Model and Mindset Implications of the GLP-1 Era</b> Syed Danish Ali, CSPA
Award Winner	<b>The Weight of Change: Mortality Differences Among Weight Maintainers, Regainers, and Cyclers</b> Ghecora Boyd, MPH, BSN, RN, AMB-BC, CPXP, LSSYB
Award Winner	<b>The Tipping Scale: Obesity, Anti-Obesity Medications, and the Shifting Arc of Mortality</b> Sathiya Livingston
Award Winner	<b>The Expanding Weight of Mortality: Reimagining Obesity’s Impact on Future Longevity</b> Sathiya Livingston
Award Winner	<b>The Weight of Risk: Obesity, Mortality, and the Actuarial Lens</b> Ankit Nanda, FSA, MAAA
Award Winner	<b>Obesity and Its Growing Impact on Future Mortality</b> Shaquille Worrell, FSA, FCIA

#### THE CALL FOR ESSAYS

At the Society of Actuaries Research Institute, calls for essays are substantively different from calls for short research papers. Research Institute research papers are required to be fact-based and objective and to

avoid advocacy, especially with respect to public policy. Research papers published by the Research Institute may inform readers about public policy topics but must refrain from taking a position on or advocating for a public policy issue.

Essays that the Research Institute published may be fact-based, short research papers. Alternatively, they may be more experiential in nature as a means of highlighting issues or calling for change, although they must refrain from advocating for or taking a position on a specific legislative or regulatory initiative. Both types of essays were invited in this call for essays, and both types of essays are included in this collection.

For context, the two sections of the call for essays that outline the subject matter request are replicated below.

## BACKGROUND AND OVERVIEW

The Society of Actuaries (SOA) Research Institute's Mortality and Longevity Research Program Steering Committee (MLPSC) is interested in examining the latest trends in the prevalence of obesity and estimating its impact on future mortality. Obesity is associated with an increased risk of developing several adverse health conditions, including cardiovascular disease, type 2 diabetes, osteoarthritis, and some types of cancer, all of which can negatively impact life expectancy. According to the CDC, the prevalence of obesity was more than 40% of adults in the United States between August 2021 and August 2023.<sup>1</sup> Recent societal and market developments, particularly the availability of anti-obesity medications (AOMs) such as GLP-1 agonists, may have affected the rates and comorbidity complexities of obesity and its influence on longer-term mortality. Given these developments, a current understanding of how obesity impacts mortality would be helpful for pricing, valuation, and other actuarial functions.

The MLPSC has sponsored prior research (2022) on obesity and its economic costs in both the United States and Canada. That research can be found here: [Obesity Trends and the Impact on Morbidity and Mortality Costs | SOA](#). It has also sponsored prior research (2024) on the relationship between obesity and cardiovascular disease: [Modeling and Forecasting Premature Cardiovascular Mortality: The Role of Obesity and Education](#).

<sup>1</sup>[NCHS Data Brief, Number 508, September 2024](#)

With this background in mind, the MLPSC is interested in a further exploration of the relationship between obesity and mortality from a variety of perspectives. The result of this effort is intended to provide a valuable resource for readers to become well-grounded on current trends in obesity and obesity management as these issues relate to mortality and mortality projections.

## ESSAY CONTENTS

The MLPSC is seeking researchers and essayists to study the impact of trends in obesity and AOMs in the United States on forecasts of future mortality. The research or essay may consider these impacts by various demographic and socio-economic factors, including gender, smoking status, age, comorbidities, length of time a person is considered obese, use of AOMs, and others.

The following illustrate the topics and questions that might be addressed in an essay or research project. Respondents to this RFP/Call for Essays are not required or expected to address all or even any of these topics/questions. Rather, they are encouraged to also consider other questions(s) or topic(s) they deem critical to the work done by the SOA and its members. To maintain a reasonable scope, researchers should be selective in the number of topics/questions they cover.

Responses to this RFP/Call for Essays should clarify the time horizon under consideration in a research project or essay.

Examples of potential areas of study include:

- What are the key data sources used for understanding the relationship between obesity and mortality rates? What methods may be used to attribute mortality to obesity?
- What are the current trends in obesity prevalence? What are the trends in the morbidly obese as a subpopulation?
- What has the historical relationship between obesity and mortality rates been? How have mortality rates changed as obesity rates have changed? Are there any expected changes in the relationship in the future? Are there other risk factors that can further affect mortality, such as comorbidities or socioeconomic risk characteristics?
- What measures, such as body mass index (BMI) and waist circumference, are used in understanding obesity as a condition and in relation to mortality? What are their advantages/disadvantages? Should differences in mortality be solely based on these measures, or are other underlying measures or factors useful in supplementing them?
- What are the current trends in obesity management? How do these trends vary by population segment? How effective are they?
- How does mortality experience differ between people who lost weight with and without AOMs?
- Does mortality experience differ between people who lost weight and kept it off and those who have regained or regained and relost weight?
- How does the U.S. experience compare to trends in other countries?

## ACKNOWLEDGMENTS

The SOA Research Institute Mortality and Longevity Strategic Research Program thanks the following members of the Project Oversight Group (POG) for their careful review and judging of the submitted essays. Any views and ideas expressed in the essays are the authors' alone and may not reflect the POG's views and ideas nor those of their employers, the authors' employers, the Society of Actuaries, the Society of Actuaries Research Institute, nor Society of Actuaries members.

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Award Winner

## Weight Loss Drugs and Insurance: Actuarial Model and Mindset Implications of the GLP-1 Era

Syed Danish Ali, CSPA

*Any views and ideas expressed in the essays are the author's alone and may not reflect the views and ideas of the Society of Actuaries, the Society of Actuaries Research Institute, Society of Actuaries members, nor the author's employer.*

### INTRODUCTION: LOSING WEIGHT IS THE NEW HEALTH FRONTIER

Obesity has long been one of the most persistent and costly drivers of mortality and morbidity in modern societies. In the United States, over 40% of adults met the clinical definition of obesity between 2021 and 2023,<sup>1</sup> a prevalence that has resisted decades of public health campaigns and lifestyle interventions. For life and health insurers, obesity has been one of the key drivers to an ever-rising claim burden and has been a foundational element in pricing, underwriting, and claims projections.

The emergence of highly effective anti-obesity medications, particularly GLP-1 receptor agonists such as liraglutide, semaglutide, and tirzepatide, has introduced the possibility of a structural shift in these assumptions. GLP-1 receptor agonists and dual GIP/GLP-1 agonists work by mimicking gut-derived hormones that regulate appetite, gastric emptying, and insulin sensitivity. Clinical trials and real-world evidence now show weight reductions of 15 to 20% in many patients; numbers once associated only with bariatric surgery.

The downstream effects extend far beyond the scale. Sustained weight loss in obese patients reduces the incidence of type 2 diabetes, hypertension, obstructive sleep apnea, certain cancers, non-alcoholic fatty liver disease (recently renamed since 2023 to metabolic dysfunction-associated steatotic liver disease, MASLD), dementia, and cardiovascular events. A 2024 meta-analysis estimated that for each sustained 5-unit drop in BMI, all-cause mortality falls by roughly 15% over 10 years in populations with baseline obesity.<sup>2</sup>

These are non-speculative benefits and measurable shifts in disease incidence and survival probabilities, which are the foundation of actuarial mortality models. If these therapies reach large portions of the population, the actuarial assumptions that have held for decades will require recalibration.

---

<sup>1</sup> Cynthia M. Hales, Margaret D. Carroll, Cheryl D. Fryar, and Cynthia L. Ogden, "Prevalence of Obesity and Severe Obesity Among Adults: United States, 2021–2023," *NCHS Data Brief*, no. 508 (Hyattsville, MD: National Center for Health Statistics, September 2024), <https://www.cdc.gov/nchs/products/databriefs/db508.htm>

<sup>2</sup> Yael L. Maxwell, "BMI Weighs Heavily on All-Cause Mortality Risk, According to a Global Meta-Analysis," *TCTMD* (July 14, 2016), <https://www.tctmd.com/news/bmi-weighs-heavily-all-cause-mortality-risk-according-global-meta-analysis>

## FROM MORTALITY TABLES TO DALYS: EXPANDING THE METRICS OF IMPACT

Mortality has been the traditional anchor for measuring the effects of health interventions on insurance portfolios, but it is not the only lens worth applying. Epidemiology has long used Disability-Adjusted Life Years (DALY) and Years of Life Lost (YLL) to capture the broader burden of disease. DALY measures years of healthy life lost to disability or premature death, while YLL focuses specifically on the gap between observed and ideal life expectancy. In the context of GLP-1 therapies, this distinction matters because living longer is not the same as living healthier. Many of the extra years gained from medical advances are lived with chronic illness, reduced function, and increased healthcare utilization.

Critical illness (CI) insurance trends illustrate this clearly. While life insurance may benefit from longevity improvements, CI claims are climbing, especially in markets where riders are increasingly attached to base policies. A middle-aged policyholder might survive a heart attack thanks to better preventive medicine, but survival is not a cure; the chronic disease remains, and so does the claim potential.

For GLP-1 therapies, actuaries should be quantifying not only the reduction in premature deaths but also the reduction in years lived with obesity-related disability. A drug that extends life without reducing the period of ill health may not deliver the same societal or economic benefit as one that compresses morbidity into a shorter end-of-life phase. Incorporating DALY and YLL analyses into actuarial work on GLP-1s would provide a more complete picture of their true value and guide both product design and public health strategy.

## UNDERWRITING IN A WORLD OF RAPID WEIGHT LOSS: SHIFTING BASELINES IN MORTALITY AND MORBIDITY

While much of the public conversation focuses on individual health benefits, the actuarial challenge is broader; adjusting mortality improvement scales is too broad a brush; the challenge is rethinking how obesity interacts with product design, selection risk, claims dynamics, and long-term strategic positioning. The impact will not be uniform, nor will it be unambiguously positive. The seeds of many chronic diseases are planted decades before their emergence (in a slow-burning, slowly accumulating manner like climate change), meaning that even if obesity rates fall, much of the future burden of ill health is already in motion.

Early trial data suggest that sustained GLP-1 use can reduce mortality in obese populations by as much as 20–40% over a decade, particularly in those with severe obesity.<sup>3</sup> If replicated in real-world conditions, these gains could offset what actuaries sometimes refer to as the “obesity drag” on mortality improvements. Life expectancy forecasts might need upward revision, and for some portfolios, the difference could be material enough to affect reserving and capital planning.

Yet optimism should be tempered with realism. Drug discontinuation rates are high, often exceeding 50% within the first year,<sup>4</sup> and two-thirds of weight loss regaining itself is common when therapy stops. From an insurance perspective, this creates a “mortality rebound” risk. To model this, actuaries can introduce a therapy lapse assumption, similar to policy lapse assumptions in life insurance. For example, assume 30% annual discontinuation after the first two years, with associated risk factors reverting toward baseline over a three-to-five-year lag. This would temper overly optimistic mortality projections and protect against underpricing.

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<sup>3</sup> Munich Re, “New Drugs Against Obesity Are Working – For Patients and the Life Insurance Industry,” March 3, 2025, <https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/corporate-news/2025/2025-03-03-new-drugs-against-obesity-are-working.html>.

<sup>4</sup> Taylor Mixides. “Insurers Navigate Risk of Two-Thirds Weight Regain with GLP-1 Medications: Swiss Re,” *Reinsurance News*, April 16, 2025, <https://www.reinsurancene.ws/insurers-navigate-risk-of-two-thirds-weight-regain-with-glp-1-medications-swiss-re/>.

A population-level improvement in mortality will depend on adherence, affordability, and integration with lifestyle changes. Moreover, the cardiometabolic benefits of weight loss are most durable when muscle mass is preserved, which is not always the case with GLP-1-induced weight loss, particularly in older adults. Loss of lean body mass could increase frailty, fall risk, and bone fractures, offsetting some morbidity gains. Actuaries need to model multi-scenario pathways; one where benefits are sustained through broad uptake and adherence, and another where early enthusiasm fades and net health impact is diluted.

The psychological dimension presents additional complexity. There is a risk that individuals may prioritize GLP-1 drugs as a “silver bullet” for weight loss, overlooking the necessity of holistic lifestyle change to achieve sustainable weight maintenance. This creates what behavioral scientists term “risk compensation;” where medical intervention reduces motivation for complementary healthy behaviors.

Actuaries must also consider the “wellness fatigue” phenomenon observed in corporate wellness programs. Initial enthusiasm often wanes as rapid early weight loss plateaus after 6 to 12 months, participants encounter side effects, lifestyle disruptions, or simply the sustained effort required for long-term success. Building these behavioral realities into GLP-1 impact models will produce more accurate projections than relying solely on clinical trial data.

### **PRICING: NAVIGATING THE SHORT-TERM SURGE AND LONG-TERM SHIFT**

While life insurers may benefit from improved survival in the long run, health insurers face near-term cost pressures. In the United States, annual costs for GLP-1 therapies often exceed \$10,000 per patient,<sup>5</sup> and utilization is rising sharply. Some employer-sponsored health plans report that these drugs already account for over 3% of total pharmacy spend.<sup>6</sup> The question is whether these upfront costs will be offset by downstream savings from avoided diabetes, heart disease, and other obesity-linked conditions.

Discontinuation rates are high, with a majority of patients stopping within the first year and many regaining lost weight. This reality tempers the optimism in long-term cost savings projections and calls for multi-scenario pricing models that distinguish between persistent and short-term use.

The near-term picture is more complex. Uptake of GLP-1 drugs is skewed toward higher income and better insured individuals who are already proactive about health. This could produce a positive selection effect in new business as healthier applicants enter the insured pool. However, there is also anti-selection risk. An individual might use GLP-1 medication briefly to qualify for preferred rates, then discontinue the drug and regain weight, leaving the insurer with an underpriced risk. Similar dynamics could affect lapse behavior, with previously rated substandard policyholders slimming down, qualifying for better rates elsewhere, and lapsing existing higher premium coverage. Pricing teams must incorporate these behavioral factors into lapse and re-entry assumptions to avoid unexpected losses.

From a life insurance perspective, the dynamic is inverted. If GLP-1 therapies meaningfully reduce mortality and morbidity, competitive pressure may force premiums down, benefiting consumers but compressing margins. Selection effects also matter. At present, uptake is skewed toward higher-income, health-conscious individuals; precisely the demographic more likely to be insured. This could produce a temporary positive selection effect.

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<sup>5</sup> Renuka Rayasam, “High Price of Popular Diabetes Drugs Deprives Low-Income People of Effective Treatment,” *KFF Health News*, May 21, 2024, <https://kffhealthnews.org/news/article/high-prices-ozempic-mounjaro-wegovy-glp1s/>.

<sup>6</sup> Chantell Sell Reagan and Cody Midlam, “GLP-1 Drugs in 2025: Cost, Access and the Future of Obesity Treatment,” *Willis Towers Watson Insights*, April 11, 2025, <https://www.wtco.com/en-us/insights/2025/04/glp-1-drugs-in-2025-cost-access-and-the-future-of-obesity-treatment>.

However, anti-selection risks are equally plausible: applicants could lose weight temporarily to qualify for preferred rates and then discontinue treatment, reverting to higher risk while the insurer is locked into lower premiums.

### **CLAIMS: THE DOUBLE-EDGED SWORD OF HEALTH IMPROVEMENT**

If GLP-1 therapies achieve sustained cardiometabolic improvements, insurers could see a broad-spectrum reduction in claims across product lines. Life insurance may experience fewer deaths from heart disease and stroke. Critical illness portfolios could benefit from fewer claims for myocardial infarction, certain cancers, and end-stage renal disease. Disability insurers might see improved return-to-work rates for claimants with obesity-aggravated conditions such as joint disorders and type 2 diabetes.

However, claims managers must be alert to offsetting risks. Loss of lean mass in older adults could increase frailty and fracture risks. Rapid weight regain after drug discontinuation may trigger acute health events. Adverse side effects, while rare, could lead to their own claims like gallbladder disease and pancreatitis as well as a black box warning on the box that says these can increase chances of thyroid cancer. Furthermore, the definition of appropriate care may evolve: in health insurance, GLP-1 therapy could become a prerequisite before approving bariatric surgery or other costly interventions, influencing claims adjudication protocols.

The GLP-1 era also introduces non-mortality risks that can indirectly affect longevity modelling. Long-term safety concerns arise as decades-long exposure data is not yet available for these medications. Off-label use for cosmetic weight loss in non-obese populations could shift public perception and payer policies in unpredictable ways. Supply chain volatility presents another challenge, as drug shortages could interrupt therapy en masse, creating mortality whiplash effects across populations. Scenario testing should include stress cases such as 50% supply disruption for one year or a major safety recall, to quantify potential impacts on mortality projections and insurer solvency.

### **OPERATIONAL INTEGRATION: FROM WELLNESS PROGRAMS TO PREVENTIVE INSURANCE**

Forward-thinking insurers are beginning to integrate GLP-1 coverage into wellness programs, often coupled with dietary and behavioral coaching to maximize adherence. Some are considering premium discounts or policy benefits for sustained weight reduction. These strategies align insurer and policyholder incentives, but they require robust tracking mechanisms.

Life and disability insurers, traditionally limited in post-issue health monitoring, may explore voluntary data-sharing through wearable devices or periodic health surveys. This raises privacy considerations but could be positioned as a value-added service.

Reinsurers and insurers are beginning to adapt. Updated underwriting manuals now recommend asking about recent use of prescription weight-loss drugs, duration of use, and maintenance history. Some guidelines suggest requiring evidence of stable weight for a certain period before granting top preferred rates, or applying temporary ratings until durability is demonstrated. The use of supplementary measures such as waist circumference, waist-to-hip ratio, and body composition is gaining ground as part of a more holistic risk assessment. Laboratory data on metabolic markers may also become routine, helping to distinguish between genuine risk improvement and temporary suppression of metrics due to medication.

Current high costs limit GLP-1 access largely to affluent segments. This will change as patents expire in the late 2020s and early 2030s, potentially making generics available at a fraction of today's price.<sup>7</sup> When that happens,

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<sup>7</sup> Debbie Smith, Prachi Patkee, Adam Strange, and Febby Mulewa, "Big Promise: Everything You Need to Know About Weight Loss Drugs," *The Actuary*, May 8, 2025, <https://www.theactuary.com/2025/05/08/big-promise-everything-you-need-know-about-weight-loss-drugs>.

uptake could expand dramatically across income groups, accelerating health improvements and potentially narrowing mortality gaps between socio-economic strata.

Sustained effectiveness depends not just on pharmaceutical intervention but equally on individual behavioral patterns. Insurance companies can harness behavioral science principles to enhance policyholder health results and more accurately evaluate applicant risk profiles in this GLP-1 era.

Disclosure remains a challenge. Applicants may avoid reporting drug use due to stigma or privacy concerns. Swiss Re's behavioral experiments<sup>8</sup> suggest that traditional binary questions may inadequately capture GLP-1 usage patterns. Using questions like "Have you tried any of the following weight management methods? Select all that apply" could yield more accurate responses than a binary "yes/no" choice and allow insurers added insight for risk assessment. This approach acknowledges the complexity of modern weight management strategies while improving disclosure accuracy.

### CONCLUSION: THE ACTUARIAL COMPASS RESETS

GLP-1 therapies offer the promise of meaningful mortality and morbidity improvements, but the path from clinical trial to lasting population-level benefit is neither linear nor guaranteed. For actuaries, the challenge is to anticipate both the direct and indirect consequences of their widespread use. This requires adjusting pricing assumptions, refining underwriting criteria, monitoring claims trends, and designing products that align incentives for adherence and healthy living. It also demands scenario analysis that considers both best-case and worst-case outcomes, as well as strategic awareness of how shifting health profiles will influence product demand and profitability.

The actuarial compass is indeed resetting, but the direction is not simply toward longer lives. It is toward a more complex interplay between longevity, morbidity, and quality of life; one that demands an equally sophisticated and holistic response from the insurance industry. Those who adapt early, blending technical rigor with practical insight, will not just weather the change; they will help define the next generation of risk management in a healthier, yet more intricate, world.

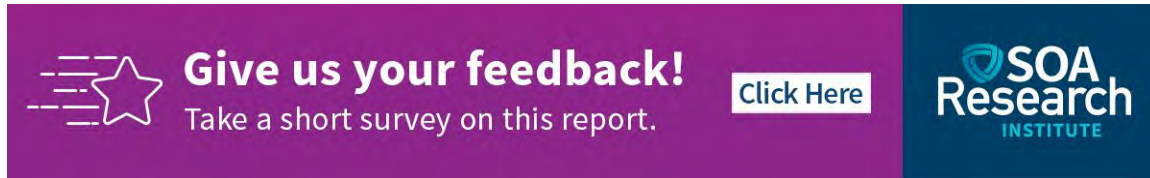
For actuaries, particularly those involved in life, health, and critical illness insurance, the GLP-1 revolution demands a recalibration of both models and mindset. For decades, actuaries could rely on the stubborn persistence of high body mass indexes and their downstream health consequences when setting assumptions. Today, we stand at a rare inflection point. A single class of drugs is challenging decades of actuarial stability, forcing us to reconcile emerging medical evidence with the realities of behavior, access, and cost. This is both a professional challenge and a personal call to apply every tool of the actuarial trade such as pricing acumen, risk modeling, and epidemiological insight, etc. to ensure our assumptions and products remain not just profitable, but relevant and responsible.


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<sup>8</sup> Komal Shah, Yung Hsu, and Grace Burke, *Life & Health Insights – Insurers, Here's How Behavioural Science Can Help You Navigate the GLP-1 Era* (Zurich: Swiss Re, 2025), <https://www.swissre.com/dam/jcr:8586b82d-ef51-4829-8ecd-8a85f2db99b5/behavioural-science-the-glp-1-medication-factsheet.pdf>.

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## The Weight of Change: Mortality Differences Among Weight Maintainers, Regainers, and Cyclers

Ghecora S. Boyd, MPH, BSN, RN, AMB-BC, CPXP, LSSYB

*Any views and ideas expressed in the essays are the author's alone and may not reflect the views and ideas of the Society of Actuaries, the Society of Actuaries Research Institute, Society of Actuaries members, nor the author's employer.*

### INTRODUCTION

Weight loss is often framed as the singular benchmark for health improvement in people that are overweight or obese. The trajectory after weight loss—whether individuals maintain, regain, or cycle through repeated loss and gains—may have profound implications for long-term health and mortality risks. Understanding these patterns is increasingly relevant in the current obesity treatment landscape where lifestyle interventions, pharmacotherapy (e.g., GLP-1 receptor agonists), and bariatric surgery offer unprecedented tools for weight reduction, while sustained maintenance remains elusive for many.

This essay explores whether mortality differs between individuals who lose weight and maintain it long term, those who regain it, and those who experience weight cycling. While the evidence is nuanced and shaped by individual health status, age, comorbidities, and intentionality of weight change, emerging data suggest that sustained weight loss is associated with more favorable mortality outcomes, whereas weight regain and cycling may attenuate or even negate some of the health gains. These patterns have direct implications for mortality modeling and long-term actuarial forecasting.

### DEFINING THE CATEGORIES: MAINTAINERS, REGAINERS, AND CYCLERS

To examine mortality differences, we must first define the populations:

**Weight Maintainers:** Individuals who lose a clinically significant amount of weight (typically  $\geq 5\text{--}10\%$  of baseline body weight) and keep it off for a sustained period (often defined as  $\geq 1$  year, but more robust evidence comes from  $\geq 5$  years of maintenance).

**Weight Regainers:** Those who lose weight but regain most or all of it, often within 1–3 years after initial loss.

**Weight Cyclers (or “yo-yo dieters”):** Those who undergo repeated cycles of weight loss and regain. This can occur intentionally (e.g., repeated dieting) or unintentionally (e.g., related to medical conditions or treatment interruptions).

Each pattern carries different physiological and psychological effects that can influence mortality—ranging from metabolic adaptation and inflammation to depression and healthcare avoidance (Montani et al., 2015).

## MORTALITY AMONG WEIGHT LOSS MAINTAINERS

There is compelling evidence that sustained weight loss improves risk factors for mortality and may confer actual survival benefits, especially among individuals with obesity and comorbidities such as diabetes, hypertension, and cardiovascular disease. The Look AHEAD trial, while not showing a statistically significant reduction in all-cause mortality over a 9.6-year follow-up, did demonstrate reduced cardiovascular risk and improved quality of life among maintainers with type 2 diabetes (Look AHEAD Research Group, 2013).

A pooled analysis of prospective cohorts found that intentional weight loss (particularly  $\geq 10\%$ ) was associated with lower all-cause and cardiovascular mortality among adults with obesity (Kritchevsky et al., 2012). Studies show biomarker improvements (e.g., blood pressure, fasting glucose, cholesterol) are sustained in those who maintain  $\geq 5\%$  weight loss, suggesting that physiologic mechanisms underlying disease and death may be durably altered (Wing & Hill, 2001). Thus, weight maintenance after loss appears protective when the weight loss is intentional and accompanied by healthy behaviors.

## MORTALITY AMONG REGAINERS: LOSING GAINS?

While initial weight loss improves many cardiometabolic markers, individuals who regain weight often experience a reversal of these benefits. In fact, some data suggest that full weight regain can eliminate mortality advantages conferred by the original loss. The CARDIA study showed that weight regain was associated with the reappearance of cardiometabolic risk factors, such as increased triglycerides and blood glucose, especially in women (Lewis et al., 2000). Regaining weight may also be accompanied by psychological stress, increased visceral fat deposition, and reduced motivation for care-seeking—all of which can negatively affect mortality risk (Mehta et al., 2014). Yet not all regainers are alike. Some individuals regain weight but still retain partial benefits (e.g., more physical activity, improved diet, lower baseline body mass index (BMI) than pre-loss levels), which may confer intermediate or “net positive” mortality effects. For these reasons, models that simply equate regain with “return to baseline risk” may underestimate the complexity of the relationship.

## WEIGHT CYCLERS: A CONTROVERSIAL LINK TO MORTALITY

Weight cycling—repeated intentional or unintentional loss and regain of weight—is a debated factor in mortality research. Early studies raised alarms that weight cycling might be more harmful than stable obesity. However, modern analyses have nuanced this view. A recent meta-analysis of 15 cohort studies found that weight cycling was associated with a modest increase in all-cause mortality risk, particularly in individuals without obesity at baseline (Zhang et al., 2019). Weight cycling may increase systemic inflammation, oxidative stress, and insulin resistance, which could explain higher risks for cardiovascular disease (CVD) and type 2 diabetes (Montani et al., 2015).

Importantly, much of the harm associated with weight cycling appears linked to unintentional weight changes—such as those due to undiagnosed illness. This reverse causality complicates interpretation (Field et al., 2009). Some studies also show no significant increase in mortality associated with weight cycling when accounting for smoking status, baseline health, and intentionality. Thus, weight cycling should be considered a heterogeneous category. For actuarial purposes, individuals with repeated loss-regain patterns may represent a population with more unstable risk profiles and greater difficulty sustaining long-term health improvements.

## THE ROLE OF INTENTIONALITY AND BASELINE HEALTH

Whether weight change is intentional or not matters significantly when considering mortality outcomes. Unintentional weight loss (e.g., due to cancer, frailty, or depression) is consistently associated with higher mortality (Alley et al., 2010). Intentional weight loss, especially through structured interventions (e.g., lifestyle programs, medications, or bariatric surgery), is associated with lower risk of death and disability (Adams et al., 2007). Additionally, the starting BMI and presence of comorbidities alters the magnitude of effect. Individuals with obesity

and diabetes, for instance, gain more mortality benefit from weight loss than those with overweight but otherwise healthy profiles (Sjöström et al., 2007).

### ACTUARIAL IMPLICATIONS: MODELING DYNAMIC WEIGHT HISTORIES

Traditional mortality models often use static measures such as baseline BMI to predict risk. Yet as GLP-1s and other anti-obesity medications gain traction, more people may move in and out of obesity categories. This raises key actuarial questions:

- Should weight loss be treated as a permanent shift in risk classification, or contingent on long-term maintenance?
- How should models capture individuals with repeated episodes of weight loss and regain?
- Can electronic health records, pharmacy claims, or behavioral tracking help stratify maintainers from regainers?

The future of mortality modeling will need to account for dynamic weight histories, especially as interventions become more common but not universally maintained. Incorporating weight trajectories—along with treatment adherence and social determinants—will improve the precision of forecasting.

### HEALTH EQUITY: WHO GETS TO BE A MAINTAINER?

It is important to acknowledge that weight maintenance after loss is not equally achievable for all populations. Structural barriers, including food insecurity, housing instability, chronic stress, and racism in healthcare, can make sustained behavioral change more difficult (Kumanyika, 2019). These disparities intersect with socioeconomic status, gender, and geography.

Furthermore, access to pharmacotherapy and long-term follow-up support is highly unequal. Many Medicaid plans still do not cover GLP-1 medications for obesity, and coverage often hinges on employer-based insurance. As such, some populations may be more likely to regain or cycle—despite equal motivation to maintain weight loss. Models that fail to account for these barriers risk underestimating mortality risk in underserved groups and overestimating benefits in populations who cannot afford sustained interventions.

### CONCLUSION

Yes, mortality experience does differ between individuals who lose weight and maintain it, and those who regain or cycle. Sustained weight loss—especially when intentional and accompanied by lifestyle change—is associated with improved survival. In contrast, regaining or repeatedly cycling weight appears to blunt or negate these benefits and may increase mortality risk in certain populations but these patterns are not uniform. Intentionality, access, comorbidities, and social determinants all shape the degree of benefit or harm.

For actuaries, these findings underscore the need for models that incorporate weight history, behavior sustainability, and equity factors, not just BMI snapshots. As weight loss interventions become more accessible and mainstream, understanding these nuances will be critical to accurate mortality forecasting and fair risk stratification.

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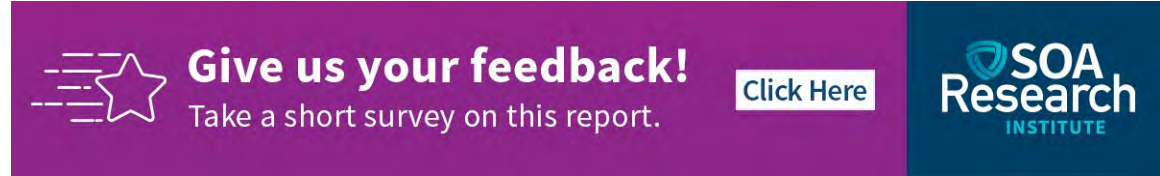
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## The Tipping Scale: Obesity, Anti-Obesity Medications, and the Shifting Arc of Mortality

Sathiya Livingston

*Any views and ideas expressed in the essays are the author's alone and may not reflect the views and ideas of the Society of Actuaries, the Society of Actuaries Research Institute, Society of Actuaries members, nor the author's employer.*

### INTRODUCTION: THE HEAVIEST VARIABLE

Obesity is no longer a slow-burning crisis—it is a fast-growing determinant of mortality in both developed and developing nations. “In the United States, **41.9% of adults were classified as obese between 2017 and 2020** (CDC/NCHS, 2021), and **projections estimate that more than 50% of U.S. adults will be obese by 2030** (Ward et al., 2019).” Obesity has far-reaching consequences beyond individual health, including reduced life expectancy, heightened mortality from comorbid conditions, increased disability-adjusted life years (DALYs), and vast implications for actuarial science, underwriting, and long-term population modeling.

As mortality improvements from reductions in smoking and cardiovascular interventions plateau, obesity emerges as the largest single countervailing force. Meanwhile, the pharmaceutical landscape is being disrupted by the rise of **anti-obesity medications (AOMs)**—GLP-1 receptor agonists such as semaglutide and tirzepatide—offering the tantalizing prospect of large-scale pharmacological reversal of obesity.

This essay explores obesity's evolving role in shaping future mortality, the influence of socio-demographics and comorbidities, the potential impact of AOMs, and how actuaries must recalibrate assumptions and models to keep pace with this unfolding health transformation.

### OBESITY'S COMPLEX RELATIONSHIP WITH MORTALITY

#### THE J-CURVE AND THE BMI CONUNDRUM

Body mass index (BMI), for all its imperfections, remains the most widely used measure for classifying weight status. The mortality curve associated with BMI has historically been modeled as **J-shaped** or **U-shaped**, with elevated risk at both low and high ends. Yet, quantifying this relationship precisely is fraught with methodological challenges: reverse causation (e.g., weight loss due to illness), selection bias, and lack of longitudinal controls.

Moreover, the **location of the nadir**—the BMI with the lowest mortality—shifts across time and populations. Earlier studies placed the nadir between 22–25 kg/m<sup>2</sup>, but more recent meta-analyses suggest a possible drift upward, possibly due to better cardiovascular treatments offsetting some of the metabolic risks of higher body weight. Nevertheless, this “obesity paradox” is likely a data artifact rather than a biological reality.

## OBESITY-DRIVEN MORTALITY: DIRECT AND INDIRECT EFFECTS

Obesity is not a disease in isolation—it is a chronic systemic condition that **amplifies** the risk of other mortality drivers. Among the most prominent are:

- **Cardiovascular Diseases:** Obesity increases hypertension, dyslipidemia, and insulin resistance.
- **Type 2 Diabetes Mellitus (T2DM):** A closely linked epidemic, with 90% of T2DM cases attributed to overweight and obesity.
- **Cancer:** Obesity is associated with 13 types of cancers, including breast, colon, liver, and pancreatic.
- **Respiratory Conditions:** Including obstructive sleep apnea and obesity hypoventilation syndrome.
- **COVID-19 Mortality:** Obesity was a strong independent predictor of severe COVID-19 outcomes.

## QUANTIFYING THE IMPACT

In actuarial terms, **years of life lost (YLL)** due to obesity are significant. “A 2016 meta-analysis of 239 prospective studies across four continents involving over 10 million participants established a clear relationship between elevated BMI and all-cause mortality (Global BMI Mortality Collaboration, 2016). A study published in *The Lancet* estimated that obesity reduces life expectancy by **five to 10 years**, depending on severity and age of onset.” When applied at the population level, this translates into millions of person-years lost—impacting pension liabilities, life insurance reserves, and public health expenditure projections.

## COMORBIDITIES AND DEMOGRAPHIC MULTIPLIERS

### THE MULTIPLICATIVE NATURE OF COMORBID RISKS

The actuarial complexity of modeling obesity lies in its **combinatorial effects**. When obesity intersects with **smoking, sedentary lifestyle, low socioeconomic status (SES), or genetic predisposition**, mortality risk is not merely additive—it is **multiplicative**.

Actuaries must consider **multi-variable risk clustering**, especially in midlife adults where obesity co-occurs with diabetes and depression, creating feedback loops that accelerate deterioration.

### RACE, GENDER, AND SOCIAL DETERMINANTS

In the U.S., obesity is **not evenly distributed**:

“According to NHANES data, non-Hispanic Black women have an obesity rate of approximately 57%, significantly higher than the national average (Hales et al., 2020).”

- Black and Hispanic women have the highest obesity prevalence rates in the United States.
- Men are more likely to under-report weight in self-reported health data, which may contribute to under-diagnosis in some surveillance contexts (CDC).
- Lower-income populations are more likely to live in food deserts, limiting access to healthy food and increasing obesity risk (USDA ERS, 2019).

“The USDA estimates that over 19 million people in the U.S. live in food deserts, limiting access to healthy food and increasing obesity risk among low-income populations (USDA ERS, 2019).”

These disparities have actuarial consequences. Mortality curves stratified by race and SES will diverge, necessitating refined underwriting practices and more granular mortality tables.

**ANTI-OBESITY MEDICATIONS—MIRACLE OR MIRAGE?**

**THE RISE OF GLP-1 AGONISTS**

In the last five years, drugs like **Ozempic (semaglutide)** and **Mounjaro (tirzepatide)** have shown extraordinary efficacy—average weight loss of 15–22% of body weight—comparable to bariatric surgery, with fewer risks. “For example, semaglutide achieved a **14.9% mean weight loss** in the STEP 1 trial (Wilding et al., 2021), while tirzepatide showed **up to 22.5% weight reduction** in the SURMOUNT-1 trial (Jastreboff et al., 2022).”

This pharmacological shift may do what decades of public health messaging could not—**reduce population-level obesity** within a generation.

**POTENTIAL MORTALITY IMPACT**

If AOMs are widely adopted and adherence remains high, mortality improvements could be substantial. Consider the implications:

- **Reduction in T2DM incidence** could lower microvascular and macrovascular deaths.
- **Reduced hypertension and cholesterol** would likely decrease stroke and MI rates.
- **Improved mobility** could reduce frailty and falls in elderly populations.

Yet, actuarial models must be cautious. Drug efficacy in trials often exceeds real-world adherence. Side effects, cost, insurance coverage, and long-term risks remain uncertain. Mortality benefits may lag behind weight loss by several years.

**WILL THE BENEFITS BE EQUALLY DISTRIBUTED?**

AOM access is currently **stratified by income and insurance coverage**. If only higher SES individuals access these medications, disparities in mortality will **widen**, not shrink. Actuarial models must incorporate **scenario analysis**: what if AOMs penetrate only 20% vs. 60% of the obese population? What happens if the FDA approves pediatric use?

**FORECASTING THE FUTURE—A TALE OF TWO CURVES**

**COMPETING TRENDS: OBESITY VS. INNOVATION**

Over the next 10–20 years, mortality outcomes will be shaped by two countervailing forces:

Driver	Direction of Impact
Rising Obesity Prevalence	↑ Mortality
Aging Population	↑ Mortality
Improved Medical Technology	↓ Mortality
Anti-Obesity Pharmacotherapy	↓ Mortality
Social Disparities	↑ Mortality
Digital Health Interventions	↓ Mortality (modestly)

If AOMs can tip the balance, we may see a **re-acceleration of mortality improvement rates**—akin to the post-statin or post-antihypertensive eras. However, without equitable access, the net gain could be modest or even negative for vulnerable subgroups.

## ACTUARIAL IMPLICATIONS

Mortality assumptions in life and annuity products, pension plans, and long-term care projections must be revisited. Key recommendations:

1. **Segmented Mortality Tables:** Separate by BMI, AOM usage, comorbidities.
2. **Scenario Modeling:** Include high/low uptake scenarios for AOMs.
3. **Lapse and Adherence Modeling:** Account for drug discontinuation and rebound weight gain.
4. **Reinsurance Strategy:** Adjust for uncertain tail risk related to novel AOM side effects.
5. **Dynamic Assumption Setting:** Incorporate real-time epidemiological data (e.g., NHANES updates).

## ETHICAL AND SOCIAL CONSIDERATIONS

### A CAUTION AGAINST MEDICALIZATION ALONE

While AOMs are promising, **medicalizing obesity** risks ignoring the **upstream determinants**: urban planning, food policy, income inequality, education. AOMs cannot substitute for equitable public health architecture.

If actuaries fail to consider social gradients in obesity and access to treatment, models may **understate longevity risk for affluent segments** and **overstate it for the poor**.

### THE FUTURE OF UNDERWRITING

As AOMs become more common, **underwriting practices** may need to evolve:

- Should BMI be replaced with **waist-to-height ratio**, which better predicts cardiovascular risk?
- Will AOM usage become a preferred risk class?
- What data rights and disclosures apply to pharmacological weight loss?

## CONCLUSION: A NEW ERA OF WEIGHT AND WORTH

Obesity, long dismissed as a lifestyle issue, is now a **primary determinant of mortality** on the actuarial horizon. Its interplay with comorbidities, socioeconomic factors, and emerging pharmacotherapies makes it a dynamic, multi-layered challenge.

The arrival of potent anti-obesity medications offers a potential **inflection point**—but only if access is widespread, long-term safety is confirmed, and behavioral change accompanies pharmacotherapy. Actuarial models must now evolve beyond static mortality assumptions and embrace a **dynamic, data-driven approach** that accounts for medical innovation, policy shifts, and social gradients.

In short, the actuarial profession must **weigh more than weight**. It must anticipate how the scale of health, equity, and technology tips in the decades to come.

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## The Expanding Weight of Mortality: Reimagining Obesity's Impact on Future Longevity

Sathiya Livingston

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### ABSTRACT

Obesity is a structural, multi-dimensional risk with profound implications for mortality, healthcare costs, and insurance solvency. Rising prevalence, particularly in children, threatens to reverse decades of public health gains. This essay examines historical trends, epidemiology, socioeconomic, and cultural drivers, and intergenerational effects. It integrates actuarial modeling, economic impacts, medical innovations, and scenario planning. Innovative frameworks, such as the Mortality Credit for Prevention and Equity Index (MCPEI), are proposed to align preventive action with financial incentives. Global comparisons and scenario projections demonstrate the urgency for forward-looking strategies. By combining epidemiology, behavioral science, and actuarial foresight, this essay highlights how obesity can be transformed from a looming crisis into an opportunity for innovation, equitable health outcomes, and sustainable longevity planning.

### INTRODUCTION AND HISTORICAL CONTEXT

Over the past century, public health and actuarial science have been shaped by successive waves of mortality risk. In the early twentieth century, infectious diseases such as tuberculosis, influenza, and polio were the leading causes of death. Mortality was largely external: pathogens, occupational hazards, and maternal complications dictated life expectancy. By mid-century, smoking emerged as a dominant behavioral risk, redefining actuarial tables and life insurance underwriting. Smoking cessation campaigns, public health interventions, and clinical awareness gradually reduced mortality rates associated with this risk. Yet, amid these shifts, obesity remained a marginal concern, rarely incorporated in mortality models or actuarial projections.

Obesity's rise is not sudden, but structural. In the 1970s and 1980s, epidemiological studies in the United States and Western Europe began documenting steadily increasing prevalence of overweight and obesity. Initially treated as a lifestyle choice or a modifiable factor, obesity's long-term implications were underestimated. Early actuarial models assumed that lifestyle modification would mitigate excess mortality. Yet, decades later, obesity has entrenched itself as a primary driver of morbidity and mortality, influencing life expectancy projections, health system costs, and insurance risk.

The acceleration of obesity prevalence correlates with deep social and economic changes. Urbanization, mechanization, and the global expansion of processed food markets reshaped dietary habits. Sedentary occupations replaced physically demanding work for large segments of the population, while urban environments often limited

physical recreational activity. Cultural shifts, including the normalization of calorie-dense diets and increased screen time, further reinforced weight gain trends. By the early twenty-first century, obesity was no longer a peripheral health concern but a structural driver of population-level mortality.

Actuarially, the implications are profound. Life tables that once ignored obesity must now integrate this chronic condition as a determinant of mortality, morbidity, and economic burden. Insurers face higher claims in multiple lines, from life and health insurance to long-term care and disability. The historical evolution of obesity—from a minor risk to a central public health threat—serves as a cautionary tale for actuaries: structural risk factors can evolve slowly yet irreversibly, demanding early identification, predictive modeling, and intervention planning.

Global comparisons highlight the uneven trajectory of obesity’s impact. The United States now reports over 40% adult obesity prevalence, with projections exceeding 50% by 2030. Canada faces 28% adult prevalence, with rural and Indigenous populations at significantly higher risk. Europe exhibits regional variation: Mediterranean nations maintain lower prevalence (~20%), whereas Northern and Eastern Europe approach 35%. In Asia, Japan and South Korea preserve historically low rates (~4–5%), but urbanization in India and China accelerates youth obesity, posing intergenerational challenges. (CDC/NCHS, 2024; Ward et al., 2019; Canadian Institute for Health Information, 2023; World Health Organization, 2024)

Understanding obesity as a structural risk requires a comprehensive, multi-layered approach. Actuarial modeling must incorporate historical trends, demographic variation, socioeconomic determinants, and environmental factors. By situating obesity within the context of decades-long shifts in diet, activity, and culture, actuaries can begin to quantify the scale, trajectory, and consequences of this pervasive risk.

### **EPIDEMIOLOGY, CHILDHOOD OBESITY, AND INTERGENERATIONAL RISK**

Globally, over one billion adults are obese, and childhood obesity has become a key predictor of long-term mortality (World Health Organization, 2024). Childhood obesity carries unique risks that amplify over the course of life. Obese children are far more likely to become obese adults (World Health Organization, 2024; Hruby & Hu, 2015), facing elevated risks of type 2 diabetes, cardiovascular disease, hypertension, non-alcoholic fatty liver disease, and musculoskeletal disorders. Actuarially, early-onset obesity compresses the premium-paying window for life insurance, increases long-term claims, and compounds fiscal liabilities in health and disability insurance. If current adolescent obesity trends persist, U.S. life expectancy could plausibly decline by 1.5 to two years over the next 30–40 years, based on the author’s synthesis of existing epidemiological and actuarial projections, potentially reversing decades of public health gains.

The intergenerational dimension further complicates projections. Maternal obesity affects offspring metabolism, predisposing children to higher BMI trajectories, altered insulin sensitivity, and elevated cardiovascular risk (World Health Organization, 2024; Afshin et al., 2017). Paternal obesity can also influence epigenetic markers, creating a cycle of transmitted risk across generations (Hruby & Hu, 2015; World Health Organization, 2024). These multigenerational effects mean that adolescent and childhood obesity are not merely transient risks but structural threats that shape mortality decades later.

Socioeconomic and environmental factors intensify these dynamics. Low-income families often face limited access to fresh, nutritious foods and safe spaces for physical activity. Behavioral economics explains how calorie-dense, nutrient-poor foods are cheaper and more accessible, reinforcing structural drivers of obesity (Hruby & Hu, 2015; World Health Organization, 2024). Cultural norms and media influence perceptions of body weight and diet, further affecting childhood and adolescent behaviors. Urban design, including walkability and recreational space, interacts with these social factors to either mitigate or exacerbate risk.

From the author’s perspective, actuarial modeling would benefit from incorporating these dimensions to improve the accuracy of mortality and morbidity projections. For instance, an insurer modeling a cohort of 50,000

adolescents might stratify risk by BMI percentile, socioeconomic status, and urban vs. rural residence. Preliminary, illustrative calculations suggest that the high-BMI, low-income subgroup could experience substantially higher mortality by mid-adulthood compared with their normal-weight, higher-income peers. Integrating these variables into predictive models allows for more precise underwriting, policy design, and preventive intervention planning.

Understanding childhood obesity through the lens of epidemiology and intergenerational risk emphasizes the need for preventive strategies. Actuarial foresight can quantify the potential benefits of interventions such as early nutritional education, school-based exercise programs, and equitable access to medical therapies. By anticipating the future trajectory of obesity and its multi-layered consequences, insurers and policymakers can take proactive measures that preserve longevity and financial stability.

### **SOCIOECONOMIC, CULTURAL, AND BEHAVIORAL DIMENSIONS**

Obesity is not merely a medical condition; it is a social and economic phenomenon, disproportionately affecting marginalized populations. In the United States, adults with household incomes below \$35,000 experience obesity prevalence around 45%, compared with approximately 32% among those earning over \$100,000. (Centers for Disease Control and Prevention, 2023; World Health Organization, 2024) Indigenous communities in Canada and rural populations face similarly elevated risks due to limited access to nutritious foods, safe recreational spaces, and quality healthcare (Canadian Institute for Health Information, 2023; World Health Organization, 2024). From the author's perspective, socioeconomic status interacts with education, occupation, and neighborhood environment to shape lifestyle behaviors, dietary choices, and physical activity, creating complex, layered mortality risks that actuarial models would benefit from incorporating.

Cultural factors play a critical role. Traditional dietary patterns, social norms regarding body weight, and community attitudes toward exercise influence both prevalence and health outcomes. In some communities, high-calorie diets are culturally celebrated, and body fat is associated with prosperity or attractiveness. Media, advertising, and digital culture amplify consumption behaviors, particularly among youth (World Health Organization, 2024; Hruby & Hu, 2015). For instance, aggressive marketing of sugar-sweetened beverages and ultra-processed foods in low-income neighborhoods drives higher caloric intake and increased obesity risk (World Health Organization, 2024; Afshin et al., 2017), reinforcing structural inequities (World Health Organization, 2024).

Behavioral economics provides insights into these trends. Obesity prevalence is often higher in populations where calorie-dense foods are cheaper, more accessible, and heavily promoted (World Health Organization, 2024; Hruby & Hu, 2015). Time scarcity, stress, and occupational demands push individuals toward convenient, energy-rich meals, while sedentary work environments reduce baseline energy expenditure. From the author's perspective, actuarial models would benefit from accounting for these behavioral drivers, given their significant contribution to long-term mortality projections.

Urban planning and built environments further shape obesity outcomes. Walkability, availability of public parks, proximity to grocery stores with fresh produce, and safe neighborhood infrastructure all modulate population-level risk (World Health Organization, 2024; Hruby & Hu, 2015). High-density urban areas may offer exercise opportunities but can simultaneously expose residents to food deserts, noise pollution, and environmental stressors, compounding health risks. Conversely, suburban sprawl often necessitates car dependence and reduces incidental physical activity, contributing to weight gain and associated mortality.

From an actuarial perspective, these factors introduce heterogeneity that cannot be captured by BMI alone. From the author's perspective, predictive modeling that integrates socioeconomic status, cultural context, behavioral tendencies, and environmental exposures could provide a more nuanced understanding of population risk. For example, stratifying a 100,000-person cohort by income, education, neighborhood walkability, and BMI can reveal subgroups at markedly higher mortality risk, informing targeted interventions, underwriting, and premium

adjustments. Preliminary, illustrative modeling by the author suggests that adults in low-income, low-education, low-walkability neighborhoods with obesity may face meaningfully higher long-term mortality risk than similar individuals in high-income, high-education, high-walkability areas, after adjusting for comorbidities.

Addressing these structural and behavioral drivers requires a multifaceted approach. From the author’s perspective, public health initiatives could focus on food access, education, cultural messaging, and urban infrastructure. Employers can incentivize wellness programs and provide supportive environments for physical activity. Insurers can use risk-adjusted premium incentives to promote healthier lifestyles while addressing inequities. From the author’s perspective, integrating these dimensions into actuarial frameworks could help ensure that models capture not just biological risk but also broader social determinants of health, potentially yielding more accurate mortality predictions and actionable policy insights.

From the author’s perspective, obesity cannot be understood solely as an individual failure of behavior or willpower. It is deeply embedded in socioeconomic, cultural, and environmental contexts. Recognizing this complexity allows actuaries, insurers, and policymakers to move beyond reactive strategies toward proactive, systemic interventions that can reduce long-term mortality risk and enhance population health.

### **ECONOMIC AND INSURANCE IMPLICATIONS, MEDICAL INNOVATIONS, AND ACTUARIAL MODELING**

Obesity imposes significant economic costs, both direct and indirect. Globally, these costs are estimated at \$2 trillion annually, or roughly 2.8% of global GDP (World Obesity Federation, 2014; World Health Organization, 2024). Direct healthcare costs include treatment for type 2 diabetes, cardiovascular disease, cancer, and musculoskeletal disorders. In the United States alone, obesity-related healthcare expenditures exceed \$170 billion per year, while in Canada, they approach \$7 billion. Indirect costs arise from lost productivity, absenteeism, disability, and premature mortality, with U.S. employers incurring an estimated \$4.3 billion annually in obesity-related absenteeism alone (Centers for Disease Control and Prevention, 2023; Canadian Institute for Health Information, 2023; World Obesity Federation, 2014). These economic pressures are amplified when viewed from an insurance perspective.

Life insurers, for example, face shortened premium-paying windows due to early mortality among obese individuals. Health insurers experience higher claim frequency and greater chronic disease burden (Centers for Disease Control and Prevention, 2023; World Health Organization, 2024). Disability and long-term care insurers contend with longer claim durations, particularly due to musculoskeletal and metabolic complications (World Health Organization, 2024; Centers for Disease Control and Prevention, 2023). Consider a life insurer underwriting 10,000 policies in 2025. If obesity increases mortality risk by 5% over 20 years for affected policyholders, the expected present value of claims could rise by \$50 million, assuming average face amounts and standard mortality multipliers. Similarly, disability insurers might see claim durations extend by 12–18 months, increasing reserve requirements and challenging solvency assumptions.

Medical innovations, however, offer potential to mitigate risk. GLP-1 receptor agonists, including semaglutide and tirzepatide, demonstrate approximately 15–20% average weight reduction in clinical trials, along with improvements in cardiometabolic risk factors and cardiovascular outcomes (Wilding et al., 2021; Jastreboff et al., 2022). From the author’s perspective, widespread adoption of these therapies could meaningfully reduce obesity prevalence over the next decade and may contribute to gains in average life expectancy in populations with broad access. Digital health interventions—wearables, AI-driven lifestyle coaching, and remote monitoring—further enhance individualized risk management, allowing insurers to model mortality trajectories based on adherence to preventive measures.

Traditional metrics like BMI, while useful, fail to capture nuances such as visceral fat distribution, metabolic health, and temporal factors like age at onset or duration of obesity. Advanced actuarial models now incorporate waist-to-

hip ratios, body fat percentages, biomarkers, and environmental exposures such as urban design and food accessibility. Behavioral variables, including stress, sedentary behavior, and diet, also refine mortality projections. Integrating these multi-dimensional data points allows insurers to stratify risk with greater precision, identify high-risk cohorts, and design interventions that are both targeted and cost-effective.

To operationalize these insights, I propose the **Mortality Credit for Prevention and Equity Index (MCPEI)**, a novel actuarial framework that rewards preventive behavior while promoting equity. Employers implementing verified wellness programs could receive reduced group insurance premiums. Individuals adhering to structured nutrition, exercise, and pharmacological regimens could earn mortality credits, reducing their long-term premium liabilities. Communities demonstrating measurable reductions in obesity prevalence could influence local risk pools, adjusting actuarial assumptions to account for collective health improvements. MCPEI aligns financial incentives with health outcomes, transforming the actuarial model from reactive risk assessment to proactive risk shaping.

My scenario analysis reflects the author's illustrative assessment of the potential impacts of obesity interventions. In an optimistic scenario, widespread GLP-1 adoption combined with robust preventive programs could plausibly reduce U.S. adult obesity by approximately 20% by 2045, helping to stabilize mortality trends and insurance claims costs. A baseline scenario assumes more modest intervention uptake, maintaining current prevalence levels and producing gradual increases in healthcare expenditures. A pessimistic scenario, characterized by continued prevalence growth and inequitable access to interventions, could see U.S. adult obesity approach 60%, accompanied by declines in life expectancy and substantial increases in long-term care and disability claims, stressing insurer solvency and government healthcare budgets.

These scenarios underscore the importance of integrating economics, medical innovation, and precise actuarial modeling. From the author's perspective, obesity is no longer a peripheral risk but a structural determinant of mortality, morbidity, and financial stability. Addressing this pervasive challenge would benefit from forward-looking, multi-dimensional strategies across insurance, policy, and public health contexts.

## SCENARIO PLANNING, GLOBAL PERSPECTIVES, AND CONCLUSION

From the author's perspective, fully grasping obesity's impact on mortality would benefit from comprehensive scenario planning. The following scenarios reflect the author's illustrative analysis. An optimistic scenario envisions widespread adoption of pharmacological interventions, digital health tools, and equitable preventive programs, which could plausibly reduce adult obesity by approximately 15–20% in the United States and Canada by 2045, with associated improvements in life expectancy, stabilization of healthcare costs, and manageable insurance claims. A baseline scenario assumes more modest intervention uptake, maintaining current prevalence levels and producing gradual increases in chronic disease, healthcare expenditures, and insurance claims. A pessimistic scenario anticipates continued obesity escalation, with U.S. adult prevalence approaching 60%, declines in life expectancy, and substantial increases in disability, long-term care, and health claims, stressing insurer solvency and public budgets..

Globally, obesity trends diverge: Northern Europe faces escalating prevalence, while Japan and South Korea maintain low rates through disciplined diet, exercise, and social norms. Low- and middle-income countries experience accelerating childhood obesity, portending intergenerational health risks (World Health Organization, 2024; Afshin et al., 2017). This divergence highlights the role of culture, policy, and environment in shaping mortality trajectories. From the author's perspective, actuarial projections would benefit from integrating local, regional, and global patterns, accounting for variations in prevalence, intervention uptake, and social determinants.

Ultimately, obesity is a structural, multi-dimensional threat that requires actuarial creativity and foresight. Integrating epidemiology, socioeconomic determinants, medical innovation, and scenario modeling allows actuaries to quantify risk, forecast trends, and shape interventions. By linking preventive action with financial and policy

incentives, the actuarial profession can transform obesity from a looming crisis into an opportunity for innovation, equity, and sustainable population health. In doing so, insurers, policymakers, and public health leaders can preserve longevity gains, stabilize healthcare systems, and enhance societal resilience in the face of one of the most pressing mortality challenges of the 21st century.

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## The Weight of Risk: Obesity, Mortality, and the Actuarial Lens

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### INTRODUCTION

Obesity has long been recognized as one of the defining health challenges of the twenty-first century, but its implications for mortality are still unfolding in ways that stretch beyond traditional actuarial frameworks. While excess body weight has been linked to cardiovascular disease and diabetes for decades, newer evidence shows its reach extends further—into liver disease, disability, frailty, and cancers.<sup>14,5,16</sup> Taken together, these conditions reveal obesity as not just a chronic risk factor but a mortality disruptor.

For actuaries, the persistence of this disruption invites comparison to recent shocks like COVID-19, which pushed U.S. insured mortality roughly 12% above expected levels in 2020–21 before returning toward baseline.<sup>1</sup> Obesity's effect is less abrupt but potentially more enduring, compounding year after year across both developed and emerging markets.<sup>3</sup>

The actuarial task is to move beyond descriptive epidemiology and toward forward-looking modeling. This requires integrating tools such as frailty indices, disability measures, and global burden of disease data,<sup>2</sup> while also accounting for payer-side assumptions around adoption, adherence, and affordability of emerging therapies. In short, obesity forces actuaries to blend population health science with financial risk modeling, bridging the gap between epidemiologic inevitability and therapeutic possibility.



Source: Victor Moussa, Adobe Stock

### EPIDEMIOLOGIC EVIDENCE

Epidemiologic studies consistently affirm obesity as a determinant of premature mortality, but recent research underscores that its impact extends beyond cardiovascular disease and diabetes.<sup>2</sup> Global data show rising

prevalence across nearly all regions, with the steepest increases in middle-income countries where urbanization, dietary transitions, and sedentary lifestyles converge.<sup>15</sup> By 2035, more than half the world’s population may be overweight or obese, with disability-adjusted life years (DALYs) attributable to high body-mass index rising accordingly.<sup>3</sup> In the United States specifically, projections suggest that all states will see adult obesity prevalence exceed 35% within the next decade, with severe obesity rates climbing even more rapidly.<sup>13</sup>

Multiple mortality pathways are now recognized. Liver disease—particularly metabolic dysfunction-associated steatohepatitis (MASH)—is a growing contributor, with recent phase-2 trials of GLP-1–based and related dual-agonist therapies demonstrating improvements in liver fat and fibrosis.<sup>4,8</sup> Obesity is also linked to elevated cancer risk across more than a dozen tumor types.<sup>14</sup> Frailty research deepens the concern: individuals with obesity accumulate health deficits earlier, often pushing frailty index scores above 0.2—a threshold strongly associated with higher mortality.<sup>5,16</sup>

Geographic variation sharpens the actuarial challenge. In the United States, prevalence is high and stable, with sustained mortality effects among middle-aged adults.<sup>13</sup> In India and other emerging economies, prevalence is rising quickly but with uneven access to prevention and treatment, pointing to sharper shocks ahead.<sup>10,15</sup> Gains from declining infectious disease may soon be offset by obesity’s rise.

For actuaries, the lesson is instructive: mortality projections may no longer be able to rely on national averages or historical curves. Integrating population-specific prevalence, comorbidity clusters, and frailty dynamics could strengthen forecasts and reduce the risk of incomplete projections.

## ACTUARIAL MORTALITY STUDIES

Epidemiology quantifies the health burden; actuarial research translates it into pricing assumptions and solvency forecasts. If COVID-19 was a sudden storm, obesity is the slow-moving tide: gradual but deeply disruptive.

Preferred underwriting classes offer one analogy. Society of Actuaries Research Institute studies show that favorable mortality in these groups diminishes over time.<sup>6</sup> A similar “wear-off” appears in obesity management: weight-loss interventions may show early success, but relapse is common, eroding long-term gains. For actuaries, the question is not whether obesity increases mortality risk, but whether interventions last long enough to change the slope of the curve.

Socioeconomic disparities compound the challenge. Mortality research reveals higher actual-to-expected ratios among lower face-amount policies, often interpreted as a proxy for lower income.<sup>17</sup> Obesity prevalence is disproportionately higher in these groups, amplifying inequities.<sup>18</sup> Insurance pricing may reflect not only medical risk, but also the socioeconomic gradient that accompanies it.

The phenomenon of unhealthy longevity complicates matters further. A landmark study covering 70 million life-years and \$58 billion in long-term care claims found that people are living longer, but often in poor health.<sup>7</sup> Obesity accelerates this trajectory by driving frailty earlier, increasing both mortality and long-term care risk.<sup>5,16</sup> For actuaries, this blurs the line between when people die and how they live before death, suggesting the value of integrated models that capture both.

In summary, obesity reshapes mortality tables in subtle but profound ways. It magnifies inequities, erodes advantages, and shifts focus from singular causes of death to multidimensional health states. It is not simply a parameter to plug into existing frameworks; it is a structural change that may warrant new modeling approaches.

## THERAPEUTIC INNOVATIONS

If epidemiology supplies the bad news, therapeutic innovation offers some counterweight. Breakthroughs in GLP-1 receptor agonists and related dual-agonist therapies have delivered double-digit weight loss and improvements in comorbid conditions such as MASH.<sup>8</sup> For the first time, obesity has a pharmaceutical lever strong enough to plausibly bend mortality projections.

Still, the actuarial puzzle is unresolved. Adoption, adherence, cost offsets, and payer churn together determine whether pharmacotherapy can materially alter mortality. Costs are high, side effects limit persistence, and benefits may dissipate once coverage lapses. Each factor shifts projected gains, making obesity pharmacotherapy a natural candidate for scenario modeling.

Three broad scenarios frame the outlook: high uptake with durable benefits; moderate use with partial offsets; and limited access with high relapse rates. In my view, actuaries should consider modeling all three, as they already do for gene therapies.

The analysis could also include non-pharmaceutical approaches. Digital health tools, bariatric surgery, and nutrition programs—while less scalable—can complement pharmacotherapy and extend its benefits. For actuaries, the task is not to predict certainty but to quantify ranges, ensuring solvency and pricing remain intact under any scenario.

## POLICY & GLOBAL PERSPECTIVES

Obesity is universal in biology but particular in policy. In the United States, much debate centers on whether Medicare and commercial payers should cover GLP-1 drugs, and on what terms. Outcome-based reimbursement, familiar in oncology, is being adapted to obesity with payment tied to sustained weight loss or reduced comorbidities.<sup>9</sup> Europe proceeds cautiously, balancing fiscal constraints against public demand.<sup>19</sup> India's policy framework is anchored by Ayushman Bharat, the national health protection scheme covering over 500 million citizens.<sup>20</sup> While it funds hospital care, obesity management and outpatient prevention largely remain in private or employer-sponsored markets.<sup>20</sup> East Asia faces a different paradox: low prevalence but aging populations that magnify the effect of modest increases.<sup>21</sup>

These contrasts matter actuarially. DALYs attributable to obesity are more than twice as high in the United States as in India, reflecting both higher prevalence and older age structure.<sup>10</sup> For multinational insurers and social insurance systems, timing and geography matter as much as prevalence itself.

The actuarial challenge therefore varies substantially by geography, reflecting differences in prevalence, healthcare infrastructure, and policy environment. Table 1 summarizes key regional characteristics that shape mortality modeling and product design considerations.

**Table 1**  
**REGIONAL OBESITY PREVALENCE AND ACTUARIAL MODELING IMPLICATIONS**

Region	Adult Obesity Prevalence (%)	Policy Focus	Actuarial Implications
United States	42 <sup>3</sup>	Coverage debates for GLP-1 drugs; outcome-based contracts; Medicare/commercial payers	Scenario modeling of drug adoption; product pricing sensitive to uptake and durability
India	7 <sup>10</sup>	Public health prevention campaigns; limited access to pharmacotherapy; employer coverage emerging	Localized mortality projections; need for prevention-driven models; emerging stop-loss relevance
Europe (Germany/UK)	20 <sup>19</sup>	Public funding constraints; cautious coverage of obesity drugs; prevention and lifestyle programs	Balance of affordability vs. mortality benefits; VBC-style risk sharing opportunities
East Asia (Japan/S. Korea)	5 <sup>21</sup>	Low prevalence but aging-driven frailty risk; long-term care integration; prevention emphasis	Mortality and LTC convergence; small prevalence increases have outsized effects on frailty and care costs

Sources: World Obesity Atlas<sup>3</sup>; India State-Level Disease Burden Initiative<sup>10</sup>; OECD<sup>19</sup>; Nishida et al.<sup>21</sup>

As shown in Table 1, markets with high prevalence face immediate actuarial implications for product pricing and benefit design, while lower-prevalence regions may need to anticipate future risk as prevalence rises.

### FINANCING & RISK-SHARING

Obesity is as much a financing challenge as a medical one. Costs accrue today, while benefits emerge decades later. That mismatch places employers, insurers, and governments in a bind—and actuaries at the drafting table.

Risk-sharing models provide one path forward. Outcome-based contracts can tie payments for obesity drugs to sustained outcomes, with manufacturers bearing downside risk. Reinsurance and stop-loss coverage can spread financial shocks across employers, particularly in small and mid-sized markets. In India, where stop-loss coverage is still maturing, obesity-related claims could plausibly accelerate its adoption.<sup>11</sup>

I believe public-private partnerships may also prove necessary. Governments may subsidize high-risk groups, while private payers manage adherence and monitoring. Actuaries can model long-term offsets—fewer heart attacks, fewer dialysis patients, delayed long-term care admissions—and weigh them against upfront spend. Prevention programs, from nutrition to digital tools, may in fact generate higher returns per health-adjusted life year than pharmacotherapy alone.<sup>12</sup>

Financing obesity is therefore a balancing act: between immediacy and deferral, private incentive and public good. An actuarial opportunity is to design structures that spread risk across time and stakeholders, helping ensure that the system bends but does not break under the weight of the problem.

### CONCLUSION

Obesity is not a passing actuarial parameter; it is a reshaper of mortality itself. It blurs the line between morbidity and mortality, accelerates frailty, and threatens to offset hard-won gains in public health. At the same time, it invites hope in the form of therapies and prevention programs that could shift the curve—if they can be adopted, afforded, and sustained.

For actuaries, in my view, the opportunity is clear: move from passive projection to active scenario-building. Blend epidemiology with finance, prevention with innovation, and global differences with local context. Above all, recognize that obesity is both a chronic risk and a test of whether actuarial tools can evolve quickly enough to meet it.

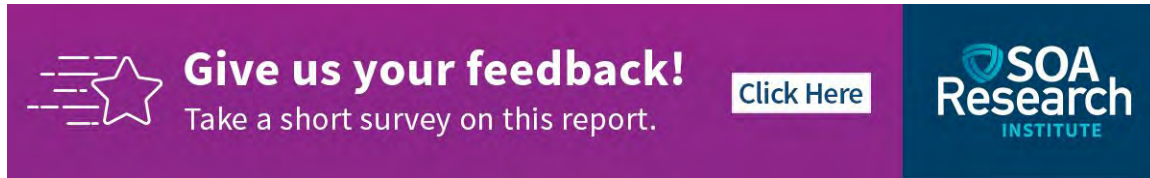
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## Obesity and Its Growing Impact on Future Mortality

Shaquille Worrell, FSA, FCIA

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### INTRODUCTION

Obesity prevalence in the U.S. has steadily increased, contributing to rising rates of chronic disease and excess mortality, with significant implications for healthcare systems and insurance programs. This essay explores the limitations of traditional obesity measures like BMI, examines trends in obesity-related mortality from 1999 to 2023, and highlights disparities across demographic groups. It also evaluates how emerging anti-obesity medications (AOMs), particularly GLP-1 and GIP receptor agonists, may shape future trends in obesity-related mortality. As of July 2025, these developments represent a pivotal moment in obesity management and public health strategy.

### OBESITY MEASUREMENT AND MORTALITY RISKS

#### MEASUREMENT

Obesity is defined as abnormal or excessive fat accumulation that presents a risk to health. Body mass index (BMI) is the most common measure of obesity, defined as weight (kg) divided by the square of height (m) ( $\text{kg}/\text{m}^2$ ). The U.S. Centers for Disease Control and Prevention (CDC) classifies overweight adults as those with a BMI over 25, and obesity as a BMI over 30. According to the CDC,<sup>1</sup> 40.3% of U.S. adults were classified as obese between August 2021 and August 2023, accounting for over 100 million adults and contributing substantially to the nation's chronic disease burden.

The advantages of BMI are that it is simple to calculate, useful as a screening tool, and widely understood and applied across clinical weight-management decisions and research. However, there has been considerable debate about the following BMI limitations, which can obscure the interpretation of obesity-related mortality studies:

- **BMI does not distinguish fat distribution.** For instance, at a given BMI, two individuals may have very different body fat composition, that is, where the fat is stored. As it relates to mortality risk, deep belly fat (visceral fat) surrounding vital organs, is more dangerous than fat stored under the skin (subcutaneous fat).

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<sup>1</sup>SD Emmerich, CD Fryar, B Stierman, CL Ogden, "Obesity and Severe Obesity Prevalence in Adults: United States, August 2021–August 2023," NCHS Data Brief, no. 508, Hyattsville, MD: National Center for Health Statistics, 2024, <https://www.cdc.gov/nchs/products/databriefs/db508.htm>.

Excess visceral fat can lead to comorbidities associated with higher mortality risk, such as diabetes, heart disease, and stroke.

- **BMI does not differentiate between muscle and fat weight.** Hence individuals with high muscle mass may be inadvertently classified as obese. These individuals, such as athletes, would usually be considered as lower mortality risk because of their typical healthy and fitness lifestyle.
- **BMI's health implications vary by age, sex, and ethnicity.** Studies have shown that BMI's health implications vary by age, sex, and ethnicity. For example, some studies propose lower BMI cutoffs for Asian populations.
- **BMI is a point-in-time measurement** and does not capture BMI duration, which may be a more meaningful indicator of health and mortality risk, as the length of time spent with obesity is strongly associated with an increased risk of comorbidities and death. For example, in a static BMI study, an obese cancer patient who was predisposed to the cancer because of the excess weight for several years but loses that weight during the last few months of the cancer's terminal stages, might be excluded from the obese category once their BMI drops below 30 due to cancer-related weight loss, despite having experienced prolonged exposure to obesity earlier on.

Given these shortcomings, the following alternative measures are gaining popularity and are improving the overall obesity risk and prevalence measurements:

- **Waist circumference (WC):** captures central (visceral) fat and correlates better with cardiovascular mortality risk.
- **Waist-to-hip ratio (WHR):** studies suggest WHR may be a stronger predictor of mortality than BMI alone, especially in older adults, where muscle loss and height decline due to aging may confound BMI. Moreover, the distribution of the ratio between WC and height was shown to be similar between sexes, therefore WHR does not require sex-specific differentiations.
- **Body shape index (BSI):** one criticism of WC and BMI is the inability to separate the impact of body shape (i.e., the degree of central and peripheral body fat accumulation in the body) from body size (height and weight) on health. The BSI addresses this criticism because it is based on WC, weight, and height. It is calculated as  $\left(\frac{WC}{BMI}\right)^{2/3} \times (height^{1/2})$ . A high BSI score indicates that WC is higher than expected for a given height and weight, suggesting increased central fat accumulation or central obesity. Studies have shown a strong association between higher BSI levels and mortality. Additional unique findings and notable advantages of BSI over BMI include its success in predicting mortality associated with cardiovascular disease, chronic kidney disease (in men but not women), and some cancers. These highlight the importance of body shape in mortality outcomes.

These alternative measures share the advantages of being relatively low-cost and quick to administer. However, shared challenges include the requirement of trained personnel to carry out the measurements and the lack of universally standardized protocols.

## OBESITY-RELATED MORTALITY RISKS

Obesity heightens the risk of coronary heart disease, stroke, hypertension, heart failure, atrial fibrillation, type 2 diabetes, and certain cancers. Numerous studies have established a strong association between rising obesity prevalence and increased all-cause, cardiovascular, and cancer mortality.

Recent analyses of CDC data<sup>2</sup> show a sharp rise in obesity-linked deaths. Achara et al. (2024) revealed that age-adjusted<sup>3</sup> obesity-related mortality rates (AAOMRs) increased from approximately 1.8 deaths per 100,000 in 2010 to 3.1 in 2020.

Further, the Al Hennawi et al. (2024) review of 1999 to 2021 CDC mortality data recorded 124,076 obesity-related deaths, with a mean AOMR of 2.7 per 100,000, noting a steady upward trend. The increase was particularly pronounced among non-Hispanic Black individuals ( $\Delta$ AAOMR  $\sim$ 4.4), followed by American Indian/Alaska Native ( $\Delta$ AAOMR  $\sim$ 3.1) and then white individuals ( $\Delta$ AAOMR  $\sim$ 2.7). Importantly, they noted that this trend appeared to be driven by growing obesity prevalence itself, not declining mortality from other causes.

Another study by Mushood Ahmed et al. (2024) took a different angle and found that approximately 80% of their observed population with type 2 diabetes (T2DM) were considered overweight or obese. The authors noted that this alarming overlap could increase mortality rates sevenfold if the current combined prevalence of obesity and T2DM continues. This strong association between T2DM and obesity formed the rationale for analyzing the two conditions together. Their retrospective observational study, which covered the period from 1999 to 2022, identified an upward trend in U.S. mortality rates linked to both T2DM and obesity.

The following mortality variations by demographic were concluded from their study:

- The mortality rate was approximately 3.58 times higher during the COVID-19 pandemic period of 2020 to 2022 compared to 1999 to 2019, suggesting that obesity-related comorbidities, particularly T2DM, significantly increased the mortality risk.
- The mortality rate for males was consistently greater than that for females. They concluded that this was likely attributed to worse glycemic control, a higher frequency of cardiovascular problems, and possibly a delay in seeking medical attention as compared to women.
- The highest mortality rate was observed in non-Hispanic (NH) Blacks or African Americans, followed by NH white, Hispanic/Latino, and other NH populations. They proposed that the inequities were due to a complicated interaction between genetic predispositions, socioeconomic circumstances, healthcare access, structural racism, and cultural variations in nutrition and lifestyle, noting that the NH Blacks or African Americans faced higher poverty rates and more limited access to healthcare.
- Rural areas exhibited higher associated mortality rates than urban regions, likely due to more restricted access to healthcare.

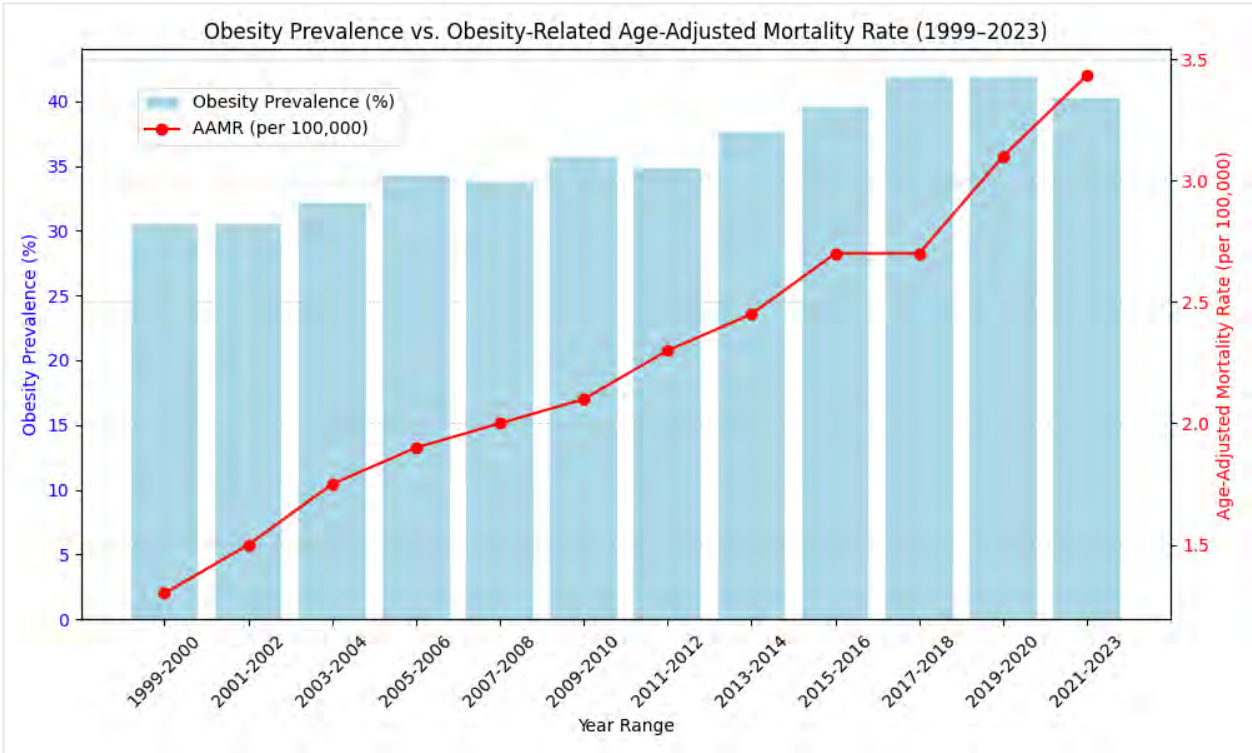
The common theme across these studies is that obesity-related mortality has increased over time. Al Hennawi et al. (2024) suggested this was linked to the rise in obesity prevalence. Therefore, to illustrate this strong association, Figure 1 independently verifies and captures the increasing trend of both metrics from 1999 to 2023.

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<sup>2</sup> CDC WONDER Database, focusing on mortality data associated with specific International Classification of Diseases, Tenth Revision (ICD-10) codes for obesity (E66.0, E66.1, E66.2, E66.8, and E66.9)

<sup>3</sup>Age-adjusted mortality rates are standardized rates that remove the effect of different age distributions. For example, suppose state A has an older population than state B. Its crude death rate may be higher, but after age-adjustment, you may find both states have the same risk. This standardization allows you to see if mortality is truly going up or down, rather than just reflecting an older population. It enables fair comparisons across time and between groups with different age distributions.

**Figure 1**  
**OBESITY PREVALENCE VS. OBESITY-RELATED AGE-ADJUSTED MORTALITY RATE (1999–2023)**



Trends from 1999 to 2023 in the age-adjusted mortality rate (AAMR) for obesity (ICD-10 code E66) among adults aged 15 years and older, alongside the prevalence of adult obesity (ages 20 and older).  
Source: CDC WONDER database and National Health and Nutrition Examination Survey (NHANES) data

**OBESITY AND WEIGHT LOSS MANAGEMENT: THE RISE OF GLP-1 AGONISTS**

Glucagon-like peptide-1 (GLP-1) receptor agonists (RA) are anti-obesity medications (AOMs) that are dually indicated to help lower blood glucose levels and promote weight loss. Originally approved by the U.S. Food and Drug Administration (FDA) for the treatment of type 2 diabetes, these medications now carry approved indications for weight management in adults with obesity, as well as cardiovascular risk reduction.

GLP-1 receptor agonists are effective in weight management because they mimic the function of the naturally occurring GLP-1 hormone. With regards to its impact on obesity, this hormone increases feelings of fullness after eating by acting on areas of the brain that regulate hunger and satiety. This leads to reduced calorie consumption and, therefore, supports weight loss. Higher doses of GLP-1 agonists produce more pronounced effects, which is a key distinction between GLP-1 medications approved for type 2 diabetes and those specifically approved for weight loss.

A second and emerging class of AOMs includes glucose-dependent insulinotropic polypeptide (GIP) receptor agonists, which are being studied and developed for their metabolic benefits. GIP is an incretin hormone, like GLP-1, that is naturally released after eating and stimulates insulin secretion in a glucose-dependent manner. Unlike GLP-1, which slows gastric emptying and promotes satiety, GIP’s primary action is to enhance insulin release and promote fat storage in adipose tissue (body fat). However, recent advances have explored combining GIP receptor agonism with GLP-1 receptor agonism (“dual agonists”) to achieve greater weight loss and improved glucose control compared to GLP-1 agonists alone. This combination appears to leverage GIP’s insulinotropic effects while modifying its impact on fat storage, leading to a synergistic effect on weight reduction and glucose metabolism.

**Table 1**  
AOMS APPROVED IN THE U.S AS OF JULY 2025

Active Ingredient (Brand Name)	Type of Receptor Agonists	FDA Approval
Liraglutide (Saxenda®)	GLP-1	December 2014
Semaglutide (Wegovy®)	GLP-1	June 2021
Tirzepatide (Zepbound®)	Dual GIP/GLP-1	November 2023

Current FDA-approved ingredients and their corresponding branded names, categorized by type of receptor agonist, along with the U.S. FDA approval dates for obesity indications.

Although liraglutide has been available for over a decade, semaglutide has quickly become the frontrunner. Its reduced dosing frequency, superior weight-loss efficacy, better cost-effectiveness, and demonstrated patient satisfaction have fueled its rapid rise in demand. Table 2 summarizes the key differences between the two first prominent AOMs.

**Table 2**  
COMPARISON OF SEMAGLUTIDE AND LIRAGLUTIDE

Feature	Semaglutide (Wegovy®)	Liraglutide (Saxenda®)
Weight Loss (% of body weight)	–15.8% at Week 68 (STEP-8 trial)	– 6.4% at Week 68 (STEP-8 trial)
Cardiovascular Risk Reduction	26% risk reduction (SELECT trial)	~13% risk reduction (LEADER trial) – less robust evidence
Dosing Frequency	Once-weekly injection (or daily oral)	Daily injection
Convenience	Weekly dosing favored in patient surveys	Daily dosing may be less convenient
Cost-Effectiveness	More cost-effective per % weight loss (~\$1,845 USD)	Higher cost per % weight loss (~\$3,256 USD)

Source: (1) Drugs.com, “Liraglutide vs semaglutide: How do they compare?” last updated August 19, 2025, <https://www.drugs.com/medical-answers/liraglutide-semaglutide-how-compare-3579997/>. (2) Joseph Azuri et al, “Liraglutide versus semaglutide for weight reduction-a cost needed to treat analysis,” *Obesity* (Silver Spring, Md) vol. 31,6 (2023):1510–1513, doi:10.1002/oby.23752. <https://onlinelibrary.wiley.com/doi/10.1002/oby.23752>

## THE CURRENT AND FUTURE IMPACT OF GLP-1 AGONISTS ON OBESITY INDICATED MORTALITY

Considering the recent surge of interest in GLP-1 therapies for weight management, much discussion has emerged around their potential to reduce obesity-related mortality.

As mentioned earlier, obesity worsens many cardiovascular (CV) risk factors, that is, characteristics or conditions that increase the likelihood of developing heart attack, stroke, or heart failure in the future. Additionally, obesity is associated with elevated risk of non-CV causes of death, including certain cancers. It has been estimated that a 5 kg/m<sup>2</sup> increase in BMI is associated with a 31% increase in risk of all-cause death, a 49% increase in CV death, a 38% increase in respiratory-related death, and a 19% increase in cancer-related death (Global BMI Mortality Collaboration, 2016).

## EFFECT OF LIRAGLUTIDE ON OBESITY-RELATED MORTALITY

There are limited published population studies linking liraglutide uptake to lower obesity-related deaths, however strong evidence from randomized controlled trials (RCT) (Marso et.al., 2016) in diabetics shows liraglutide lowers CV and all-cause death by roughly 15%, but no direct RCT has yet shown a mortality benefit in non-diabetic obese patients.

## EFFECT OF SEMAGLUTIDE ON OBESITY-RELATED MORTALITY

Likewise, for semaglutide there are limited credible obesity-related mortality studies, particularly given that semaglutide was only recently approved as an AOM in 2021. One notable study that sought to investigate obesity-related mortality was the SELECT trial (Lincoff et.al., 2023) where it was tested in adult participants across 41 countries with obesity and established CV risk but without diabetes.

Over approximately 3.3 years, it was found that semaglutide cut major CV events by approximately 20%.

Additionally, compared to trial participants without the AOM, it was found that semaglutide resulted in lower rates of all-cause death by 19%, driven similarly by reductions in CV death by 15% and non-CV death by 23%.

## CONCLUSION

The obesity epidemic in the U.S. continues to escalate, driving substantial increases in mortality across all major population groups. Although reversing this trend is complex, recent pharmaceutical breakthroughs offer promising methods for intervention.

The emergence of more effective GLP-1 and GIP anti-obesity medications (AOMs) marks a promising development in obesity management. Early research and real-world evidence suggest that these interventions may significantly reduce obesity rates and contribute to long-term improvements in obesity-related mortality.

However, these AOMs are not standalone solutions but important components in a broader strategy. Their full impact depends on continued research and refinement, equitable access, affordability, and integration with healthy lifestyle-based public health efforts. Looking ahead, it is essential that policymakers, healthcare systems, and insurers prioritize these therapies while addressing social and structural barriers to care. A coordinated, data-informed approach will be important to effectively reduce the long-term burden of obesity-related mortality.

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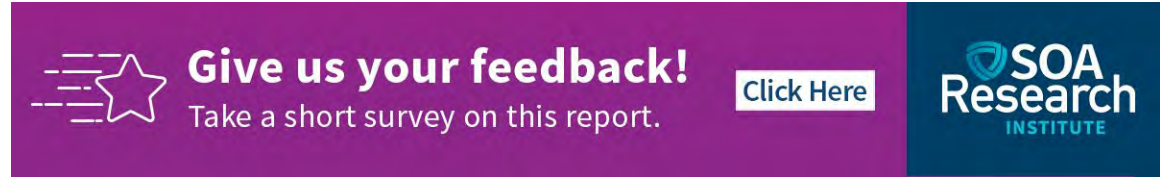
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## GLP-1s and Obesity

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The ongoing fight against obesity, whether fueled by aesthetic or medical concerns, has been raging for quite some time. Obesity treatments have had a mixed history. For decades, although pharmaceutical treatment or prevention of obesity had been deemed to be the holy grail for the pharmaceutical industry, most supposed developments have failed miserably. Nevertheless, things may be different this time.

The recent global growth of obesity has been gradual yet persistent for many decades. Although earlier in this century, some believed obesity was primarily an American problem, the trend of increasing obesity has now spread to nearly all countries. At the same time, obesity has been measured using various metrics – it is most commonly measured by use of the Body Mass Index, a measure of weight and height; better measures are now being used, focusing on the extent of body fat and where that fat is located, e.g., through waist circumference. Regardless of how it is measured, obesity, which has become a significant and growing health risk factor itself and a health risk multiplier for a variety of adverse health problems, has gained heightened interest now that more effective medical treatments have become available.

Causes of obesity are many and varied. Although most people attribute excess weight to the quantity and type of food we eat and to a lack of physical activity, other factors can also be blamed. They include the easy availability of relatively inexpensive, highly processed foods and sweetened beverages, excessive screen time, certain intestinal microbiota, diet culture, limited access to healthy foods, weight stigma, weight cycling, and food insecurity. For many years, a lack of willpower was considered by some to be a significant driver and was associated with substantial social stigma; however, this factor is generally no longer regarded as a key driver, though it can still contribute.

Additionally, it is important to remember that genetic predisposition to obesity can also play a role in its development, although its relative influence may diminish as a person ages. The personal toll of being obese or attempting to prevent obesity can be huge. Unlike many chronic conditions, the existence of obesity is visible, which may be why so many people struggle with it so much, often facing repeated setbacks that lead to self-imposed shame.

The focus of this essay is on a new class of pharmacological drugs, known as glucagon-like peptide-1 (GLP-1) receptor agonists (GLP-1RA), such as semaglutide (e.g., Ozempic for diabetes treatment and Wegovy for other purposes) and tirzepatide (e.g., Mounjaro and Zepbound), which appear highly effective in promoting weight loss when used consistently and in offsetting other adverse health outcomes.

Over the last four years, clinical trials have confirmed additional benefits, reporting up to a 25% improvement in various health conditions, as described below. These have included diabetes, cardiovascular and kidney diseases,

and stroke. Excess weight is associated with numerous comorbidities, including poor mental health, and can result in harmful societal stigma.

It was first found that the gut hormone GLP-1 was successful in treating diabetes.<sup>1</sup> It gained widespread attention in 2021 when Novo Nordisk's Wegovy was approved for the treatment of obesity. Unlike its predecessors, it could be taken weekly rather than once or twice a day and was shown to reduce body weight by up to 15%. Additional benefits might include a reduction in chronic back pain, fatigue, and sleep apnea, with certain studies even suggesting that they can help control addictions, such as from alcohol and nicotine misuse, and even avert opioid overdose. These advancements have led to a frenzy of drug development and testing, as this class of drugs eliminates the need for superhuman willpower. The development of GLP-1s was named *Science's* Breakthrough of the Year in 2023.<sup>2</sup>

Although they have been used since 2005 to treat diabetes, it wasn't until 2021, when semaglutide was approved under the product name Wegovy for the treatment of obesity, that the media began referring to them as the medical sensation of the decade.

There is a wide range of estimated current usage, with possibly 6–8% of American adults currently taking these medications, around 12% who have ever taken them, and about a third of the population expressing interest in using them. The demand for these drugs has been increasing and is unlikely to stop soon, especially as enhancements become available.

By mimicking a hormone naturally produced after a meal, semaglutide and related drugs can help regulate blood sugar by slowing the rate of gastric emptying, increasing insulin release from the pancreas in response to glucose, suppressing appetite by slowing digestion, and helping people feel full longer. This is why these drugs are effective in treating diabetes.<sup>3</sup> However, keeping food in the stomach longer can also lead to feelings of nausea or distress.

They also appear to reduce inflammation, raising hope that they could be used to treat neurodegenerative diseases such as Alzheimer's and Parkinson's.<sup>4</sup> Since weight loss alone does not fully explain these benefits, it's likely that other characteristics of these drugs also contribute to positive health outcomes. Recent studies suggest they can also help address chronic kidney disease and metabolic dysfunction in certain liver diseases, as well as reduce sleep apnea by nearly two-thirds.<sup>5</sup>

I developed a crude estimate of the effects of these medications on mortality. First, I assumed that the significant reduction in mortality from GLP-1s is due to reduced deaths from cardiovascular, stroke, and diabetes, which currently cause about a third of adult mortality in the U.S. I made two other assumptions: that adult U.S. obesity prevalence is roughly 40%, and the average reduction in mortality from these diseases is approximately 20%

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<sup>1</sup> In 1986 the Danish scientist Jens Juul Holst found that gut hormone GLP-1 stimulated insulin and suppressed appetite.

<sup>2</sup> Jennifer Couzin-Frankel, "Obesity Meets Its Match," *Science* 382, no. 6676 (December 15, 2023), <https://doi.org/10.1126/science.adn4691>.

<sup>3</sup> Chika Anekwe, "How Does Ozempic Work? Understanding GLP-1s for Diabetes, Weight Loss, and Beyond," Harvard Health Publishing, accessed June 2, 2026, <https://www.health.harvard.edu/healthy-aging-and-longevity/how-does-ozempic-work-understanding-glp-1s-for-diabetes-weight-loss-and-beyond>

<sup>4</sup> For patients with type 2 diabetes and obesity, GLP-1 drugs may offer neuroprotective and cerebrovascular benefits in addition to glycemic control. Huan-Tan Lin, Yun-Fong Tai, et al. (2025). "Neurodegeneration and Stroke After Semaglutide and Tirzepatide in Patients With Diabetes and Obesity." *JAMA Network Open*. Published Online: July 15, 2025. 2025;8;(7):e2521016. doi:10.1001/jamanetworkopen.2025.21016. They found that, during an average follow-up of two years, U.S. adults aged 40 or older taking semaglutide or tirzepatide had a lower risk of dementia, stroke, and all-cause mortality than did people taking other antidiabetic drugs. It did not find an association between GLP-1 medication and lower risk of Parkinson's disease or intracerebral hemorrhage. The most pronounced benefits were observed among patients aged 60 years or older, women, and those with a body mass index of 30 to 40, also suggesting that GLP-1 drugs may improve long-term cognitive outcomes for certain patients.

<sup>5</sup> Maria J. Gonzalez-Rellan and Daniel J. Drucker (2025). The expanding benefits of GLP-1 medicines. *Cell Reports Medicine* 6, 102214, July 15, 2025. <https://www.glucaagon.com/pdfs/GonzalezRellanCRM2025.pdf>

(although current goals are somewhat higher). This would result in a 2%-3% reduction in overall mortality (1/3 x 40% x 20%).

### POTENTIAL SIDE-EFFECTS

One reason people stop taking GLP-1s is that they are expensive and may not be covered by insurance. Another reason is the side effects many users experience — one study indicated that around 30% of GLP-1 users stopped treatment within four weeks of starting, with side effects representing a significant factor. These include muscle loss, fatigue, and various gastrointestinal adverse effects, including nausea (33-44%), diarrhea (23-31%), vomiting (11-25%), constipation (17-23%), and dyspepsia (9-10%)<sup>6</sup> that affect some users, especially at high doses. Pharmaceutical companies are working to address these issues by tweaking or supplementing these medicines.

In addition, some adverse medical risks have emerged, including intestinal obstruction and pancreatitis. The pharmaceutical and medical communities will closely monitor these possible side effects.

At least in their current form, once treatment ends, the weight lost is often regained, in some cases accompanied by muscle loss and an increase in body fat percentage. Clinical data show that 25-40% of weight loss results from a reduction in lean body mass, including muscle, which is especially concerning for older patients. The Food and Drug Administration has advised that these drugs be used in combination with diet and exercise, not as a replacement.

In early 2025, the momentum toward greater use of these drugs was somewhat arrested by a combination of factors, including chronic shortages of the name-brand GLP-1 therapies, high costs, insurance obstacles, and undesirable side effects. A study of the likelihood of developing Alzheimer's disease using these drugs found that individuals taking these drugs were at a greater risk of arthritic, kidney, and pancreatic disorders. As a result, many people who started the drugs ultimately stopped, with discontinuation rates in clinical trials ranging from 37 to 81% within their first year, which adversely affects the cost-benefit of these drugs.

Their next generation may come in pill form, likely containing an absorption-enhancing ingredient to help the peptide cross the stomach wall. However, a high dose may be required and must be taken on an empty stomach. A small-molecule pill version currently under development is also more easily absorbed and possibly easier to manufacture at scale than an injection. However, it may require up to 20 times the amount of active ingredients as an injection and must be taken daily for the rest of one's life.

KFF estimates that in 2024, about 6% of all Americans are using these drugs. Morgan Stanley projects that as many as 9% of Americans will take brand-name versions of these weight-loss medications by 2035, excluding copycat or generic versions. If further studies demonstrate greater effectiveness with fewer side effects, the use of this class of drugs may be higher, possibly much higher.

These developments have led to calls for more widespread prescribing of GPL-1 drugs, for drugmakers to reduce prices, and for insurers and governments to cover their cost. However, neither private nor public insurance automatically covers these medicines. Many, including Medicare, cover these drugs if the patient has diabetes or other serious conditions, but they do not yet cover them solely for weight loss (a smaller dose is prescribed for diabetes).

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<sup>6</sup> Kushner, Robert, Jaime Almandoz, Domenica Rubino (2025). "Managing Adverse Effects of Incretin-Based Medications for Obesity." *Clinical Review & Education JAMA Insights*. Published online July 29, 2025. <https://edhub.ama-assn.org/jn-learning/module/2836876>. It also provides approaches to battle these side-effects.

## COST AND RISKS

They are expensive due to their high cost.<sup>7</sup> They also need to be refrigerated and mostly now have to be injected, as they cannot pass through the gastrointestinal tract without breaking down. This will make them inaccessible in many countries. However, if their popularity continues to skyrocket, their production costs will decline. Over the next several years, more people will be able to access them.

Although insurance may cover some of the costs, such coverage is not universal. To reach the masses, especially since those of lower socioeconomic status are less likely to have health insurance but more likely to be obese, the government may have to step in to cover these costs if it is willing and able. So far, approximately 50 million Americans have insurance coverage for Wegovy,<sup>8</sup> for example, and it has been approved to help reduce cardiovascular risks in overweight and obese patients.<sup>9</sup> Coverage is likely to expand, especially if future generations of these drugs become more effective at achieving significant weight loss and are more affordable.

With so many potential users, the market is becoming increasingly competitive. When this essay was written, demand was outstripping supply, even at their very high prices. Reportedly, there are more than two hundred candidate drugs in various stages of development—thus, future advances are inevitable. The goal is to ensure that patients can tolerate the medicine and find it easy to use—oral formulations at a lower price.

Documents obtained by the Washington Post from the Centers for Medicare & Medicaid Services on August 1, 2025,<sup>10</sup> reveal a planned five-year pilot that would allow state Medicaid programs and Medicare Part D insurers to voluntarily cover Ozempic, Wegovy, Mounjaro, and Zepbound for patients seeking weight management treatment. This pilot program is expected to start in April 2026 for Medicaid and in January 2027 for Medicare plans. If this initiative and any subsequent implementation are deemed successful, it could further expand the use of these products in the United States.

Because of their newness, there have necessarily been no studies of their long-term effectiveness. However, the same types of questions arose two decades ago regarding the long-term risks associated with bariatric surgery, which have not yet become evident.

## CHILDREN

Most research and applications of these medications have focused on adults. However, overweight and obese children may face a greater risk of developing overall health problems, including diabetes and liver problems. The earlier these diseases develop, the greater their future impact might be. Even though other traditional techniques can be employed to address these problems, about 60,000 people aged 12 to 25 were already taking weight-loss drugs in 2023 (according to a University of Michigan survey<sup>11</sup>).

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<sup>7</sup> Currently, they can cost the American consumer or their insurer over \$1,000 per month. If treatment continues over a lifetime (they are sometimes referred to as “forever drugs,” as often weight is regained after their use is stopped), they can cumulatively prove quite expensive. Additionally, their continued effectiveness over a lifetime remains uncertain. Copycat or compounded drugs are currently available, with the name brands scheduled to go off patent in the next several years. When this occurs, generic drugs will undoubtedly be made available at a reduced cost.

<sup>8</sup> Stephanie Brown, “Over 50% of U.S. Adults Are Eligible for Ozempic and Wegovy, But Access Remains Difficult,” Program on Medicines and Public Health, University of Southern California, January 13, 2025, <https://sites.usc.edu/pmph/2025/01/13/over-50-of-u-s-adults-are-eligible-for-ozempic-and-wegovy-but-access-remains-difficult/>

<sup>9</sup> “The FDA Has Announced a New Cardiovascular Indication for Wegovy®,” Premera Blue Cross Provider News, March 2024, <https://providernews.premera.com/the-fda-has-announced-a-new-cardiovascular-indication-for-wegovy/>

<sup>10</sup> Paige Winfield Cunningham, “Medicare, Medicaid Plan to Experiment with Covering Weight Loss Drugs,” Washington Post, August 1, 2025, <https://www.washingtonpost.com/health/2025/08/01/medicare-medicare-weight-loss-drugs/>

<sup>11</sup> Meghan Rosen, “The New Weight-Loss Drugs Are Changing How We Think About Obesity,” Science News, January 25, 2024, <https://www.sciencenews.org/article/diabetes-weight-loss-drugs-glp1-ozempic>

Some scientists and clinicians, including the American Academy of Pediatrics, advocate using these drugs in combination with healthy lifestyles. This differs from some doctors and researchers who worry that we have limited knowledge regarding how weight-loss treatments will affect children’s growing bodies, let alone their long-term health. Nevertheless, liraglutide, a medication in the same class as Ozempic, has been approved by the FDA for use by children aged six to 12 years.

## SURGICAL ALTERNATIVE

For decades, bariatric surgery has been the gold standard for treating obesity. Its various forms include gastric bypass (Roux-en-Y), gastric sleeve (sleeve gastrectomy), and adjustable gastric band surgery. These procedures have been found to result in substantial and sustained weight loss and to improve obesity-related health conditions. They have had a strong safety record, with rates of serious complications and mortality that are comparable to, or even lower than, those of standard procedures such as gallbladder removal and knee replacement. Its cost ranges from \$17,000 to \$26,000.<sup>12</sup>

In 2022, the International Federation for Obesity and Metabolic Disorders (FOMD) and its U.S. counterpart updated their guidelines, lowering the recommended minimum BMI thresholds for surgery eligibility to make the procedure more accessible to those who could benefit.<sup>13</sup> There are also opportunities to expand the surgery’s reach to people who discontinue GLP-1 therapy or who fail to achieve results with medication alone.

The American College of Surgeons has indicated that bariatric surgery is more cost-effective over the long term than GLP-1 medications alone. They have determined that bariatric surgery remains the most effective and durable treatment for severe obesity.<sup>14</sup> Conventional bariatric surgeries, which have been widely used since the 1980s to reroute the flow of food through the gut or to restrict the stomach’s size, have gained fairly broad appeal.

In 2022 compared to 2021, the total number of bariatric procedures across all age groups increased by almost 6.5%, from 262,893 to 280,000. Estimates for 2023 and 2024 have differed. For example, the American Society of Metabolic and Bariatric Surgery indicated a slight decrease to about 270,000 in 2023,<sup>15</sup> with an annual number of metabolic and bariatric procedures in the United States between 2011 and 2022 ranging from 180,000 to 280,000. However, with the rise of GLP-1 drugs, another estimate indicated a decrease of around 25% in bariatric surgery procedures among obese non-diabetic patients between the last six months of 2022 and the last six months of 2023.<sup>16</sup>

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<sup>12</sup> American Society for Metabolic and Bariatric Surgery, “Metabolic and Bariatric Surgery,” accessed June 2, 2026, <https://asmbs.org/resources/metabolic-and-bariatric-surgery/>

<sup>13</sup> Dan Eisenberg et al. (2022). 2022 American Society for Metabolic and Bariatric Surgery (ASMBS) and International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO): Indications for Metabolic and Bariatric Surgery. V18(12). p1345-1356. December 2022. <https://www.soard.org/action/showPdf?pii=S1550-7289%2822%2900641-4>.

<sup>14</sup> Marcus Cunningham et al. (2024). An Analysis of the Cost-Effectiveness of Roux-en-Y Gastric Bypass and Sleeve Gastrectomy for Obesity Management. *Journal of the American College of Surgeons*. 239(5): P S21-S46, November 2024. | Doi: 10.1097/Xcs.0000000000001157

<sup>15</sup> American Society for Metabolic and Bariatric Surgery, “Estimate of Bariatric Surgery Numbers, 2011–2023,” accessed June 2, 2026, <https://asmbs.org/resources/estimate-of-bariatric-surgery-numbers/>

<sup>16</sup> Lin, Kevin, Ateev Mehrotra, Thomas Tsai (2024). Metabolic Bariatric Surgery in the Era of GLP-1 Receptor Agonists for Obesity Management *JAMA Network*. 2024;7(10):e2441380. doi:10.1001/jamanetworkopen.2024.41380. Adult patients without diabetes with medical and pharmaceutical coverage through commercial and Medicare Advantage insurance in the OptumLabs Data Warehouse.

## OTHER METHODS

Many people with obesity view bariatric surgery as a last resort. The percentage of eligible individuals who undergo the procedures has remained low—around 1% in the United States, and not much higher elsewhere.<sup>17</sup>

The arrival of semaglutide and tirzepatide provided a way to reach the other 99%—offering similar weight loss results without the invasiveness, recovery time, or stigma often linked to surgical intervention. These new drugs could make surgery a second-tier treatment option.

Another approach, involving calorie counting and peer support/pressure, was espoused by Weight Watchers. This helped many individuals who have struggled with obesity or being overweight reduce excess weight and keep it off. However, partly because of the popularity of GLP-1s, participation in their programs declined, and Weight Watchers filed for bankruptcy in May 2025.<sup>18</sup>

It is essential to remember that losing weight does not guarantee overall health and well-being. Many do it to look and feel better—thinness can signal to some that the person can afford healthy foods and has the education to know which diet to follow. Note that this reaction is the opposite of what occurs in some low-income countries, where food is scarce for people living in poverty. In these cases, obesity is more desirable than it was in the pre-industrial West. However, the medical objective to maintain an optimal weight is to help people become less vulnerable to illness or death from strokes or cancers.

In every study I recall reading about weight-loss medications, it has been noted that the medications should complement or supplement, rather than totally replace, healthy habits. It is important to note that most testing of GLP-1 drugs has been conducted on individuals who are also following a healthy lifestyle regimen.

As GLP-1 drugs become more widely used, public awareness of the benefits of diet, exercise, and the potential misuse of these drugs remains essential, along with enhanced food labeling and greater access to physical activity.

## THE FUTURE

Now that the early stages of effective weight-loss drugs are underway, these medicinal tools will likely continue to be expanded and improved, whether by making them easier to use, reducing side effects, or increasing effectiveness. The convenience, cost, and range of options will likely increase the likelihood of achieving the practical social and personal goal of reducing the extent of obesity. A multidimensional approach may enable people to better manage their future health.

The potential market for these medications is enormous—1.1 billion people globally (14% of the global population) are now obese, with many being added to this tally each day.<sup>19</sup> List prices for these medications are now quite high—upward of \$15,000 per patient per year, although future average costs will undoubtedly decrease. With so many who might be eligible, the total cost could be enormous. Determining whether this cost is justified (since, of course, cost is not everything!) involves comparing the long-term benefits of future medical and related advantages of alternative weight-control methods involving nutrition and physical activity, which have often proven

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<sup>17</sup> Ragui Sadek, “Why Only 1 Percent of Eligible Patients Choose Bariatric Surgery,” *Advanced Surgical & Bariatrics of NJ*, October 30, 2020, <https://www.bariatricsurgerynewjersey.com/why-only-1-percent-patients-choose-bariatric-surgery/>

<sup>18</sup> Jordan Valinsky, “WeightWatchers Files for Bankruptcy,” *CNN*, May 6, 2025, <https://www.cnn.com/2025/05/06/business/weight-watchers-bankruptcy>

<sup>19</sup> NCD Risk Factor Collaboration (2024). 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. *The Lancet*. V403 (10431). p1027-1050. March 16, 2024. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(23\)02750-2/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(23)02750-2/fulltext)

unsuccessful. I believe that the aspirational goal of weight health is often not solely about shedding weight; it also involves adopting sustained habits that promote overall physical and mental well-being.

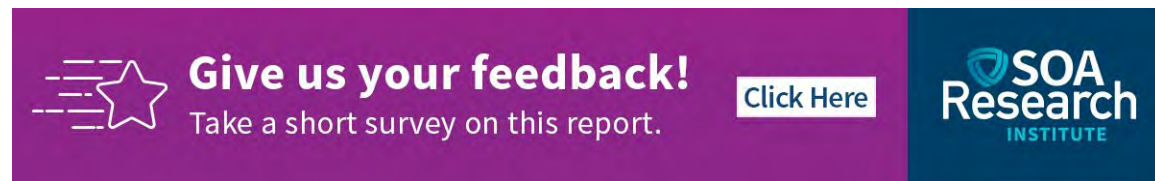
The widespread use of GLP-1 or successor drugs could help bring about profound economic and social changes by enhancing freedom and productivity. The extent of these drugs' success will likely lead to next-generation therapies that may improve health outcomes across a wide range of areas. Future obesity-related healthcare costs and mortality rates would also be affected.

However, many industries would have to adapt; for example, junk food companies might shift at least part of their focus from quantity to food quality.

I hope that those who continue to use these medications successfully also support healthy nutrition and regular physical activity. Nevertheless, it will be easy for many to declare victory and become complacent about their personal lives, only to regain weight. This may remain a continuing challenge for many.

\* \* \* \* \*

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## Severe Obesity

Sam Gutterman, FSA, CERA, FCAS, MAAA, FCA, HonFIA

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As shown in Table 1, although the overall prevalence of obesity in the U.S. population has appeared to have plateaued or even decreased somewhat in 2023, the level of severe obesity<sup>1</sup> has continued to increase.<sup>2</sup>

Most obesity measurements have historically used the Body Mass Index (BMI),<sup>3</sup> although this metric is somewhat problematic. As indicated in Emmerich et al. (2025), BMI “has limitations. Body fat can vary among individuals with the same BMI for several factors, including sex, age, racial/ethnic category, and place of origin. BMI does not directly measure body fat, nor does it provide information on body fat distribution. The distribution of excess body fat contributes to the risk of diseases such as cardiovascular disease, kidney disease, and metabolic disorders. Despite these limitations, BMI is a simple and inexpensive screening tool for conditions that may increase the risk of certain chronic diseases.” Nevertheless, its results are generally correlated with other measures, such as waist circumference, so its use in assessing the scope and impact of severe obesity is reasonable. In any case, at higher weights and BMIs, the effect on health outcomes becomes more pronounced.

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<sup>1</sup> Severe obesity has sometimes been referred to as morbid obesity. Expressed in terms of BMI (measured by weight (in kilograms) / height (in meters)<sup>2</sup>), severe obesity is generally defined as a BMI of 40 and over, while obesity is defined as a BMI of 30 and over. BMI obesity can be sub-categorized as class 1, with a BMI between 30 and 34, class 2 between 35 and 39, class 3 between 40 and 44, and class 4 between 45 and 49, and so on. According to the WHO, abdominal obesity is defined as a waist circumference of greater than 94 cm for men and 80 cm for women; severe abdominal obesity is defined for men at greater than 102 cm and for women at greater than 88 cm. According to the U.S. National Institutes of Health, central obesity is defined as a waist circumference of 102 cm for men and 88 cm for women; although there is no severe central obesity category, values greater than 120 cm for men and 110 cm for women are sometimes used.

<sup>2</sup> See, for example, (1) Emmerich SD, Fryar CD, Stierman B, Ogden CL. “Obesity and Severe Obesity Prevalence in Adults: United States, August 2021–August 2023.” NCHS Data Brief, no 508. Hyattsville, MD: National Center for Health Statistics. November 2024. doi: <https://stacks.cdc.gov/view/cdc/159281> (2) Koliaki, Chrysi, Maria Dalamaga, Stavros Liatis (2023). “Update on the Obesity Epidemic: After the Sudden Rise, Is the Upward Trajectory Beginning to Flatten?” *Current Obesity Reports*. (2023) 12:514–527.

<https://link.springer.com/article/10.1007/s13679-023-00527-y> and (3) Wang Y, Beydoun MA, Min J, Xue H, Kaminsky LA, Cheskin LJ. “Has the prevalence of overweight, obesity, and central obesity levelled off in the United States? Trends, patterns, disparities, and future projections for the obesity epidemic.” *International Journal of Epidemiology*. 2021;49:810–23. doi: 10.1093/ije/dyz273. <https://academic.oup.com/ije/article/49/3/810/5722224>

<sup>3</sup> Body Mass Index (BMI), a function of weight and height (weight (kg)/height (m)<sup>2</sup>), is the most commonly used metric of obesity. It is losing favor because it focuses on total weight, rather than adipose tissue that especially resides around the waist and is stored around internal organs. Several studies have shown that either waist circumference or the waist-to-hip ratio is a better predictor of mortality. In addition, rather than solely relying on BMI, an international panel has recently proposed a new definition of obesity—distinguishing people who experience adverse health and life impacts due to obesity and those who don't. BMI is a classification not based on physical well-being—‘clinical obesity,’ where weight impairs daily activities or contributes to other disease conditions, contrasts with ‘preclinical obesity’ that refers to otherwise healthy individuals, such as those with a stocky build or well-muscled athletes, who may be at risk of complications but do not necessarily need treatment.

Obesity is a complex, multifactorial, often relapsing, and difficult-to-treat chronic disease that is associated with significant morbidity and mortality, ranging from premature death to chronic conditions such as diabetes, cardiovascular disease, and certain cancers, which can severely compromise patients' life expectancies and their overall quality of life. As shown in Tables 1, 2, and 3, obesity is more common in women, in socioeconomically disadvantaged racial/ethnic groups, and in individuals with lower educational attainment.

Although genetics can also have a significant effect, according to the energy theory of weight, the primary factors influencing weight change are nutrition (energy intake) and physical activity (energy expenditure). There has been considerable debate regarding the relative contributions of these factors. Nevertheless, a growing consensus is that the quantity and type of nutrition have been the primary contributors to this process.

Based on a review of the literature, the 70% of the U.S. population<sup>4</sup> who are either overweight or obese also usually suffer from one or more significant comorbidities that further increase their rates of morbidity and mortality. At the same time, they may also incur greater healthcare costs and reduce their quality of life and mental health. Although it is not uncommon to be obese and healthy, it is less common to be healthy and severely obese.<sup>5</sup> Social stigma and employment obstacles often accompany severe obesity, which can lead to significant personal struggles and contribute to what I have referred to as a public health crisis, as roughly two out of five adults are obese, and one in ten are severely obese.

The current obesity epidemic in many higher-income countries began in the 1970s and 1980s (in the United States, as shown by the NHANES series, which began in the 1970s) and has continued to the present. However, its trajectories, speeds, and intensities have differed by country. A series of powerful driving forces in international food production and supply systems, which interact with local environmental factors, has resulted in considerable heterogeneity in obesity prevalence across populations and countries. Overall, these forces have included a shift toward increased energy availability and urbanization, as well as more efficient food manufacturing, distribution, and marketing. I believe that these have made unhealthy, energy-dense foods (such as junk, fast, and highly processed foods) widely accessible and affordable, especially to many lower-income population segments. Thus, there has been an explosion in the availability of inexpensive, tasty, and highly processed foods of low nutritional value.

According to the World Health Organization (WHO), obesity prevalence has more than tripled globally since the mid-1970s and increased by a factor of almost five among children and adolescents.<sup>6</sup> As access to unhealthy food has become more affordable and convenient, and physical activity has fallen (partly due to a move from an agrarian/manufacturing to service/financial/technical workforce), the World Obesity Federation (WOF) suggests that a quarter of a billion children are forecast to be obese by 2030.<sup>7</sup>

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<sup>4</sup> According to NHANES, about 40% of American adults are obese and about 30% are overweight. Although the United States is 'ahead' of the global average, nearly half the world's population is projected to be overweight or obese by 2030.

<sup>5</sup> For example, Nguyen NT, et al. (2011). Relationship between obesity and diabetes in a US adult population: findings from the National Health and Nutrition Examination Survey, 1999-2006. *Obes Surg.* 2011 Mar;21(3):351-5. doi: 10.1007/s11695-010-0335-4, approximately 43% of adults with severe obesity have diabetes, a rate significantly higher than in other weight categories. Severe obesity is strongly linked to a high prevalence of comorbidities, with studies indicating that over 60% of people with severe obesity face serious complications like microvascular disease.

<sup>6</sup> Boutari, C. and C.S. Mantzoros (2025). A 2022 update on the epidemiology of obesity and a call to action: as its twin COVID-19 pandemic appears to be receding, the obesity and dysmetabolism pandemic continues to rage on. *Metabolism.* 2022 May 15;133:155217. doi: [10.1016/j.metabol.2022.155217](https://doi.org/10.1016/j.metabol.2022.155217).

<sup>7</sup> World Obesity Federation. Atlas of Childhood Obesity. October 2019. [https://s3-eu-west-1.amazonaws.com/wof-files/WOF\\_Childhood\\_Obesity\\_Atlas\\_Report\\_Oct19\\_V2.pdf](https://s3-eu-west-1.amazonaws.com/wof-files/WOF_Childhood_Obesity_Atlas_Report_Oct19_V2.pdf).

The WOF also expects that the annual cost of overweight and obesity will represent around 3% of global GDP, including healthcare costs, high costs of the new family of medications, reduced work productivity, and premature retirement or death. Other organizations have estimated this cost at more than 2% of global GDP.<sup>8</sup>

Time is a significant factor. For example, there is sometimes a considerable lag time (time delay) between the existence of obesity and the manifestation of its adverse health consequences. It has been found that both the maximum lifetime BMI and the period during which a person is obese can significantly affect the extent of future mortality risk.<sup>9</sup> However, the benefits of significant weight reduction, whether the result of surgery or GLP-1 medication, appear to manifest themselves fairly rapidly.<sup>10</sup> However, further study is warranted due to the relatively recent introduction of new medicines, such as GLP-1s.

Although there is some debate regarding the additional mortality that the marginally obese experience, there is a consensus that severe obesity has a significant effect on mortality and morbidity.<sup>11</sup>

### PREVALENCE AND TREND

As shown in Table 1, unlike the total prevalence of obesity, which may be plateauing and even gradually declining in the 2020s, the prevalence of severe obesity (measured by BMI) may not yet have reached a peak. If the prevalence rate remains at about 10% of the total U.S. adult population, the number of those who are severely obese (BMI > 40) will be at least 25 million adults.

The bottom third of Table 1 also shows that the prevalence of class 1 and class 2 obesity, which excludes the severely obese, has remained relatively stable over the last decade. However, the prevalence among males has increased. In contrast, the prevalence of those who are severely obese has increased over this period for each sex and age category. This demonstrates the movement toward increasing prevalence of severe obesity among U.S. adults (in other words, the distribution of BMI in the country has shifted to the right).

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<sup>8</sup> For example, Okunogbe A, Nugent R, Spencer G, Powis J, Ralston J, Wilding J. Economic impacts of overweight and obesity: current and future estimates for 161 countries. *BMJ Glob Health*. 2022 Sep;7(9):e009773. doi: 10.1136/bmjgh-2022-009773 which projected a cost of 3.29% of GDP globally by 2060.

<sup>9</sup> For example, see Hanfei, Xu, Adrienne Cupples, Andrew Stokes, Ching-Ti Liu (2018). Association of Obesity With Mortality Over 24 Years of Weight History Findings From the Framingham Heart Study. *JAMA Network Open*. 2018;1(7):e184587. doi:10.1001/jamanetworkopen.2018.4587.

<sup>10</sup> Grace Niewijk, "Research Shows GLP-1 Drugs Are Effective but Complex," UChicago Medicine Forefront, accessed June 2, 2026, <https://www.uchicagomedicine.org/forefront/research-and-discoveries-articles/research-on-glp-1-drugs>

<sup>11</sup> See Gutterman (2016). "Obesity, Mortality, and the Obesity Paradox." *North American Actuarial Journal*. V20, 2016, issue 4, p 355-403. <https://www.tandfonline.com/doi/full/10.1080/10920277.2016.1241183>

**Table 1**  
**OBESE AND SEVERELY OBESE PREVALENCE IN UNITED STATES ADULTS (2013-2023)**

	Severe obesity					
	Males+Females	Males	Females	20-39	40-59	60+
2013-2014	7.7%	5.5%	9.9%	8.0%	8.6%	5.8%
2015-2016	7.7%	5.6%	9.7%	7.8%	8.5%	6.3%
2017-2020	9.2%	6.6%	11.7%	9.7%	10.7%	6.1%
2021-2023	9.7%	6.8%	12.6%	9.5%	12.0%	6.6%
	Obese, including Severe obese					
	Males+Females	Males	Females	20-39	40-59	60+
2013-2014	37.7%	35.0%	40.4%	34.4%	41.0%	38.5%
2015-2016	39.6%	37.9%	41.1%	35.7%	42.8%	41.0%
2017-2020	41.9%	41.8%	41.8%	39.8%	44.7%	41.5%
2021-2023	40.3%	41.4%	41.4%	35.5%	46.4%	38.9%
	Obese, excluding Severe obese					
	Males+Females	Males	Females	20-39	40-59	60+
2013-2014	30.0%	29.5%	30.5%	26.4%	32.4%	32.7%
2015-2016	31.9%	32.3%	31.4%	27.9%	34.3%	34.7%
2017-2020	32.7%	35.2%	30.1%	30.1%	34.0%	35.4%
2021-2023	30.6%	34.6%	28.8%	26.0%	34.4%	32.3%

Source: Emmerich, Samuel D., Cheryl D. Fryar, Bryan Stierman, Qiuping Gu, Joseph Afful, Cynthia L. Ogden (2025). "Trends in Obesity-Related Measures Among US Children, Adolescents, and Adults." *Journal of the American Medical Association*. Published online February 13, 2025. doi:10.1001/jama.2024.27676. <https://jamanetwork.com/journals/jama/fullarticle/2830299>.

In aggregate, there does not appear to be significant differences by sex in overall obesity prevalence in the 2021-2023 National Health and Nutrition Examination Survey (NHANES)<sup>12</sup>, although a significant difference by sex remains in the two obesity subgroups, as shown in Table 1 (6.8% versus 12.6%, and 34.6% versus 28.8%), in the proportion with severe obesity. This suggests the need to study such experience by sex.

Additionally, there are noticeable differences in educational attainment and racial/ethnic group (the latter split is not publicly available from the most recent NHANES<sup>13</sup>). Table 2 shows the prevalence of severe obesity by sex and educational attainment group. Those who obtained at least a Bachelor's degree have a much lower prevalence of obesity than those who have not.

<sup>12</sup> Samuel D. Emmerich, Cheryl D. Fryar, Bryan Stierman, and Cynthia L. Ogden, Obesity and Severe Obesity Prevalence in Adults: United States, August 2021–August 2023, NCHS Data Brief No. 508 (Hyattsville, MD: National Center for Health Statistics, September 2024), <https://www.cdc.gov/nchs/data/databriefs/db508.pdf>

<sup>13</sup> Other national surveys of obesity are also conducted, but they generally suffer by using self-reported body measurements, which tend to result in slightly lower prevalence rates. These include the National Health Interview Survey and the Behavioral Risk Factor Surveillance System.

Table 2

## OBESE PREVALENCE BY SEX AND EDUCATIONAL ATTAINMENT – UNITED STATES 2021-2023

2021-2023	Males+Females	Males	Females
High school or less	44.6%	43.3%	46.0%
Some college	45.0%	43.0%	46.9%
Bachelor's or more	31.6%	31.3%	31.9%

Source: 2021-2023 NHANES

Table 3 shows the prevalence of severe obesity in the United States by sex, age group, and major racial/ethnic categories, based on data from the 2013-2014 NHANES. Although somewhat dated, Table 3 highlights the importance of these variables. Notably, non-Hispanic Black females have a very high percentage of severe obesity. It also shows a smaller difference by racial/ethnic categories among males ages 20 to 39. Although not shown in Table 3, non-Hispanic Asian Americans have a very low percentage of severe obesity.

Table 3

## SEVERE ADULT OBESITY PREVALENCE REPORTED IN THE 2013-2014 NHANES

2013-2014	Males			
	Total	Non-Hispanic Whites	Non-Hispanic Blacks	Hispanics
Ages				
20-39	6.0%	6.1%	6.6%	6.3%
40-59	5.2%	5.2%	8.5%	6.0%
60+	5.0%	5.3%	6.3%	3.2%
Total	5.5%	5.6%	7.2%	5.4%
	Females			
Ages	Total	Non-Hispanic Whites	Non-Hispanic Blacks	Hispanics
20-39	10.1%	10.1%	16.2%	8.9%
40-59	11.9%	11.7%	19.4%	9.9%
60+	6.4%	5.8%	13.9%	6.5%
Total	9.9%	9.7%	16.8%	8.7%

Sources: NHANES, for adults aged 20 and above; Flegal et al. (2016); Fryar et al. (2016).

The above focuses on the prevalence of severe obesity in U.S. adults. In addition, significant concerns regarding childhood obesity have also been raised, as around 20 percent of children are currently assessed as being obese.<sup>14</sup> The definitions of obesity and severe obesity for children and adolescents are not as well-established as those for adults. However, the definition of obesity sometimes used in the United States is anyone above the 95<sup>th</sup> percentile on the CDC sex- and age-specific growth charts, which are updated periodically. Severe obesity has been defined as greater than 120% of these values.

As shown in Table 4, which displays data from the 2013-2014 NHANES through the 2021-2023 NHANES for children and adolescents, there has been a steady increase in obesity over this decade across all categories, a continuation of

<sup>14</sup> Emmerich, Samuel D., Cheryl D. Fryar, Bryan Stierman, Qiuping Gu, Joseph Afful, Cynthia L. Ogden (2025). "Trends in Obesity-Related Measures Among US Children, Adolescents, and Adults." *Journal of the American Medical Association*. Published online February 13, 2025. doi:10.1001/jama.2024.27676. <https://jamanetwork.com/journals/jama/fullarticle/2830299>.

the trend observed in several prior decades. This does not bode well for future rates of adult obesity and severe obesity for all ages.

**Table 4**  
**CHILDREN AND ADOLESCENTS, AGES 2-19 YEARS, NHANES 2021-2023**

<b>Obesity (≥95th percentile on sex-specific CDC growth charts)</b>				
	<b>2013-2014</b>	<b>2015-2016</b>	<b>2017-2020</b>	<b>2021-2023</b>
<b>Overall</b>	17.2%	18.5%	19.7%	21.1%
<b>Males</b>	17.2%	19.1%	20.9%	23.0%
<b>Females</b>	17.1%	17.8%	18.5%	19.1%
<b>2-5 years</b>	9.4%	13.9%	12.7%	14.9%
<b>6-11 years</b>	17.4%	18.4%	20.7%	22.1%
<b>12-19 years</b>	20.6%	20.6%	22.2%	22.9%
<b>Severe obesity (≥120% of the sex-specific 95th percentile on CDC growth charts)</b>				
	<b>2013-2014</b>	<b>2015-2016</b>	<b>2017-2020</b>	<b>2021-2023</b>
<b>Overall</b>	6.0%	5.6%	6.7%	7.0%
<b>Males</b>	5.6%	6.3%	7.3%	7.8%
<b>Females</b>	6.3%	4.9%	6.1%	6.3%
<b>2-5 years</b>	1.7%	1.8%	2.5%	3.4%
<b>6-11 years</b>	4.3%	5.2%	6.9%	6.5%
<b>12-19 years</b>	9.1%	7.7%	8.5%	8.9%
<b>Obesity (100%-119.9% ≥95th percentile on sex-specific CDC growth charts)</b>				
	<b>2013-2014</b>	<b>2015-2016</b>	<b>2017-2020</b>	<b>2021-2023</b>
<b>Overall</b>	11.2%	12.9%	13.0%	14.1%
<b>Males</b>	11.6%	12.8%	13.6%	15.2%
<b>Females</b>	10.8%	12.9%	12.4%	12.8%
<b>2-5 years</b>	7.7%	12.1%	10.2%	11.5%
<b>6-11 years</b>	13.1%	13.2%	13.8%	15.6%
<b>12-19 years</b>	11.5%	12.9%	13.7%	14.0%

Source: Emmerich, Samuel D., Cheryl D. Fryar, Bryan Stierman, Qiuping Gu, Joseph Afful, Cynthia L. Ogden (2025). "Trends in Obesity-Related Measures Among US Children, Adolescents, and Adults." *Journal of the American Medical Association*. Published online February 13, 2025. doi:10.1001/jama.2024.27676. <https://jamanetwork.com/journals/jama/fullarticle/2830299>

In a study of NHANES data from 2007-2008 through 2021-2023, Münte et al. (2025)<sup>15</sup> found that the prevalence of extremely severe obesity among children and adolescents increased from 0.32% to 1.13%. The prevalence was 2.04% for non-Hispanic Blacks, 0.47% for non-Hispanic Whites, and 0.57% for all other and multi-racial groups. This

<sup>15</sup> Eliane Münte, Xinlian Zhang, Amit Khurana, Philipp Hartmann (2025). "Prevalence of Extremely Severe Obesity and Metabolic Dysfunction Among U.S. Children and Adolescents." *JAMA Network Open*. 2025;8(7):e2521170. <https://doi:10.1001/jamanetworkopen.2025.21170>.

suggests that the distribution of obesity levels among children and adolescents has been shifting toward higher severity. Odds ratios indicate that boys are 1.50 times more likely than girls to have extremely severe obesity; those aged 12-19 are 3.19 times more likely than those aged 2-11; and non-Hispanic Blacks are 2.89 times more likely than all others. Throughout the periods studied, the experiences of individuals with extremely severe obesity were compared to those with Class 1 through 3 obesity (BMI greater than or equal to the 95<sup>th</sup> percentile to less than 160% of the 95<sup>th</sup> percentile). This comparison revealed that significant adverse medical conditions with high risk included metabolic dysfunction–associated steatotic liver disease (afflicting about 38% of children with obesity), prediabetes and type 2 diabetes, severe insulin resistance, metabolic syndrome, dyslipidemia (affecting roughly 40% of children with obesity), and hypertension (about a quarter of children with obesity have this condition). The authors describe this situation as a public health emergency.

## MORTALITY

Data attribution issues have hampered the study of the mortality of the obese, as obesity and severe obesity have represented only one of many underlying contributing drivers influencing mortality risk, and people’s obesity level can shift from time to time. As a result, most mortality studies have focused on the reported direct causes of death (e.g., cardiovascular or cancer-related deaths), rather than exploring the root causes or drivers of mortality. Consequently, findings of these studies, especially for those with class 1 and 2 obesity, have been somewhat inconsistent. Nevertheless, most of these studies indicate that the mortality rate of those people with severe obesity has been significantly higher than that of those with standard or overweight BMI, as well as compared to the mortality of those with less severe obesity.

Two examples of studies linking mortality to BMI levels include:

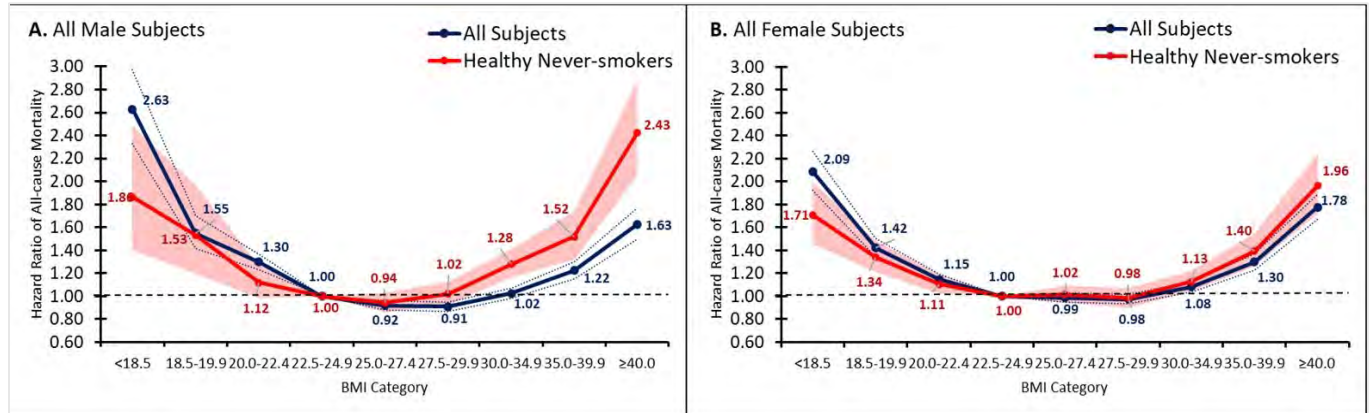
- A study based on the National Health Interview Survey.<sup>16</sup> This study, the results of which are shown in Figures 1A and 1B, compared mortality across various BMI categories with that of the 22.5-24.9 BMI category. It demonstrates mortality hazard ratios to follow a U-shaped curve, in which the mortality risk of the severely obese is considerably higher than that of the standard, overweight, and obese categories, particularly the severe obesity category.
- A study of global mortality indicates a J-shaped curve in a meta-analysis, with excess mortality beginning at the overweight category (BMIs between 25.0 and 29.9), and even larger mortality ratios at obese levels. What is clear is the much higher ratios at the severe mortality category (2.76 for all-cause mortality, with even higher ratios for many individual causes of death).

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<sup>16</sup> Aayush Visaria and Soko Setoguchi (2023). “Body mass index and all-cause mortality in a 21st century U.S. population: A National Health Interview Survey analysis” (2023). *PLoS ONE* 18(7): e0287218. <https://doi.org/10.1371/journal.pone.0287218>.

Figures 1A and 1B

MORTALITY HAZARD RATIOS OF U.S. ADULTS BY BMI CATEGORY BY SEX AND NEVER-SMOKERS VS. EVER-SMOKERS



Source: Visaria and Setoguchi (2023)

Table 5

GLOBAL MORTALITY HAZARD RATIOS, COMPARED WITH THOSE IN THE 22.5-24.9 BMI LEVEL

	15.0–18.4	18.5–19.9	20.0–22.4	22.5–24.9	25.0–27.4	27.5–29.9	30.0–34.9	35.0–39.9	40.0–59.9
All-cause	1.51	1.13	1.00	1.00	1.07	1.20	1.45	1.94	2.76
Cardiovascular	1.33	1.14	0.98	1.00	1.11	1.35	1.75	2.73	4.03
Coronary	1.10	0.95	0.89	1.00	1.18	1.45	1.89	2.61	3.54
Stroke	1.38	1.15	1.01	1.00	1.05	1.23	1.49	2.47	3.28
Respiratory	3.26	1.73	1.22	1.00	1.00	1.10	1.30	2.03	3.27
Cancer	1.11	1.01	0.96	1.00	1.05	1.13	1.28	1.55	1.90
Males	1.83	1.00	1.00	1.00	1.12	1.12	1.70	2.68	4.24
Females	1.53	1.00	1.00	1.00	1.08	1.08	1.37	1.86	2.73
Never-smokers	1.53	1.00	1.00	1.00	1.07	1.07	1.39	1.86	2.69
Ever smokers	1.86	1.00	1.00	1.00	0.94	0.94	1.13	1.51	2.04
Measured < 1990	1.43	1.00	1.00	1.00	1.14	1.14	1.58	2.10	2.88
Measured ≥ 1990	1.53	1.00	1.00	1.00	1.05	1.05	1.31	1.76	2.49

Sources: Global BMI Mortality Collaboration (2016).<sup>17</sup> Cause-related data are based on 189 studies, with male data from 157 and female data from 141, published from January 1970 to January 2015. Smoker status data are based on 98 studies, earlier period data are based on 113 studies, and later period data are based on 76 studies. Values for certain categories were aggregated for BMIs of 18.5-24.9 and 25.0-29.9.

As seen from these two studies, mortality in relation to BMI typically follows a U- or J-shaped curve, with higher mortality rates at both the very underweight and obese levels. In some studies, mortality hazard ratios for individuals with low levels of obesity may or may not be as high as those at overweight BMIs. However, for most studies (except among very old populations), the mortality risk for severely obese individuals is significantly greater than for those in the overweight category.

<sup>17</sup> Global Mortality Collaboration (2016). "Body-Mass Index and All-Cause Mortality: Individual Participant Data Meta-analysis of 239 Prospective Studies of 4 Continents." *The Lancet* 388 (10046): 776-786.

These relationships are also evident in life insurance underwriting, where most individuals who are severely obese have been either denied coverage or rated as highly substandard. Underwriters have recognized for some time the adverse mortality risks that these individuals represent.

When analyzing U.S. mortality experience, I find it essential to rely on relatively recent data, as earlier historical experience may have occurred during periods of lower obesity and severe obesity prevalence. However, the expected impact of bariatric surgery and recently introduced obesity-reduction medications might offset these adverse trends to some extent in the future.

## PREVENTION/TREATMENTS

There are several treatment options available to help reduce severe obesity. These include medication (e.g., GLP-1 drugs), behavioral interventions (including the quantity and quality of nutrition and increased physical activity), and surgical techniques. However, none of these are easy to implement, nor are they guaranteed to work for many of those affected. Repeated cycles of treatments may occur, whether due to choice, loss of insurance, or unavailability, raising questions about their effectiveness. A multi-pronged, comprehensive approach will continue to be needed.

## CONCLUSION


The United States and, indeed, the world, are in the midst of an obesity epidemic. Although the prevalence of obesity in the United States may have plateaued or even turned the corner somewhat, the prevalence of severe obesity has not yet reached that stage. This epidemic will continue to put pressure on mortality rates and healthcare costs, among other impacts, in all countries, as well as on individual lives. Considerable effort and expense will be required to manage it effectively. However, the development of new GLP-1 medications to treat obesity may offer a way forward to address some of this trend; in any case, further progress will come at a high price.

Only time will reveal future patterns and consequences related to the mortality and morbidity of the large obese population, especially given the growing prevalence of the severely obese in the United States.

Notably, according to the 2021-2023 NHANES, the steady increase in severe obesity prevalence that, based on BMI, is 8.9% among 12- to 19-year-olds and 9.7% among adults, serves as an ominous early warning sign of a concerning factor that could lead to higher overall mortality rates in the United States. This group, nearing one in ten Americans, now makes up about a quarter of adults and roughly 40% of 12- to 19-year-olds who are obese. Despite the potential of GLP-1 medications and bariatric surgery, I believe the exceptionally high mortality risk of this subgroup makes it a serious threat to American health, healthcare costs, and mortality.

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## Measures of Obesity and Mortality: Strengths, Limitations, and the Need for Broader Perspectives

Xinyi (Cindy) Hu, ASA, MAAA

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### INTRODUCTION

Obesity remains one of the most pressing public health and actuarial challenges of the 21st century. Its high prevalence—exceeding 40% of U.S. adults as of 2023, according to the National Center for Health Statistics (2024)—and its well-documented associations with cardiovascular disease, type 2 diabetes, certain cancers, and reduced life expectancy underscore its impact on both individual health and population-level mortality projections. To understand and forecast these impacts, actuaries and researchers rely on measurable indicators of obesity. Among the most widely used are body mass index (BMI) and waist circumference (WC). While both have practical advantages, each has significant limitations when considered alone. This essay explores these two measures, evaluates their utility in relation to mortality, and argues for a more comprehensive framework that incorporates additional factors to better capture the complexities of obesity and its mortality risk.

### BODY MASS INDEX (BMI)

BMI is calculated as weight in kilograms divided by height in meters squared ( $\text{kg}/\text{m}^2$ ) and is categorized into ranges such as underweight ( $<18.5$ ), normal ( $18.5\text{--}24.9$ ), overweight ( $25\text{--}29.9$ ), and obese ( $\geq 30$ ). Its primary advantages are simplicity, low cost, and applicability to large-scale data collection. BMI is easily understood and facilitates comparisons across populations and over time. Epidemiological studies have consistently shown a J- or U-shaped relationship between BMI and mortality, with increased risks at both very low and very high BMI levels (Dwivedi, Dubey, Cistola, & Reddy, 2020).

However, BMI's limitations are substantial. It does not differentiate between fat and lean body mass, nor does it account for fat distribution. Thus, highly muscular individuals can be misclassified as overweight or obese, while people with low muscle mass but high visceral fat (so-called "normal weight obesity") may appear healthy by BMI standards yet still face elevated metabolic and mortality risks (Romero-Corral et al., 2008). BMI also does not capture changes in body composition over time, which may be particularly important in assessing the effects of weight loss interventions, aging, or chronic illness.

### WAIST CIRCUMFERENCE (WC)

To address some of BMI's shortcomings, WC is often used as a complementary measure. WC quantifies abdominal (visceral) fat, which is more strongly associated with metabolic complications and mortality risk than subcutaneous fat. Studies have shown that individuals with high WC—even if their BMI is in the "normal" range—are at elevated

risk of cardiovascular disease and premature death (Pischon et al., 2008). WC is also simple to measure and inexpensive.

Nonetheless, WC has its own challenges. Measurement techniques can vary, leading to inconsistent data, and there is less global consensus on cutoff values than for BMI (World Health Organization, 2011). WC also does not distinguish between visceral and subcutaneous fat within the abdomen, nor does it account for differences in body proportions across sexes, ages, and ethnic groups. Furthermore, both BMI and WC are cross-sectional measures and do not directly reflect the duration or timing of obesity exposure, which may independently affect mortality risk.

## BEYOND BMI AND WC: ADDITIONAL FACTORS AND MEASURES

Given the limitations of BMI and WC, relying solely on these measures to predict mortality risks can be misleading. Several additional methods and factors offer a more comprehensive understanding of obesity's impact, though each comes with its own strengths and weaknesses.

Body composition analysis, through techniques such as bioelectrical impedance, dual-energy X-ray absorptiometry (DXA), or imaging (CT and MRI), provides detailed information on the proportions of fat and lean mass, and distinguishes between visceral and subcutaneous fat. This level of precision allows researchers and clinicians to assess the forms of fat most closely tied to metabolic risk and mortality. The advantage of these methods is that they directly measure body composition, which is a more meaningful predictor of health outcomes than body size alone. However, these techniques are costly, require specialized equipment and trained personnel, and are generally impractical for large-scale epidemiological studies. In some cases, they also expose subjects to small amounts of radiation.

Understanding the duration and trajectory of obesity adds another layer of insight. Research has shown that the cumulative time an individual spends obese, as well as whether their weight has remained stable, cycled, or gradually increased over time, influences their mortality risk (Abdullah et al., 2011). This perspective has the advantage of reflecting the long-term physiological damage of chronic obesity, distinguishing it from short-term or episodic weight changes. Yet this approach requires reliable longitudinal data, which can be difficult to obtain, and may rely on self-reported weight histories that are vulnerable to recall bias.

Assessing metabolic health status—through indicators such as blood glucose, lipids, blood pressure, and inflammation markers—can help distinguish between individuals who are metabolically healthy despite being obese and those who have significant metabolic dysfunction at the same BMI. This approach's key advantage is that it directly measures the physiological processes driving morbidity and mortality, providing a more individualized risk profile. However, these assessments require laboratory testing and clinical visits, are not standardized across all studies or settings, and there remains disagreement in the scientific community about how to define “metabolically healthy obesity” (Blüher, 2020).

Incorporating sociodemographic and behavioral factors such as age, sex, smoking, socioeconomic status, diet, physical activity, and access to healthcare is also essential in understanding how obesity affects mortality. These factors shape an individual's health trajectory and can either amplify or mitigate the risks associated with obesity. They allow for identifying vulnerable subpopulations and contextualizing obesity within broader determinants of health. The challenge, however, is that these variables are often difficult to quantify precisely, their effects can interact in complex ways, and such data may not always be consistently collected or available in actuarial datasets.

Finally, genetic and epigenetic factors are emerging as important contributors to the heterogeneity of obesity outcomes. Genetic predisposition may explain why some individuals develop obesity-related complications while others do not and can also influence response to treatment (Loos & Yeo, 2022). While this information holds promise for more personalized approaches to risk assessment and intervention, its use in population-level mortality

projections remains limited. Genetic data are expensive to collect and analyze, and translating genetic findings into actionable insights for large-scale modeling is still in its early stages.

## IMPLICATIONS FOR MORTALITY MODELING

For actuaries tasked with forecasting mortality trends, incorporating BMI and WC remains useful due to their wide availability and strong associations with adverse outcomes. However, these measures should be supplemented with additional data where feasible to stratify risk more accurately. For instance, distinguishing between metabolically healthy and unhealthy obese individuals or accounting for weight history can refine mortality projections. Moreover, emerging trends—such as the uptake of anti-obesity medications (AOMs) like GLP-1 receptor agonists—may alter the relationship between obesity and mortality (Rubino et al., 2021), emphasizing the need for dynamic models that incorporate treatment effects and behavioral changes over time.

## CONCLUSION

BMI and WC are indispensable tools in assessing obesity and projecting its impact on mortality because of their simplicity, affordability, and established predictive value. However, their limitations—particularly their inability to fully capture fat distribution, body composition, and metabolic health—necessitate caution in relying on them as sole indicators. It may be worthwhile for future actuarial and public health models to integrate a broader set of measures and contextual factors, including obesity duration, weight change trajectories, metabolic health, and socioeconomic determinants, to reflect the complex interplay more accurately between obesity and mortality. As obesity management evolves, particularly with the advent of effective pharmacotherapies, a more refined understanding of risk stratification will be critical for accurate mortality projections and informed decision-making.

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## Mortality Experience: AOMs vs. Lifestyle-Based Weight Loss

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*Any views and ideas expressed in the essays are the author's alone and may not reflect the views and ideas of the Society of Actuaries, the Society of Actuaries Research Institute, Society of Actuaries members, nor the author's employer.*

### INTRODUCTION

Obesity is one of the most pressing health crises in the United States, affecting more than 40% of adults between 2021 and 2023 (CDC, 2024). It significantly increases the risk of chronic conditions such as cardiovascular disease, type 2 diabetes, and certain cancers that contribute to higher mortality and escalating morbidity costs. Sustained weight loss is crucial to mitigate these risks.

Historically, lifestyle-based interventions such as diet, exercise, and behavioral therapy have yielded modest and often temporary results. The emergence of anti-obesity medications (AOMs), particularly GLP-1 receptor agonists, introduces a promising new avenue for weight management. While these interventions yield substantial weight loss, their long-term effects on mortality remain uncertain, posing new questions for actuaries and health systems alike.

For actuaries, this shift is pivotal. If the method of weight loss influences mortality outcomes, conventional models may require recalibration. This essay compares mortality outcomes associated with AOM-assisted weight loss versus traditional lifestyle changes and explores how actuaries might reflect this evolving divergence in pricing, underwriting, and reserving assumptions.

### WEIGHT LOSS AND MORTALITY

Lifestyle interventions have demonstrated reductions in risk factors associated with all-cause mortality, particularly by improving glycemic control and cardiovascular health. However, the Look AHEAD (Action for Health in Diabetes) trial found that these improvements did not translate into a statistically significant reduction in mortality, even though participants experienced better metabolic control and physical functioning that may indirectly support longevity.

However, the challenge with lifestyle changes lies in adherence. Long-term success is elusive for many, leading to growing interest in pharmacological alternatives like AOMs, which provide more consistent outcomes, often independent of behavioral persistence.

### EMERGENCE AND EFFICACY OF AOMS

GLP-1 receptor agonists, such as semaglutide and liraglutide, have dramatically changed the landscape of obesity treatment. Alongside drugs like phentermine/topiramate and naltrexone/bupropion, these medications represent a significant advancement in clinical obesity treatment.

Clinical trials, including LEADER and SUSTAIN-6, have reported favorable cardiometabolic outcomes for GLP-1 users with type 2 diabetes. However, mortality risk can vary across drug classes. A retrospective review of the FDA Adverse Event Reporting System (FAERS, 2013–2020) noted over 1,000 deaths and 7,400 hospitalizations linked to AOMs, with cardiovascular complications comprising a notable portion of adverse events. It is important to note that FAERS relies on voluntary reporting and cannot establish causality, but the data suggests that mortality risks may differ significantly by medication type.

### TRADITIONAL MORTALITY MODELING

Actuaries traditionally forecast mortality using models like multi-state life tables, Cox proportional hazards models, and aggregate mortality improvement scales (e.g., Lee-Carter, Cairns-Blake-Dowd):

- **Multi-state models** allow transitions between health states (e.g., obesity → diabetes → death).
- **Cox models** assess individual-level risk factors, such as BMI and smoking status.
- **Lee-Carter and CBD models** support population-level mortality forecasting for pricing and reserving.

However, these models often assume homogeneity in weight loss outcomes, a premise increasingly challenged by new treatment pathways.

### LIMITATIONS OF CURRENT MODELS

Key limitations include:

- **Insufficient granularity:** Most models do not distinguish between weight loss achieved via lifestyle versus medication.
- **Static assumptions:** Uniform improvement rates overlook treatment-specific variations.
- **Lagging data:** Mortality databases often trail real-time AOM adoption trends.
- **Confounding bias:** AOM users may have different baseline characteristics (e.g., comorbidity burden, healthcare access) than those pursuing lifestyle changes.

### INTEGRATING AOM IMPACTS INTO ACTUARIAL MODELS

To reflect this emerging divergence, actuaries can consider:

- **Segmented hazard models:** Building mortality tables differentiating AOM users from lifestyle adherents.
- **Dynamic covariates:** Incorporating time-varying factors like medication duration, adherence, and weight cycling into extended Cox or discrete-time models.
- **Machine Learning:** Using ensemble methods (e.g., random forests, XGBoost) to capture nonlinear risk profiles from clinical and claims data.
- **Cause-specific models:** Isolating impacts on cardiovascular versus non-cardiovascular mortality.

### BENEFITS OF AOM-INFORMED MORTALITY MODELING

Benefits of integrating AOM impacts into actuarial models include:

- **Improved pricing accuracy:** Better alignment of premiums and reserves with observed mortality.
- **Refined underwriting:** AOM history can serve as a dynamic health indicator, beyond static metrics like BMI.
- **Policy implications:** Enhanced projections can support public health decisions and coverage strategies related to AOM access.

## CHALLENGES AND CONSIDERATIONS

However, incorporating AOM impacts also brings challenges and other considerations, including:

- **Regulatory concerns:** Using AOM data in underwriting raises privacy and fairness issues.
- **Limited longitudinal data:** Most AOM trials span only two to three years, restricting long-term forecasting.
- **Selection bias:** Early adopters may have socioeconomic advantages, skewing outcome comparisons.
- **Hybrid pathways:** Many individuals combine treatments, complicating attribution and modeling.

## CONCLUSION

As pharmacologic obesity treatments gain traction, the authors argue that actuarial modeling frameworks may need to evolve to reflect treatment-specific mortality impacts. Mortality projections that do not distinguish between treatment modalities may become increasingly less informative. Incorporating modality-based stratification has the potential to improve accuracy while supporting greater transparency and foresight.

As obesity care evolves, the authors suggest that actuarial models may benefit from adapting to reflect emerging treatment patterns. Actuaries who integrate real-world data, flexible models, and nuanced assumptions are, in the authors' view, better positioned to contribute to the future of mortality modeling.

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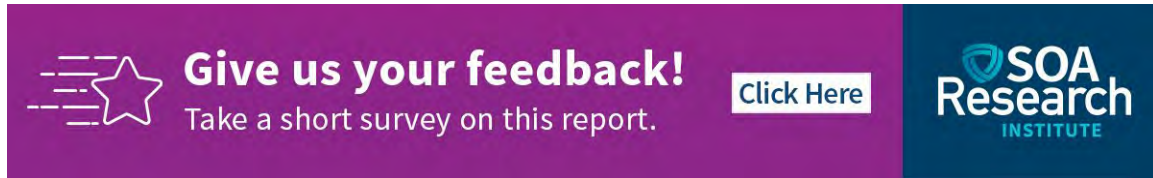
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## Obesity and Its Risking Impact on Future Mortality: A Comprehensive Perspective

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### INTRODUCTION

Obesity has emerged as one of the most significant public health challenges of the modern era, with implications that extend beyond individual health to healthcare systems, life expectancy, and actuarial mortality forecasting. Recent data indicate that between August 2021 and August 2023, more than 40% of adults in the United States were classified as obese, underscoring the scale and persistence of the issue (National Center for Health Statistics, (2024), 2024). Elevated levels of obesity are widely associated with a higher prevalence of chronic conditions such as type 2 diabetes, cardiovascular disease, certain cancers, and osteoarthritis, all of which are linked to increased mortality risk (Afshin, 2017).

At the same time, advances in medical treatment, particularly the development of glucagon-like peptide-1 (GLP-1) receptor agonists, are reshaping how obesity is managed. These developments may influence long-term health outcomes and, by extension, future mortality patterns. This essay examines the relationship between obesity and mortality through recent trends, measurement challenges, treatment developments, and international comparisons, with particular attention to implications for actuarial science.

### TRENDS IN OBESITY AND CONTRIBUTING FACTORS

Obesity prevalence in the United States has increased steadily over the past several decades, transitioning from a relatively limited public health concern to a widespread population-level issue. In addition to rising overall prevalence, the proportion of individuals classified as having severe obesity (body mass index [BMI]  $\geq 40$ ) has also grown. Multiple interrelated factors appear to contribute to this trend.

Dietary patterns have shifted toward increased consumption of processed and energy-dense foods, many of which are high in added sugars and saturated fats. At the same time, physical activity levels have declined as sedentary occupations, increased screen time, and urban transportation patterns reduce daily movement. Socioeconomic factors also play a role, as individuals in lower-income communities may face barriers to accessing nutritious food and safe environments for physical activity. Biological and environmental influences, including genetic predisposition, hormonal regulation, and exposure to certain chemicals, may further interact with behavioral factors to influence weight outcomes.

The consequences of severe obesity are particularly pronounced. Research suggests that individuals with very high BMI levels may experience substantial reductions in life expectancy, in some cases approaching a decade, largely due to elevated cardiovascular and metabolic risk (Fontaine, 2003).

### **ASSESSING OBESITY: BEYOND BMI**

BMI remains the most commonly used metric for classifying overweight and obesity due to its simplicity and ease of application. However, it has several well-documented limitations. BMI does not distinguish between lean muscle mass and body fat, which can result in misclassification, particularly among individuals with high muscle density. In addition, BMI does not capture fat distribution, despite evidence that visceral adiposity is more strongly associated with adverse health outcomes than subcutaneous fat (Snijder, 2006).

Population-level differences further complicate interpretation. Certain ethnic groups, including South Asian populations, may experience elevated cardiometabolic risk at lower BMI thresholds compared to European populations, suggesting that uniform BMI cutoffs may not fully reflect health risk across populations ((2004), 2004)

Alternative measures such as waist circumference and waist-to-hip ratio have been shown to provide additional insight into cardiometabolic risk and may enhance future mortality assessments when used alongside BMI rather than as replacements.

### **THE OBESITY-MORTALITY CONNECTION: PAST, PRESENT, AND FUTURE**

Historically, obesity has been associated with increased all-cause mortality, particularly through its relationship with chronic diseases such as heart disease and diabetes. However, some studies have identified what is often referred to as the “obesity paradox,” wherein individuals classified as mildly obese appear to have similar or, in some cases, lower mortality than those in normal-weight categories (Flegal, 2013). Proposed explanations include earlier medical intervention among individuals with higher body weight and the influence of survivor bias.

Looking ahead, pharmaceutical innovations may alter established patterns. Clinical trials of GLP-1 receptor agonists such as semaglutide and tirzepatide have demonstrated substantial and sustained weight loss among individuals with obesity (Wilding, 2021) (Rubino, 2023). While these outcomes suggest potential downstream health benefits, evidence directly linking pharmacologically induced weight loss to long-term reductions in mortality remains limited. As a result, it is my perspective that ongoing monitoring and longitudinal research will be necessary before firm conclusions can be drawn.

### **MANAGING OBESITY: WHAT WORKS AND WHAT’S CHANGING**

Current obesity management strategies generally fall into three broad categories. Lifestyle-based interventions, including dietary modification and increased physical activity, remain foundational but are often difficult to maintain over the long term. Pharmacological treatments have expanded in recent years, with newer medications offering greater average weight loss than earlier therapies, though cost and long-term adherence remain important considerations.

Surgical interventions, particularly bariatric procedures such as gastric bypass, have demonstrated significant and durable weight loss and are associated with meaningful reductions in long-term mortality in some populations (Adams, 2007) (Sjöström, 2007). Despite these advances, several unresolved questions remain relevant for actuaries and health researchers. These include whether weight loss achieved through medication produces similar mortality benefits to lifestyle-based weight loss, how repeated cycles of weight loss and regain affect long-term survival, and whether widespread adoption of new therapies will materially alter population-level obesity prevalence.

## A GLOBAL PERSPECTIVE ON OBESITY

Although the United States continues to report among the highest obesity rates globally, similar upward trends are observed in other countries, including the United Kingdom and Mexico. In contrast, countries such as Japan and South Korea maintain relatively low obesity prevalence, often attributed to dietary traditions, cultural norms, and higher baseline levels of daily physical activity. Cross-national comparisons suggest that environmental and social factors play a substantial role in shaping obesity outcomes, offering potential insights for public health strategy, even if direct policy transfer may be limited (Organisation for Economic Co-operation and Development. (2023)).

## CONCLUSION: WHAT IT MEANS FOR ACTUARIAL SCIENCE

The relationship between obesity and mortality is multifaceted and continues to evolve as population trends and medical treatments change. For actuaries, these dynamics present both challenges and opportunities. Updating mortality models to reflect shifting obesity prevalence, incorporating improved measures of adiposity, and accounting for differential access to emerging treatments may enhance future projections.

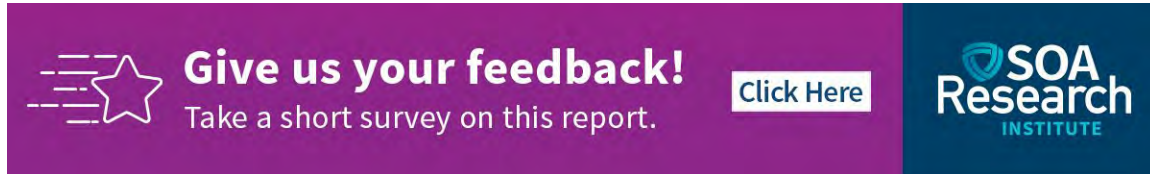
Key areas for continued attention may include tracking obesity trends across demographic groups, evaluating long-term outcomes associated with new pharmacological therapies, and considering the role of socioeconomic factors in shaping health and mortality risk. As medical innovation accelerates, it is my opinion that actuarial approaches that remain adaptable will help ensure mortality assumptions reflect an increasingly complex health landscape.



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## Current Trends in Obesity Management: Population Variability and Effectiveness

Kayla T. Stephens, MPH

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### INTRODUCTION

Obesity is a global public health crisis affecting over 650 million adults and 340 million children and adolescents worldwide (World Health Organization [WHO], 2024). In the United States alone, more than 42% of adults and 20% of youth are classified as obese, with prevalence steadily increasing over the last three decades (Centers for Disease Control and Prevention [CDC], 2023). As obesity contributes to a range of chronic conditions—including cardiovascular disease, type 2 diabetes, and some cancers—it demands multifaceted intervention strategies. In recent years, advancements in pharmacological therapies, digital health tools, surgical procedures, and preventive public health policies have significantly transformed how obesity is managed. This essay explores the current trends in obesity management, examines how these strategies vary across population segments, and evaluates their overall effectiveness.

### PHARMACOLOGICAL INTERVENTIONS: A GAME CHANGER

One of the most significant developments in obesity management is the widespread adoption of glucagon-like peptide-1 (GLP-1) receptor agonists such as semaglutide (Wegovy, Ozempic) and tirzepatide (Mounjaro). These medications, originally developed for type 2 diabetes, are now prescribed for weight loss with remarkable results—patients typically lose 6–12% of their body weight over several months (Wilding et al., 2021). In the UK, prescriptions more than doubled from 1.4 million to 2.7 million in just one year (Kantar, 2024).

New oral alternatives are on the horizon. Orforglipron, an investigational oral GLP-1 agonist developed by Eli Lilly, has shown 8% weight loss in clinical trials, offering a more accessible option, particularly for individuals in low-resource settings (Lilly, 2024). The convenience and non-invasive nature of oral drugs are likely to expand the reach of pharmacotherapy in obesity care.

Effectiveness: These drugs are highly effective in the short term. However, weight regain is common after discontinuation, and long-term adherence is limited by cost and side effects (Rubino et al., 2022). Additionally, not all patients respond equally, underscoring the need for personalized treatment strategies.

### LIFESTYLE AND BEHAVIORAL INTERVENTIONS

Despite pharmaceutical advancements, lifestyle modification—encompassing dietary changes, physical activity, and behavioral counseling—is still the cornerstone of obesity management. High-intensity interventions, especially when

tailored for specific populations (e.g., low socioeconomic status, racial minorities), can produce sustainable weight loss of 5% or more over 12 to 24 months (LeBlanc et al., 2022).

Digital health innovations have enhanced accessibility. Mobile apps, virtual coaching, and telemedicine platforms enable remote support and behavior tracking (Schoeppe et al., 2016). Cognitive-behavioral therapy delivered through virtual reality (VR) has been used to address triggers like emotional eating, reducing binge episodes by over 30% in some studies (Manzoni et al., 2016).

Effectiveness: While lifestyle interventions require sustained engagement, they are safe, cost-effective, and adaptable to diverse populations. Their success is closely tied to individual motivation and system-level support, such as workplace wellness programs and community education.

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## Beyond BMI: A Multi-Dimensional Framework for Predicting Mortality in a Dynamic Health Landscape

Peik Hong Tan, FSA

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### OBESITY IN THE LAST 20 YEARS

When you think about obesity, what comes to mind? A number on a scale? A BMI chart? Now ask yourself, does that number really tell the whole story?

According to a World Health Organization report, one in eight people worldwide is living with obesity in 2022. That's more than double the rate among adults since 1990 and quadruple among adolescents.<sup>1</sup>We often hear these figures and nod in concern. But what if the way we understand and measure obesity hasn't kept up with the lifestyle we're actually living?

Obesity is more than just excess body fat. On a deeper level, it results from a combination of behavioral, environmental, and biological influences. In wealthier cities, ultra-processed, hyper-palatable foods have become staples. For example, instant noodles, convenience-store pastries, and sugary drinks can be delivered to our door in minutes.

In addition, technology now affects how we work, shop, and socialize. Movement is no longer a necessity, rather it's a lifestyle choice that we have to constantly put effort into. Screens become an important part of our life, and blue light alters our sleep-wake cycles, hormones, and metabolism. With all these changing dynamics, how should we measure obesity and more importantly, the health risks it poses?

### HOW DO WE MEASURE OBESITY?

Traditionally, clinicians and actuaries have leaned on body mass index (BMI) and waist circumference. These metrics are simple, accessible, and scalable. However, they could also be outdated proxies for actual health risk.

BMI classifies people by weight and height but does not provide information about fat distribution, muscle mass, or inflammatory risk. An athlete may be flagged as obese, while an older adult with low muscle and high visceral fat may appear "normal."

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<sup>1</sup> World Health Organization, "Obesity and Overweight," last modified December 8, 2025, [Obesity and Overweight Fact Sheet](#)

Waist circumference would be better at indicating central obesity. However, it also has its own pitfalls. This measurement varies by posture, measurement method, and body type. Neither tool captures individual risk with precision, especially as mortality risk modeling becomes more personalized.

Emerging tools are now getting more important:

- Waist-to-hip ratio (WHR) reflects fat distribution, which is a strong predictor of cardiovascular and metabolic mortality, even in people with normal BMI.
- Body fat percentage (BFP) and bioimpedance analysis (BIA) help distinguish between lean mass, fat mass, and water, offering a more complete view of physical health.

Here's the question to ask ourselves: If our tools lack precision, are we misclassifying risk? Are we unfairly penalizing some and over-compensating others? More importantly, are we missing critical signals of early mortality hidden behind a "normal" BMI? It's time we changed our thinking. Let's explore what it truly means to link obesity and mortality, not just statistically, but meaningfully in a way that reflects individual risk, not just population averages.

### LINKING OBESITY TO MORTALITY AND MORBIDITY: WHERE THE MEASURES FALL SHORT

We often hear that a higher BMI means higher health risk, but is that always true? Surprisingly, the answer isn't so simple. While BMI has been used for generations to classify obesity, the actual relationship between body size and health outcomes, especially mortality, is not that straightforward.

Let's start with a pattern observed across many large studies: the U-shaped or J-shaped BMI–mortality curve. People at both ends of the BMI spectrum, either "very low or very high" tend to have higher risk of death, while those in the middle, often in the "overweight" range (BMI 25–29.9), sometimes have the lowest mortality rates. Why would that be? On the high end, excess fat is clearly linked to conditions like diabetes and cardiovascular disease. But at the low end, a very low BMI can be a marker for malnutrition or underlying illness, especially in older adults. So, someone who appears "healthy" based on BMI might actually be carrying hidden health risks.

In certain groups, particularly the elderly or individuals with chronic diseases like kidney disease, being slightly overweight has been associated with better survival outcomes.<sup>2</sup> How can this be? One possible explanation is that overweight individuals may retain more muscle mass,<sup>3</sup> which isn't captured by BMI. Of course, we should note that not all muscle gain in overweight individuals is beneficial as visceral fat can still increase mortality risk.

This leads us to another critical distinction that not all obesity is metabolically unhealthy, and not all normal-weight individuals are in good health. There's a group often referred to as metabolically healthy obese (MHO), people with a high BMI but normal blood pressure, blood sugar, cholesterol, and inflammation markers. They may be physically active and have a favorable fat distribution. In contrast, some people with normal BMI have high levels of visceral fat, poor insulin sensitivity, and systemic inflammation, making them high risk despite appearing "healthy" on paper or from appearance. BMI alone won't capture this difference, and the consequences of misclassification can be serious. When intervention is delayed, the window to prevent chronic disease minimizes.

The real issue we should realize is that BMI is a rough estimate, not a precise tool. It works well for large-scale population screening, but when used to assess individual mortality or morbidity risk, it can be misleading. In today's

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<sup>2</sup> Kamyar Kalantar-Zadeh et al., "The Obesity Paradox in Kidney Disease: How to Reconcile It With Obesity Management," *Kidney International Reports* 2, no. 2 (2017): 271–281, <https://pmc.ncbi.nlm.nih.gov/articles/PMC5399774/>

<sup>3</sup> Neda Naderi et al., "Obesity Paradox in Advanced Kidney Disease: From Bedside to the Bench," *Progress in Cardiovascular Diseases* 61, no. 2 (2018): 168–181, <https://pmc.ncbi.nlm.nih.gov/articles/PMC6131022/>

environment of increasingly sedentary lifestyles, processed food, and rising metabolic disorders, we're seeing a growing disconnect between weight and health. Two people with the same BMI could have entirely different risk profiles. One could be thriving, while the other could be on the brink of disease.

This raises an important question. If we continue relying on BMI alone, how many high-risk individuals are we overlooking and how many low-risk individuals are we penalizing unnecessarily? To better understand and manage real health risk, we'll need to look beyond body size and into what truly matters, which are metabolic health, fat distribution, and functional capacity. The reality is there's no single metric that fits all. Health risk is multi-dimensional, and trying to explain it with one indicator, like BMI, oversimplifies a complex picture. Instead, what we need is a framework-based assessment that integrates multiple health indicators. By combining physiological, behavioral, and metabolic markers, we can uncover the real drivers of mortality and morbidity, and move toward a more accurate, fair, and actionable understanding of health risk.

### **NEW PERSPECTIVES: A MULTI-DIMENSIONAL FRAMEWORK**

Imagine having a framework, not a single indicator, but a layered approach that considers the person's underlying metabolic health, how they move, how they live, and where they come from. We can consider having a framework that is structured through five interconnected layers, which are: (1) body composition, (2) metabolic health, (3) functional ability, (4) behavioral patterns, and (5) demographic context. Through joining together, they offer a more complete view of mortality and morbidity risk, which are multi-factor, evidence-based, and predictive.

#### **FIRST LAYER: BODY COMPOSITION**

We begin with what BMI fails to capture. Body composition refers to the proportion of fat, muscle, and bone in the body, while fat distribution reveals where that fat is stored. Why is this important? Consider two women with a BMI of 23. One has 20% body fat, the other has 38%, concentrated viscerally around her organs. The second individual is at a much higher risk for insulin resistance, cardiovascular disease, and ultimately premature mortality. But her "normal" BMI hides that risk. Incorporating tools like waist-to-hip ratio, body fat percentage via bioimpedance or DEXA, and waist circumference can uncover hidden health risks, allowing us to distinguish whether it's real muscle or something off in the metabolism.

#### **SECOND LAYER: METABOLIC HEALTH**

Next, we move from the "outside" to the "inside." Metabolic health assesses how well the body manages energy, blood sugar regulation, lipid metabolism, and inflammation. Let's imagine two men, both with BMIs around 27. The first has ideal blood glucose, low triglycerides, and healthy HDL cholesterol. The second has prediabetes and elevated c-reactive protein (CRP), a marker of systemic inflammation. Their metabolic trajectories are vastly different and so are their long-term health risks. Metabolic health is assessed through markers like fasting glucose, HbA1c, triglyceride/HDL ratio, blood pressure, and inflammatory biomarkers like CRP. A metabolically unhealthy profile is an important signal of potential increased health risks,<sup>4</sup> even if a person looks "normal" from the outside. This is an emerging phenomenon now known as TOFI: Thin Outside, Fat Inside.

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<sup>4</sup> Xin Zheng et al., "Metabolic Obesity Phenotypes and the Risk of Cancer: A Prospective Study of the Kailuan Cohort," *Frontiers in Endocrinology* 15 (October 16, 2024): Article 1333488, <https://pmc.ncbi.nlm.nih.gov/articles/PMC11521940/>

### THIRD LAYER: FUNCTIONAL ABILITY

Health goes beyond just what's happening within our body, it's also about what we can physically do. Functional ability assesses strength, mobility, and endurance. This becomes more important as we age. Imagine an older adult who has a healthy BMI and good metabolic numbers but struggles to rise from a chair or walk 10 minutes without fatigue. These limitations are possibly early signs of health deterioration. Tests like grip strength, walking speed, sit-to-stand repetitions, and balance evaluations are simple tools in identifying people whose risk might not yet show up in bloodwork.<sup>5</sup> And this isn't just for the elderly. Office workers in their 40s or 50s who sit all day and rarely exercise may have excellent lab results but poor functional ability. Neglecting this aspect means missing signals of physical decline.

### FOURTH LAYER: BEHAVIORAL PATTERNS

What we do everyday shapes what our labs and scans eventually reveal. Two people may have identical clinical profiles, but if one smokes, skips sleep, eats erratically, and experiences chronic stress, while the other exercises regularly, eats a whole-food diet, and sleeps well, the outcome over time could possibly be different. Behavioral pattern assessment includes lifestyle habits like physical activity, nutrition, sleep quality, alcohol use, smoking, and stress management. While this information is self-reported today during health checkups, these metrics are becoming more quantifiable through wearable devices and digital health apps. Could insurers one day use real-time behavioral data to adjust pricing or identify rising risk before disease strikes? This isn't just a possibility. The technology is already here.

### FIFTH LAYER: DEMOGRAPHIC CONTEXT

Finally, we would also need to take a different perspective from the outer context. Demographic context doesn't just describe who a person is. It helps explain why their risk looks the way it does. Factors like ethnicity, education, income, geography, and access to care all play a role in health outcomes. For example, someone living in a walkable suburb may have vastly different cardiovascular risks than a similarly built individual living in a car-dependent city with an abundance of ultra-processed foods. Or think about migration, a person born in the U.S. who relocates to Singapore may shift toward a different lifestyle, different dietary patterns, and routine health screenings, all of which compound over time to reshape their risk. Understanding demographic context helps us personalize interpretations, rather than applying generic cutoffs across diverse populations.

### THE BOTTOM LINE

Each of these layers alone tells only one part of the story. But when viewed together, they offer a rich, refined, and forward-looking picture of an individual's true health projection. Just like a multi-factor insurance model produces more accurate pricing, this five-dimensional framework refines our ability to anticipate mortality and morbidity risk before it becomes visible. I think it is time we evolve from one-size-fits-all indicators to a system that respects human complexity. Because when it comes to predicting risk, sophistication isn't optional, from my perspective, it could possibly be a necessity in the future.

### CONCLUSION: RETHINKING THE WAY FORWARD

Is this framework a completely new idea in the clinical world? Not entirely. Physicians have long assessed multiple dimensions like metabolic panels or functional ability to diagnose and treat disease. I think what's currently missing

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<sup>5</sup> Ronny Bergquist et al., "Performance-Based Clinical Tests of Balance and Muscle Strength Used in Young Seniors: A Systematic Literature Review," *BMC Geriatrics* 19, no. 1 (2019): Article 9, <https://pmc.ncbi.nlm.nih.gov/articles/PMC6327480/>

is the need, or perhaps the ambition, to bring these components together into a structured, proactive assessment unless symptoms are already present until now.


What if this approach became assessable, scalable, and usable within the insurance industry? The implications would be transformative. We could move beyond today's generalized models and toward a precise underwriting approach. One that reflects an individual's actual health profile, not just their age or BMI. This would enable the next evolution, possibly adaptive personalized pricing, where people are neither unfairly penalized nor inadvertently subsidized based on outdated assumptions. In my view on the environment now, health risk is no longer a linear function of age or BMI. It fluctuates with behavior, biology, and lifestyle.

If this framework is successfully implemented, the impact on mortality risk assessment could potentially be profound. We could begin to detect risk patterns that BMI alone would miss, such as individuals with normal weight but poor metabolic health, or those who appear fit yet are experiencing functional decline. This means better alignment between observed health status and actual risk. The result would be more accurate mortality projections, sharper segmentation, and improved portfolio resilience, particularly in aging or chronic diseases. Insurers could shift from reactive to dynamic risk tracking. We wouldn't be catching up to risk after it emerges. We would be anticipating it.

And what might this mean for mortality improvement? It could mean early detection, more accurate health signals, and better-timed interventions could possibly change the curve of population health. Predictability could improve, and so could prevention. This is where we could evolve from being reactive to proactive. The opportunity ahead is not just to assess risk better, but to reshape how we understand and influence it. That's the future worth considering.


\* \* \* \* \*

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## Current Trends in Obesity Management

Sheena Thompson, DHA(c), MPH, CPhT

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### INTRODUCTION

Obesity has become a major health epidemic worldwide that afflicts more than 650 million adults across the world and causes metabolic disorders, cardiovascular diseases, and shortened lifespan (World Health Organization, 2021). Modern obesity treatment has been gravitating towards a personalized and holistic approach that combines new pharmacotherapy, online solutions, and behavior-based approaches. This essay argues that the most promising trends in obesity management involve multicomponent, individualized interventions that leverage medical advances and digital health, yet their effectiveness varies substantially according to population segments such as socioeconomic status, phenotype, and geographic context.

### DISCUSSION

The first notable trend in obesity management is the integration of pharmacotherapy as a central component of treatment. Glucagon-like peptide-1 (GLP-1) receptor agonists, particularly semaglutide, have demonstrated robust results in large-scale trials, achieving approximately 14.9–15% weight reduction over 68 weeks (Frías et al., 2022). More recently, tirzepatide, a dual GLP-1 and gastric inhibitory peptide (GIP) agonist, has outperformed semaglutide in head-to-head comparisons. In a recent phase IIIb SURMOUNT-5 trial, adults receiving tirzepatide lost about 20% of body weight over 72 weeks, compared to 14% with semaglutide (Frías et al., 2022). As per Frías et al. (2022), real-world evidence also suggests higher efficacy with tirzepatide: in a cohort of 18,386 patients, tirzepatide use was associated with significantly greater weight loss than semaglutide.

However, pharmacotherapies are characterized by cost-related constraints, side effects (on the gastrointestinal system), discontinuation rates, and unequal access. As per Frías et al. (2022), these interventions are only used by about 3% of eligible people, with the disparities linked to socioeconomic status, race, and insurance coverage. Therefore, on the one hand, the interventions are scientifically revolutionary, but on the other, fair application is a major challenge.

Bariatric and endoscopic procedures continue to represent a critical strategy for severe obesity management. Bariatric surgery remains the most effective intervention, often yielding 25–35% weight reduction and conferring significant metabolic and mortality benefits (Král et al., 2021). As per Král et al. (2021), studies also reveal that surgical patients may lose five times more weight over three years than those using GLP-1 drugs. For individuals with contraindications or reluctance toward surgery, endoscopic sleeve gastropasty (ESG) provides a less invasive alternative, achieving approximately 13–16% weight loss at 12 months (Král et al., 2021). Collectively, these

procedural approaches remain the gold standard for high-risk patients, particularly when pharmacotherapy or lifestyle interventions prove insufficient.

Digital health (eHealth/mHealth) innovations are another very large trend, particularly among groups with reduced access to conventional care. Systematic reviews demonstrate that eHealth weight-management interventions are superior to no care and similarly effective as face-to-face programs, resulting in a mean of an additional three to 4.3 kg weight loss compared with controls (Kupila et al., 2023). Notably, the eHealth strategies can potentially alleviate the conventional drawbacks of time limits, travel, and financial affordability in the low SES groups. However, inconsistency in the quality and mixed results indicate that human-guided digital intervention is more effective than complete automation (Kupila et al., 2023). Digital solutions likewise encompass behavioral applications (e.g., dietary monitoring and real-time coaching) and remote monitoring through wearable devices, which have had encouraging results improving self-management behaviors.

Behavioral and lifestyle-modification interventions are traditional and have been developed with modifications to target individual needs depending on age, obesity phenotype, and comorbidities. The current dietary guidelines suggest interventions focused on reduced energy intake (calorie restriction) and increased physical activity that are expected to lead to 5–10% weight reduction to achieve clinically meaningful changes in metabolism (Jensen et al., 2014). Pediatrics and adolescents now have special mHealth applications, modeled with AI-feedback and wearable data, which may implement timely interventions in case of complications (Kupila et al., 2023). Phenotype-based strategies, similarly, by subgrouping people into those with metabolically healthy obesity and insulin-resistant phenotypes, are informing outpatient therapeutic choices, such as the choice of specific pharmacotherapy, such as GLP-1 RAs or combinatorial drugs.

When comparing these approaches across population segments, disparities are evident. Individuals of lower SES benefit from eHealth solutions that circumvent structural barriers, and community-based efforts have yielded short-term gains in underserved groups (Myers-Ingram et al., 2023). Socioeconomic and digital gaps, however, can diminish the interaction with app-based tools. Systematic disparities are also evident in the access to costly anti-obesity medicines, which lie in favor of individuals with higher incomes (Myers-Ingram et al., 2023). Individual characteristics like age factor also play a role in treatment, as adolescents can interact well with gamified mHealth formats, but may not receive insurance coverage for pharmacotherapy. Bariatric surgery or ESG is more effective and commonly used in individuals who are older and have severe obesity (Král et al., 2021). Moreover, research suggests that advanced drug treatments are not as accessible to people of diverse backgrounds or living in disparate geographic locations, particularly low-income neighborhoods (Wilding et al., 2021).

Regarding effectiveness, pharmacotherapy with dual agonists appears to lead the pack, yielding up to 20–21% weight loss in trials and real-world settings (Frías et al., 2022). Bariatric surgery has been shown to achieve the most substantial reductions (25–35%), though it carries greater procedural risks and resource requirements (Král et al., 2021). ESG appears to offer moderate efficacy (~13–16%) with better safety and recovery profiles (Král et al., 2021). Digital interventions have been found to produce modest weight loss (approximately 3–5 kg), particularly when combined with periodic professional support (Kupila et al., 2023). Evidence suggests that all approaches benefit from ongoing lifestyle support, especially to maintain weight loss and address behavioral relapse. However, differential adherence rates, affordability, and access result in considerable variability in outcomes based on SES, geography, and population segment.

## CONCLUSION

The latest tendencies in obesity care indicate a paradigm shift towards integrated, personalized, and technology-aided care. The most successful intervention is pharmacologic therapy, especially dual GLP-1/GIP agonists and developed GLP-1 agents, which are seen to open a new era in medical obesity management. Surgery and endoscopy are still providing transformative effects as well. Similarly, digital health interventions are used to increase

accessibility. Nonetheless, individual modalities pose different obstacles, whether through expenses, compliance, digital competency, or access, which contributes to variation in efficiency across demographic groups.

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