

# BENEATH THE SURFACE

## THE HIDDEN SOCIOECONOMIC IMPACTS OF WEIGHT LOSS

Report for the:  
**United Arab Emirates**  
Kingdom of Saudi Arabia

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**W/S**  
WHITESHIELD

*Lilly*  
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# Executive Summary

## SUMMARY: MEDICAL INNOVATION, WEIGHT LOSS, AND THE HIDDEN COUNTRY-WIDE SOCIOECONOMIC BENEFITS

In recent years, significant advancements in the obesity pharmacotherapy have yielded new and more effective medications. These developments have the potential to revolutionize obesity management and achieve sustainable weight loss, ultimately reducing obesity rates<sup>1</sup>.

This country-level perspective departs from the traditional narrow lens of measuring obesity's impact on healthcare outcomes and spending.

### **Obesity affects 1 in 8 people worldwide<sup>2</sup>, including 1 in 3 adults in the UAE<sup>3</sup>; could innovative weight loss treatments be the solution?**

Global obesity rates have doubled since 1990 and now affect more than 890 million adults worldwide<sup>4</sup>, and are likely to increase further as people are less physically active, have poorer diets, and are ageing. If the current trend continues, global rates of overweight and obese adults could rise to about 57.4% for men and 60.3% for women by 2050<sup>5</sup>. UAE adult obesity rates are more than double the global average, with Emiratis and women being disproportionately impacted<sup>6</sup>.

The challenges from obesity are clear. Adults living with obesity can lose up to eight years of life expectancy due to obesity-related conditions, such as Type 2 diabetes<sup>7</sup>. Quality of life also diminishes and people living with obesity may lose up to 18 quality life years<sup>8</sup>. Obesity is linked to increased rates of depression and poorer mental health, which in turn reduces social engagement, physical activity, and overall productivity<sup>9</sup>.

Past policy efforts to contain obesity have had little success. Multiple factors contribute to obesity, such as genetics, environment, and medical conditions, which complicate effective obesity-reduction efforts<sup>10</sup>. New innovative

treatments, such as incretin-based anti-obesity medications, provide people living with obesity an effective way to significantly lose weight, sometimes up to 20% of total body weight<sup>11</sup>. Adoption of these innovative treatments depends on accessibility, which is usually driven by physician recommendations, availability of the treatment, and reimbursement coverage.

### **The benefits of weight loss at a country scale deserve a first of its kind holistic examination**

The impact of weight loss on people is well known: Obesity related conditions (e.g., cardiometabolic conditions)<sup>12</sup> are prevented and people spend less on healthcare, thereby reducing financial burdens, are more productive at work, and change their lifestyle. The straightforward estimated decrease in healthcare spending from losing weight and even the cost savings from a person being less sick are clear. But the benefits at the country level are not yet well understood, as the impact of a large share of society moving from living with obesity to losing weight has wide ranging effects. For example:

- A person who loses weight is more productive at work, which boosts economy-wide production and output, with knock-on effects across many economic sectors<sup>13</sup>.
- Young adults with lower weight may be more inclined to attend university and get higher-skill jobs, increasing a country's pool of educated labour<sup>14</sup>.

These dynamic interactions need to be modelled together as a system to understand the true country impact of weight loss, particularly if a large share of the population significantly loses weight.

## UAE: Three scenarios for the future of weight loss

Comparing the current projected trajectory of obesity in the UAE until 2031 with two weight loss scenarios, based on the reach of obesity interventions, shows the extent of the benefits that extreme weight loss can have on a country's economy and society:

**Status quo:** Obesity evolves at its historical pace, projected to stagnate at nearly a 32% prevalence, which is due to the continued influx into the UAE of young active migrant populations, who are less likely to live with obesity

**Moderate intervention:** 380,000 adults could transition out of obesity by 2031, as innovative weight loss solutions reach 15% of adults living with obesity.

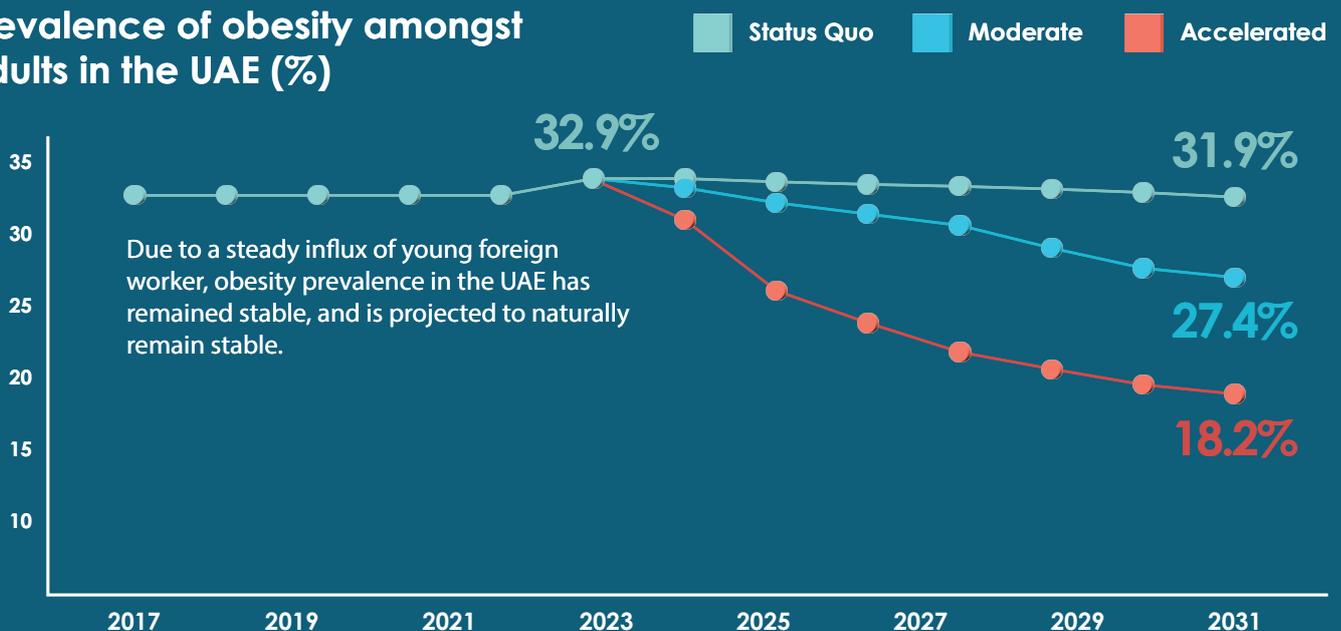
**Accelerated intervention:** 1,200,000 adults could transition out of obesity by 2031, as innovative weight loss solutions reach 57% of adults living with obesity.

## Reducing weight at a national scale, particularly in an accelerated intervention, could transform the UAE across 5 areas

1,200,000 adults transitioning out of obesity, in an accelerated scenario, would transform the UAE across five areas:

- **Health:** Obesity-related illnesses, such as diabetes and 13 types of cancer, are estimated to decline due to lower demand for medical treatments, hospitalizations, and long-term care, reducing the burden on healthcare systems and promoting longer, healthier lives<sup>15</sup>. In the UAE, up to \$1.5 Bn in healthcare costs to the government and individuals could be averted by 2031, equivalent to nearly one full year of the public expenditure on healthcare. Life expectancy may increase by 2.4 years for nearly 1.2 million people previously living with obesity.

## Prevalence of obesity amongst adults in the UAE (%)



- **Economy:** People overcoming obesity are typically more productive and have fewer health-related absences, in part due to improved mental health<sup>16</sup>. GDP growth could rise on average by one percentage points above the projected growth rate until 2031, reaching \$790 Bn by 2031.
- **Society:** Adults living with obesity may be hindered from conceiving or carrying pregnancy to term<sup>17</sup>. Freed from obesity-related conditions, up to 75,000 additional births may take place, cumulatively by 2031.
- **Education:** Students no longer affected by obesity have improved physical and mental well-being and are shown to better perform academically<sup>18</sup>.

Bachelor's program enrollments could grow by over 2,000 additional students by 2031

- **Security:** Improving physical fitness among young Emiratis can expand the pool of people eligible for military service<sup>19</sup>. By 2031, up to 5,700 additional Emirati youth could meet the necessary criteria in an accelerated intervention scenario.

Even in the moderate weight loss scenario, benefits remain significant for the UAE, with positive impacts across all five areas. Due to novel weight loss solutions, these benefits, at whatever level they are realised, are in reach in only a few years. Policymakers now have a unique opportunity to deploy these tools in the fight against obesity.



# Future Scenarios

The introduction of innovative weight loss solutions may reshape societies.

## STATUS QUO

Obesity continues to evolve at its historical pace, with prevalence largely stagnating. Other scenarios are compared to this baseline to determine the socioeconomic impacts of weight loss.

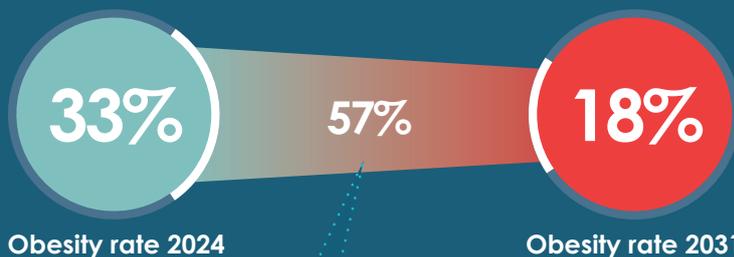
## MODERATE INTERVENTION SCENARIO



**-380,000**

adults living with obesity

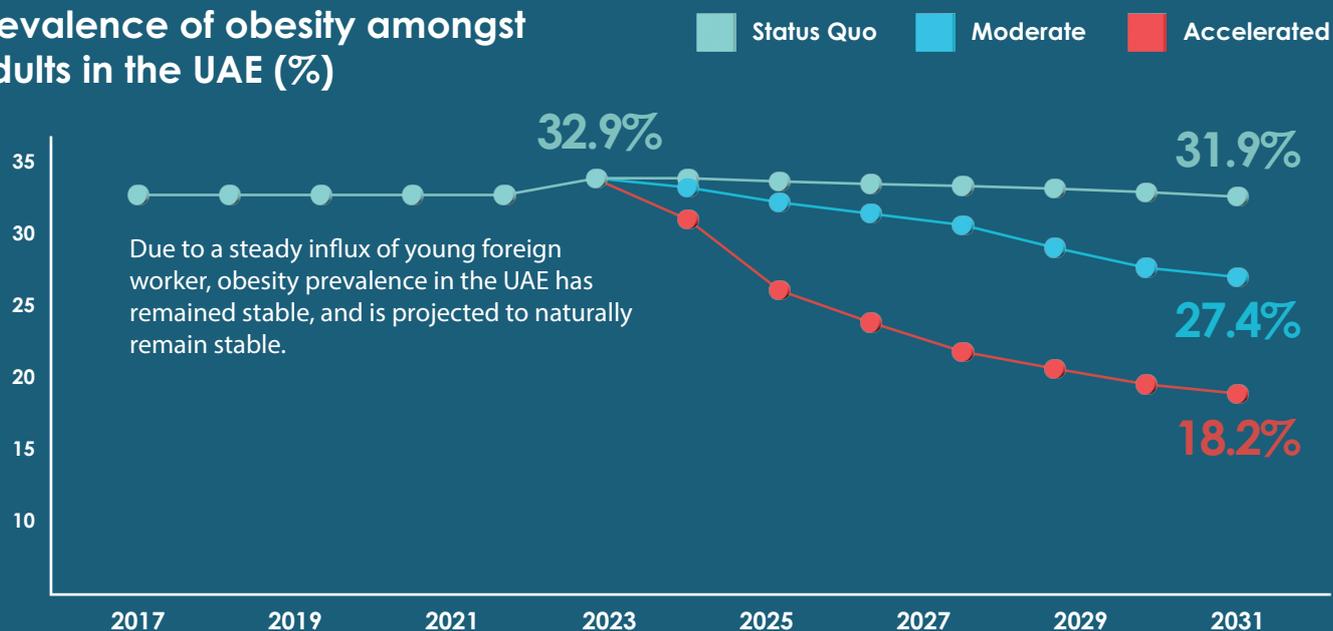
## ACCELERATED INTERVENTION SCENARIO



**-1,200,000**

adults living with obesity

## Prevalence of obesity amongst adults in the UAE (%)



# Impacts of obesity and weight loss

Conventional  
Perspective



Health outcomes  
and health care  
savings

Economy



Society



Education



Security



Holistic  
Perspective



# Health

Weight loss helps individuals lead longer, healthier lives

Obesity rate by  
weight loss scenario  
**2031**



Status Quo

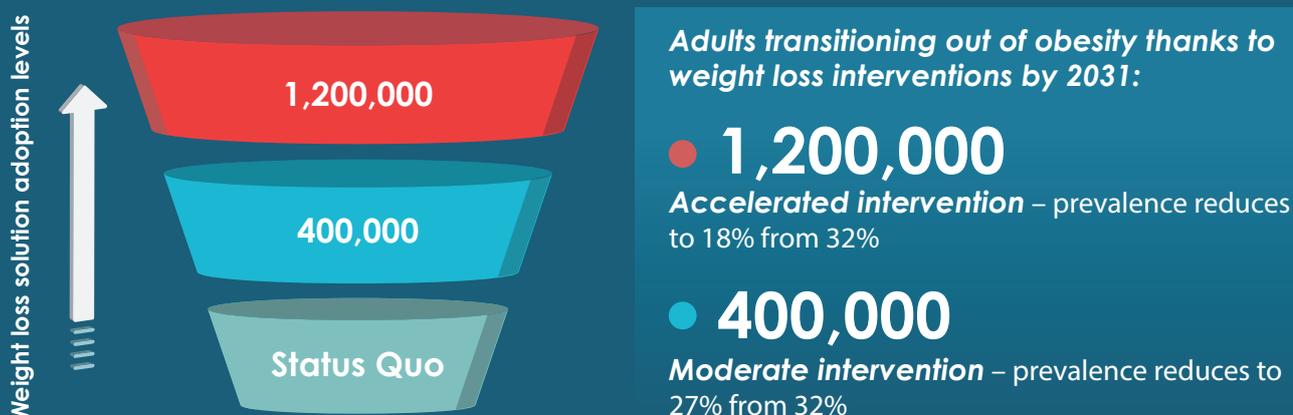


Moderate



Accelerated

1.2 million people transition out of obesity in a high adoption scenario...



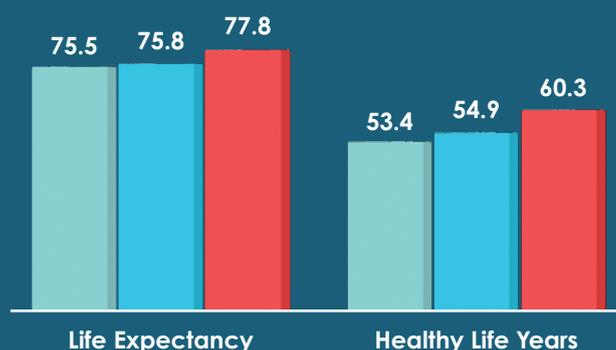
...this substantially reduces comorbidities and lengthens healthy life by up to 6.8 years...



**+6.8 years**

of healthy life for each adult that previously lived with obesity

Population-wide Life Expectancy and Healthy Life years<sup>1</sup> (2031)



...and frees up to \$1.5 Bn of healthcare resources to be reallocated



Cumulative healthcare savings<sup>2</sup>

**Up to \$1.5 Bn**

In the high adoption scenario - where prevalence reduces from 32% to 18%



# Economy

1.2 Mn people no longer suffer from obesity and realize their full economic potential

Obesity rate by  
weight loss scenario  
**2031**



Status Quo

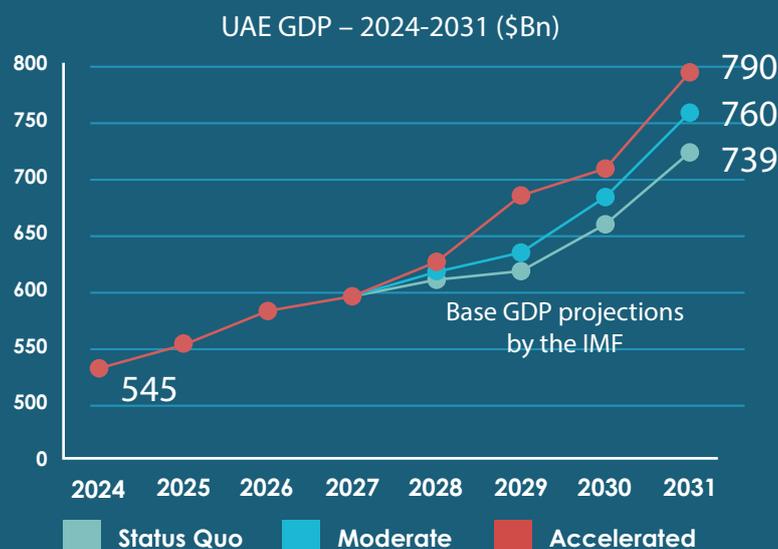


Moderate



Accelerated

A healthier population could boost GDP growth by an additional 1.4%...



Addition to GDP in 2031



**+\$51 Bn**

Accelerated Intervention



**+\$21 Bn**

Moderate Intervention

...due to healthier workers who gain up to 6 days of productive work<sup>2</sup> per year...



**+2.1 to 5**

Days of productive work per previously obese worker



**+\$358 to \$772** /year

Average increase in annual income for the population by 2031

...a 6.3% yearly increase in consumption drives the economy forward and lifts VAT collections

Increase in Consumption<sup>3</sup> (\$ Bn)

**+\$42 Bn**



**+\$123 Bn**

cumulative gain driven by increased productivity and higher income



Up to

**+\$2.1 Bn**

Yearly increase in VAT receipts by 2031 in the high adoption scenario as 1.15 Mn people experience weight loss

1. International Monetary Fund, Whiteshield Analysis

2. Sheehan, Rasmussen, and Sweeny, "The Impact of Health on Worker Attendance and Productivity in the APEC Region"

3. Obesity Drugs' Ripple Effects, Morgan Stanley



# Society

Healthy individuals contribute to a more cohesive and prosperous society

Obesity rate by weight loss scenario  
**2031**



Status Quo



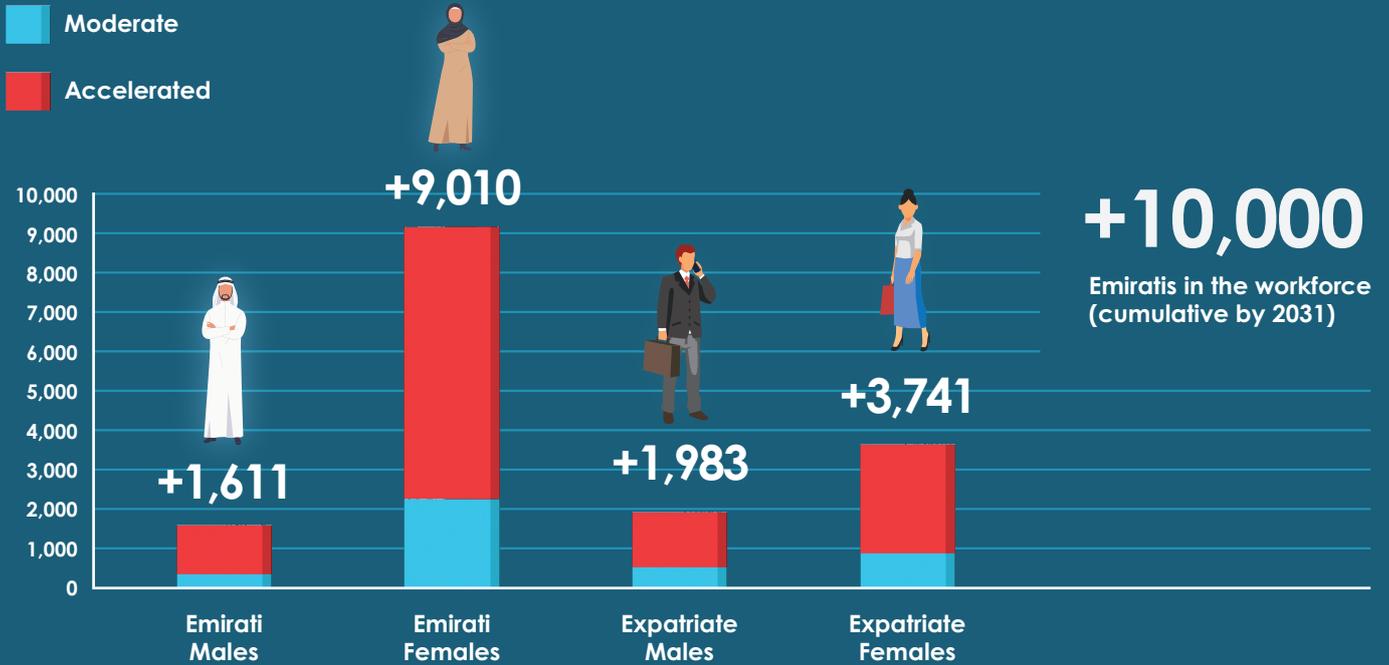
Moderate



Accelerated

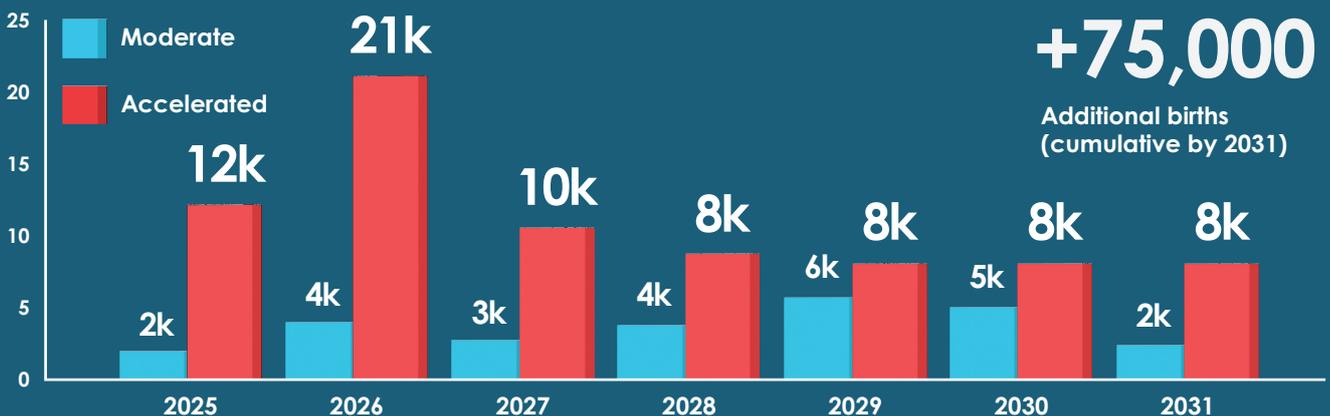
**10,000**

Over 10,000 Emiratis are empowered to join the workforce. Addition to the workforce by 2031<sup>(1)</sup>



**75,000**

Combined with infertility dropping, leading to 75,000 additional births<sup>(2)</sup>  
Additional births due to reduction in the infertile population thanks to weight loss (000s)



1. Lee et al., "Impact of Obesity on Employment and Wages among Young Adults"  
2. The Impact of Obesity on Reproductive Health and Pregnancy Outcomes - PMC



# Education

A fitter youth is empowered to take on and complete higher education

Obesity rate by weight loss scenario  
**2031**



Status Quo



Moderate



Accelerated

Healthy youth are more likely to undertake higher education...



Weight loss in obesity drives higher education<sup>1</sup>

Additional students in bachelors' programs (in 2031)



**+2,000** in accelerated intervention



**+600** in moderate intervention

...and to complete their diploma, boosting the UAE's Education Index ranking



**+3,000**

Up to 3,130 more students finish their bachelors program by 2031

**DROPOUT RATE**

**14.0% → 12.6%**

in high adoption –  
As 148,000 youth are no longer obese

UNDP Human Development Index (Education rankings) – (2024-2031)

20<sup>th</sup> UAE (2031)

21<sup>st</sup> UAE (2024)

21<sup>st</sup> Latvia

21<sup>st</sup> Hong Kong

21<sup>st</sup> Argentina

1. Cohen et al., "Educational Attainment and Obesity"



# Security

The police and military forces have an expanded pool of service-ready candidates

Obesity rate by weight loss scenario  
**2031**



Status Quo



Moderate



Accelerated

**5,700** Weight loss helps 5,700+ young Emirati males to become physically and mentally fit...

Increased talent pool of security forces help safeguard the UAE

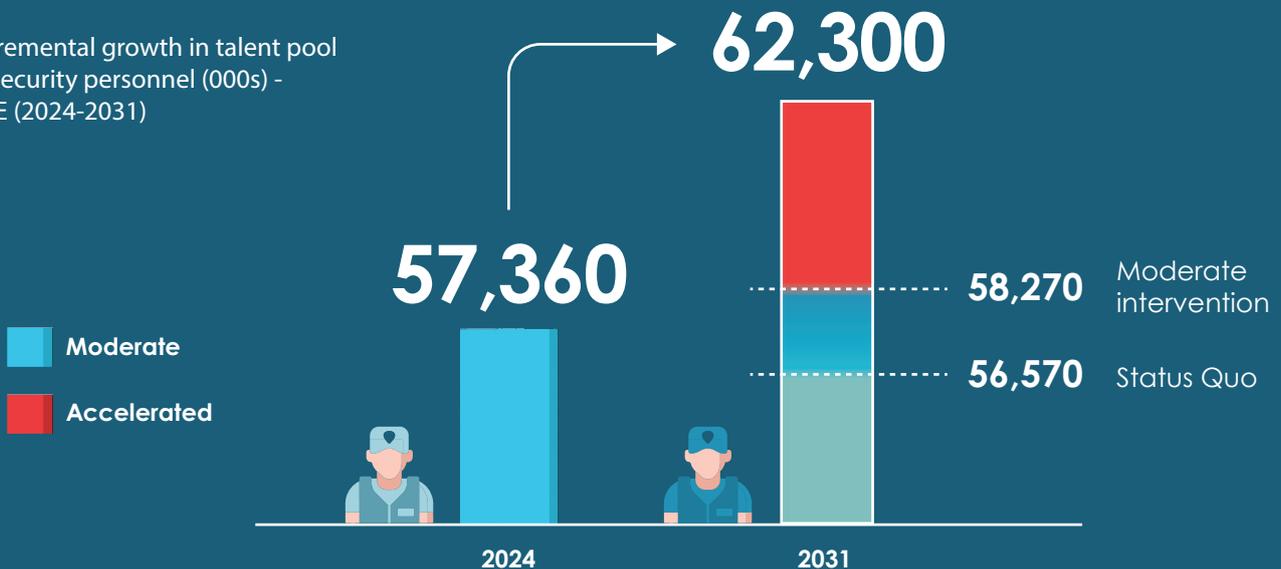


Increase in service-ready pool by 2031<sup>1</sup>



...boosting the number of fit citizens by 10%

Incremental growth in talent pool of security personnel (000s) - UAE (2024-2031)



1. Obesity in the Military, The George Washington University; Whiteshield Analysis.

Table 1: Results overview

Category	Indicator (by 2031)	Measure	Status Quo (2024)	Base Scenario (2031)	Moderate Intervention (2031)	Accelerated Intervention (2031)
<b>Scenarios</b>	Adoption of weight loss interventions	Adoption among adults living with obesity	3%	0%	15%	57%
 <b>Health</b>	Prevalence of Obesity	%	32.8%	31.9%	27%	18%
	Healthcare costs	\$ Bn	4.38	4.48	(0.14)	(0.37)
	Life expectancy	Years (adults living with obesity)	75.5	75.5	+0.3 years	+2.4 years
	QALY savings	Healthy Life Years (adults living with obesity)	53.4	53.4	+1.5 years	+6.8 years
 <b>Economy</b>	GDP	\$ Bn	545	739	+21	+51
	GDP growth rate	%	5.1%	4.3%	+0.7% points	+1.5% points
	Productivity savings	Days per year per adult previously living with obesity	260	260	+2	+5
	Government revenue (VAT only)	\$ Bn	12	15.3	+0.9	+2.1
	Consumption	\$ Bn	226	306	+17	+42
	Individual income	\$	49,040	52,057	+358	+722
 <b>Society</b>	Total births	#	99,290	91,530	+2,289	+7,778
	Additions to workforce	#	7.2 Mn	9.1 Mn	+5,403	+16,638
	Women in the workforce	#	1,456,000	1,820,000	+4,128	+12,744
	Youth in the workforce	#	1,800,000	2,275,000	+2,700	+8,319
 <b>Education</b>	Bachelor's enrolment	#	250,000	253,000	+667	+2,027
	Students dropping out	#	35,000	35,280	(1,200)	(3,000)
 <b>Security</b>	Security Talent Pool	% of healthy weight young Emirati males	57,360	56,570	+1,700	+5,730

# Context: Implications of obesity

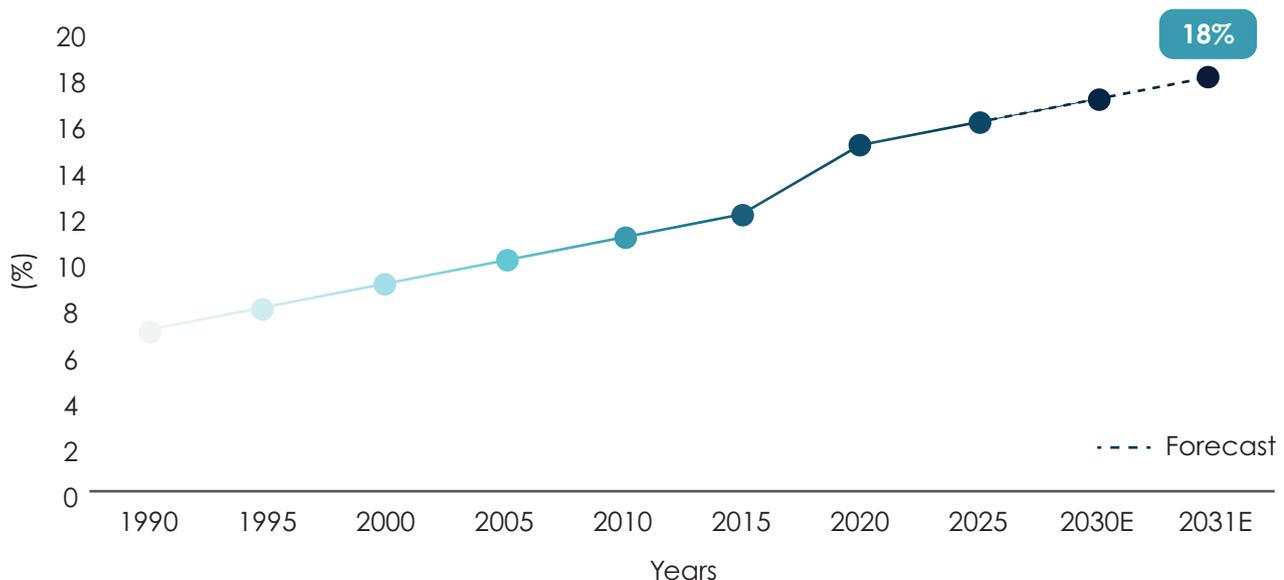
## GLOBAL EPIDEMIC

MORE THAN 1 BN PEOPLE WILL LIVE WITH OBESITY BY 2031

Obesity is a global epidemic, with 15% of the global population or 890 million adults suffering from obesity<sup>20</sup>. **The prevalence of obesity has increased from 6.8% in 1990 to 15% in 2020 and is expected to affect 18% of the adult population by 2031<sup>21</sup>.** According to the World Health Organization (WHO), a person living with obesity has a body mass index

(BMI) greater than 30 – for example, someone 170 cm tall, weighing 87 kilograms or more. Individuals living with obesity are likely to earn less, to attend fewer years of school, to have fewer children, to have higher rates of unemployment, and to have a shorter life expectancy than people who do not suffer from obesity<sup>22</sup>.

**Figure 1: Global Prevalence of Obesity – WHO (1990-2035)**



The prevalence of obesity varies between countries, genders, and incomes, though across all demographics obesity rates are rising. The global obesity prevalence among adult men was 14% in 2022, compared to 18.5% for women<sup>23</sup>. Geographically, obesity prevalence varies from as low as 8.8% in South Korea to as high as 41% in the United States<sup>24</sup>.

However, obesity prevalence in certain countries, such as the United States has started showing a surprising trend. For the first time in a decade, the country's prevalence of obesity decreased, from 41.9% to 40.3%<sup>25</sup>. This decline is particularly interesting given the US's long-standing struggle with high obesity rates. It suggests that recent public health initiatives,

increased awareness, and advancements in weight management strategies may be beginning to have a positive impact. **The downwards variation in obesity prevalence in the US demonstrates that public health improvements are achievable with concentrated efforts and interventions.**

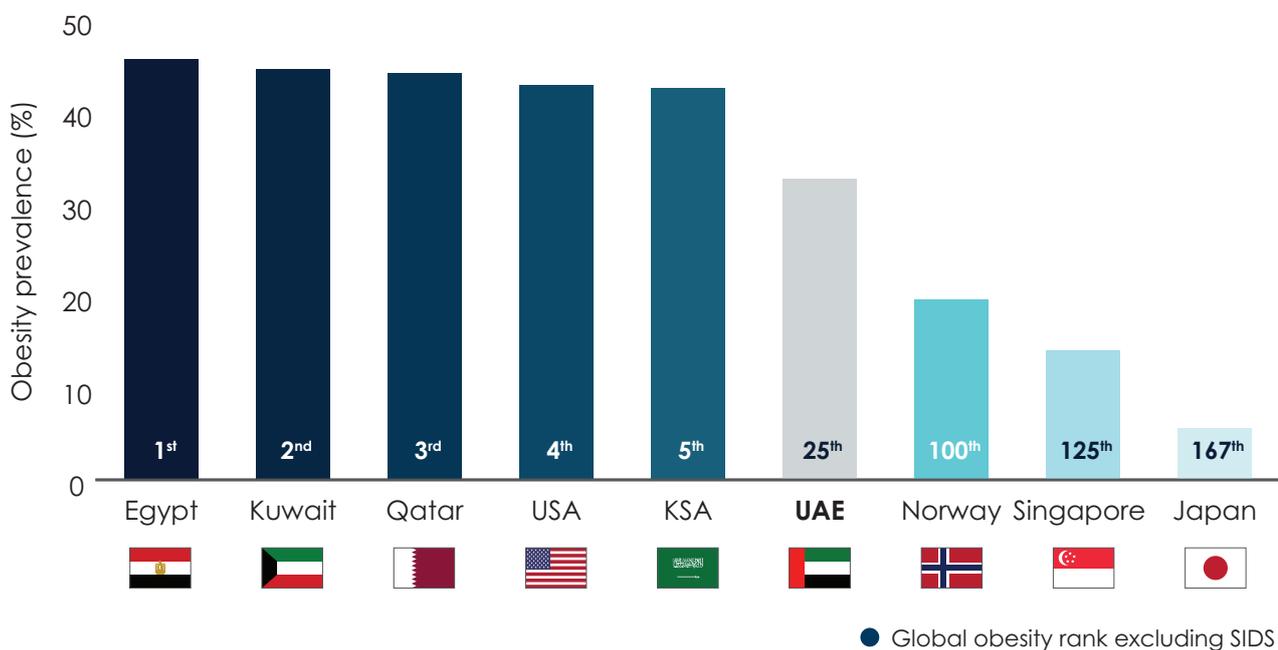
While obesity has multiple contributing factors (e.g., genetics, specific conditions, etc.), an imbalance between caloric intake and expenditure plays a key role<sup>25</sup>, particularly in the UAE, where environmental factors further exacerbate the issue (see environmental drivers of obesity in the UAE on the following page).

## UAE: 33% OF ADULTS LIVE WITH OBESITY

The UAE is ranked 25th in global obesity prevalence: 33% of adults live with obesity. The consequences of obesity

are strongly felt in the Emirates, and prevalence is still much higher than that of other developed nations.

**Figure 2: Obesity prevalence and world ranking 2024 (excluding Small Developing Island Nations)**



### Increasing obesity trend:

Obesity rates in the UAE have been increasing over time. In 2000, the prevalence of obesity among the adult population was 22%, significantly increasing to 33% in 2024.

### Obesity rates vary between nationals and expatriates:

UAE nationals have a higher obesity prevalence than expatriates, 47% compared to 31%. The higher obesity prevalence among UAE nationals compared to expatriates could be attributed to a combination of genetic predispositions, lifestyle habits, socio-economic conditions, environmental influences, and urbanization<sup>26</sup>. These factors collectively create a more obesogenic environment for UAE nationals, leading to higher obesity morbidity.

### Gender also leads to varying obesity levels:

Women in the UAE also suffer from higher obesity rates, at 39% compared to 30% among men, which is in line with global trends of higher obesity rates among women. This may be due to various physiological factors such as loss of muscle mass, pregnancy and hormonal changes that affect women. Additionally, social dynamics may influence women's participation in fitness facilities and recreational activities, which can contribute to the higher prevalence of obesity among women<sup>27</sup>.

### Variation in obesity level among Emirates:

Obesity prevalence in the UAE differs between emirates- from 22% in Dubai to 39% in Ajman and Fujairah. Cultural factors and variations in population demographics across these emirates, such as the percentage of expatriate population,

which usually have a lower prevalence of obesity compared to nationals, contribute to the higher obesity rates observed in Ajman and Fujairah.

**In the UAE, lifestyle is a particularly important driver of obesity.**

The car-centric lifestyle, low levels of physical activity

(58% of adults reported being inactive<sup>28</sup>), and high caloric intake due to an abundance of fast food options as well as the local cuisine's preference for high fat and sugar content can all contribute to an environment promoting obesity.

## CHALLENGE: LIMITED UNDERSTANDING OF THE BENEFITS OF WEIGHT LOSS

Although the negative impacts of obesity on society are well studied, one common prism to analyze the consequences of obesity is through its healthcare-related costs. Obesity-related comorbidities, including Type 2 diabetes, cardiovascular diseases, certain cancers and musculoskeletal disorders like osteoarthritis, require long-term medical management, leading to high healthcare costs<sup>29</sup>.

- Globally, obesity related medical costs were estimated at **~\$820 Bn** in 2024, which is 20% of all healthcare costs<sup>30</sup>
- In the UAE, the healthcare costs attributable to obesity are expected to reach **\$4.5 Bn by 2035**, around 0.5% of GDP<sup>31</sup>

**Impact assessments of obesity reduction typically focus on comparing the cost of weight loss solutions to the costs of treatment for obesity-related conditions.** These assessments may expand to touch on the loss of productivity due to increased absenteeism and presenteeism. For example, the World Obesity Foundation has led impact studies that cover medical costs, premature mortality and productivity costs<sup>32</sup>.

**In this paradigm, interventions that may have a highly positive societal impact might still appear to be cost ineffective.** Indeed, health-related challenges are the tip of the societal iceberg that is obesity. Understanding the links between weight and socioeconomic impact is key to informing decision-making, and correctly framing obesity and its consequences beyond healthcare.

**This study encompasses a “whole-of-society” approach to bring a novel, and more complete, perspective on the societal benefits of weight loss.**

To achieve this, the study segments these benefits into five key themes, aiming to capture the primary societal dimensions influenced by weight loss, consistent with scientific literature on the subject.



### Health:

Reduction in obesity may lower the prevalence and incidence of chronic diseases, enhances mental well-being, improving quality of life and longevity<sup>33</sup>.



### Economy:

Improved health could support greater workforce participation, enhances productivity, and drives economic growth. As consumption patterns evolve, sectors such as retail and hospitality may benefit, while increased economic activity could also contribute to government revenues through higher tax collection<sup>34</sup>.



### Society:

Promoting overall health and well-being could support reproductive health, help maintain demographic balance, and contribute to intergenerational equity and sustainable development<sup>35</sup>.



### Education:

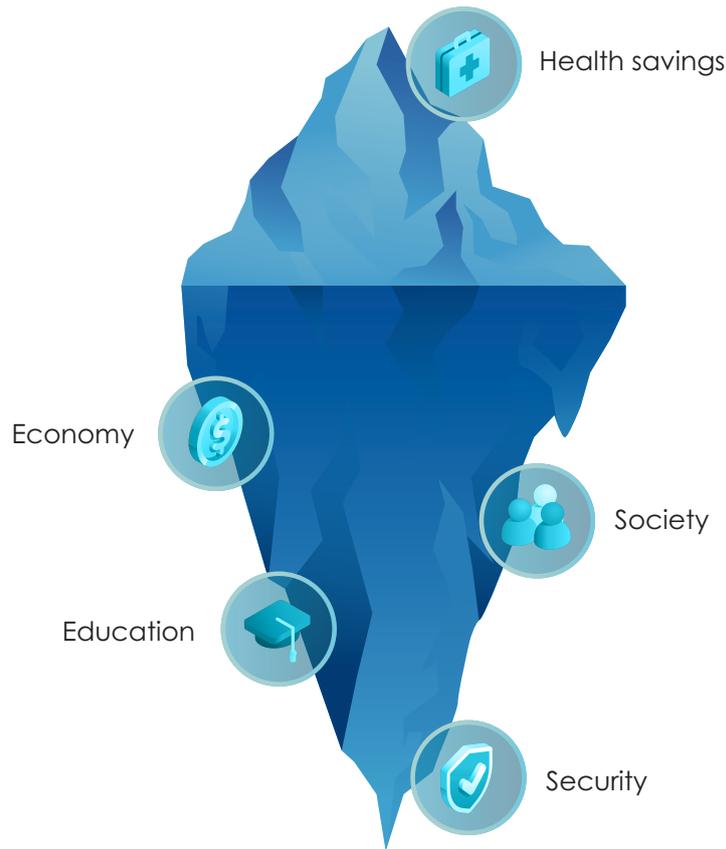
Improved health outcomes among students could help achieve better academic outcomes, bolstering the UAE's human capital<sup>36</sup>.



### Security:

Supporting physical fitness initiatives could broaden the pool of individuals eligible for military service and helps reduce the risk of training-related injuries<sup>37</sup>.

**Figure 3: Impacts of obesity and weight loss**



## INNOVATION: A NEW OPTION TO TACKLE WEIGHT LOSS

**Policymakers have long attempted to reduce the prevalence of obesity**, oftentimes with communication campaigns, supporting healthy eating and lifestyles, or through medical interventions, **but these interventions do not seem to have significantly reduced obesity prevalence**<sup>38</sup>.

The UAE government, at the federal and local levels, has undertaken various initiatives such as the National Program to Combat Obesity among Children and Adolescents, National UAE Taskforce on Obesity, Together We Move campaign and the Makom initiative. Rates of obesity in the country have remained stagnant over the past few years, which may signal success in stopping the progression of obesity prevalence. However, more can be done to significantly reduce obesity<sup>39</sup>.

Medical interventions for obesity can have high costs and carry significant risks. For example, while bariatric surgery is highly effective it is also extremely costly, only applicable to those living the most severe levels of obesity, and carries risks of complication<sup>40</sup>. Less invasive interventions such as conventional weight loss medicines lacked effectiveness and were often associated with strong side effects<sup>41</sup>.

To combat obesity, innovative weight loss solutions, such as GLP-1 agonists, have recently been made available to adults living with obesity. These novel solutions are transforming obesity management, offering more effective results beyond traditional lifestyle interventions<sup>42</sup>. These solutions include incretin-based GLP-1 medications, which leverage the body's natural metabolic pathways to regulate appetite and improve energy balance.

**Innovative weight loss solutions were recently adopted at scale in the United States, which may be responsible for the first observed drop in obesity prevalence since 2012 in the country**<sup>43</sup>. It is important to emphasize, however, that medication is only one tool in the broader obesity care toolkit. Effective obesity management should be grounded in a holistic, patient-centred approach—one that combines lifestyle modification, behavioural support, pharmacotherapy, and, where appropriate, surgical options. Ultimately, treatment decisions should be made collaboratively between healthcare providers and patients, ensuring alignment with each individual's needs, preferences, and clinical circumstances.

# Methodology

## Using advanced economic analysis

Recognizing that most traditional research focuses primarily on healthcare costs and outcomes, this study aims to provide a more holistic understanding of the full socioeconomic benefits of weight loss at the population level. A broader perspective may enable readers to better grasp the

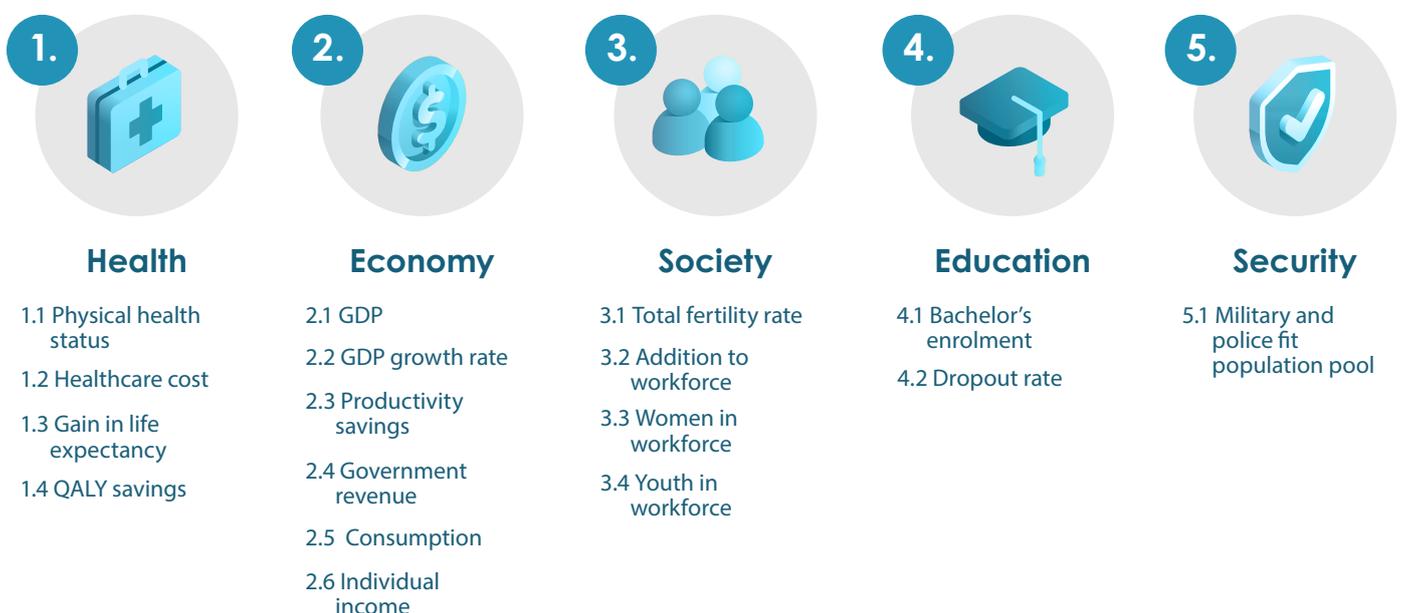
complexity of obesity, which spans all demographic groups and has lifelong implications for health, education, employment, and community engagement. The following section outlines the methodology behind this research, more details can be found in the appendix of this report.

### CAPTURING SHIFTS IN SOCIETAL VARIABLES ACROSS COHORTS

To understand the full socio-economic impact of weight loss and inform policy makers, five societal themes capturing 18 variables were assessed. In addition, each of the variables was examined by:

- Nationality (UAE national, expatriate)
- Gender (female, male)
- Age (youth 18-29 years old, core working age 30-59 years old)

**Figure 4: 5 societal themes and 18 socioeconomic indicators**





## MODELLING THE IMPACT OF WEIGHT LOSS ON SOCIETY

Figure 5: 4-step approach



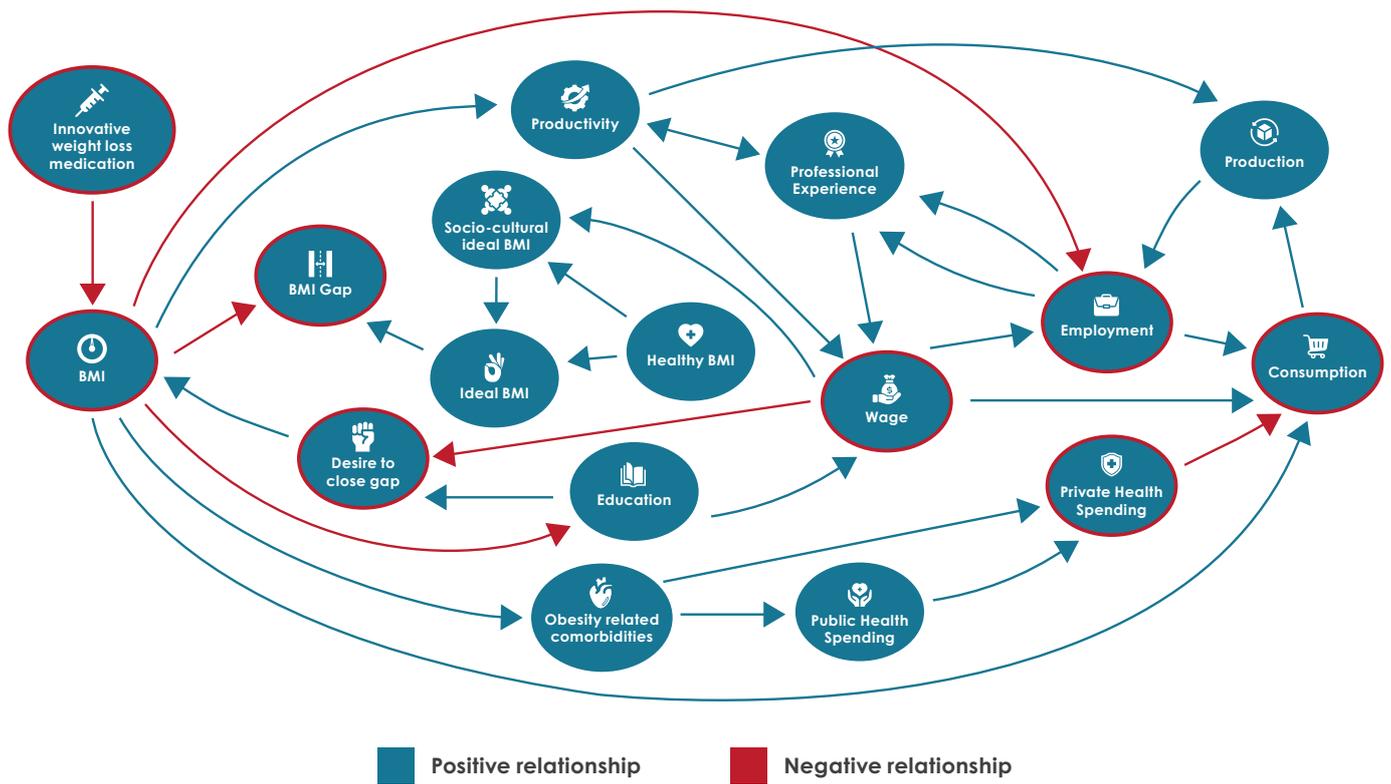
### a. Mapping the links

Studies examining obesity's impact typically rely on a one-directional approach. For instance, productivity losses due to obesity are usually estimated by multiplying the number of individuals living with obesity by a fixed monetary cost per person. These methods fail to link the underlying drivers of weight loss that also improve productivity with broader socio-economic factors, such as educational attainment or fertility rates.

**A system-thinking approach that maps the relationships between socio-economic variables can uncover knock-on effects and reinforcing behavioral loops driven by weight loss.**

The uptake of novel weight loss solutions among adults living with obesity, and the subsequent weight loss, triggers a cascade of socio-economic effects<sup>44</sup>, based on links established in scientific literature. These impacts are modeled over time. These impacts translate to changes in socio-economic variables, which are compared to a status quo scenario, where no weight loss solutions are introduced. The resulting findings of this analysis are discussed throughout the report.

Figure 6: Conceptual and simplified depiction of the societal impact channels



## b. Defining three weight loss scenarios

Three main weight loss scenarios have been defined for the UAE, a Status quo scenario, a Moderate intervention scenario and an Accelerated intervention scenario.

**Table 1 : Description of weight loss scenarios**

Indicator (2031)	Base scenario	Moderate intervention scenario	Accelerated intervention scenario
<b>Description</b>	No weight loss interventions are implemented Obesity prevalence progresses at current trajectory	Limited intervention towards weight loss Obesity declines but at a slow rate	Aggressive weight loss interventions are implemented Obesity declines at a rapid pace
<b>Intervention rationale</b>	N.A	Modelled on the uptake of semaglutide for type 2 diabetes treatment in the US	Based on the uptake trend observed in statin usage for cholesterol management as well as diabetes medication prescription in the UK
<b>Intervention curve</b>	No intervention takes place	15% of the target population by 2031	57% of the target population by 2031
<b>Obesity prevalence (Adult population)</b>	32%	27%	18%
<b>No. of adults transitioning out of obesity by 2031</b>	0	380,858	1,154,979
<b>Population Coverage</b>	N.A	All	All
<b>Regional Coverage</b>	N.A	All 7 emirates are covered equally	All 7 emirates are covered equally

In these scenarios, the population receiving innovative weight loss solutions consists solely of the adults suffering from obesity in the UAE. The period between 2025-2031 was chosen considering the 'We the UAE 2031' vision, which has set specific aims for various socio-economic indicators in

the country. Baseline data for scenarios was collected from national statistics agencies, the World Health Organization (WHO)<sup>45</sup>, the United Nations (UN) and academic literature. Variables, particularly obesity prevalence, were broken down by nationality, gender, and age.

## c. Applying an analytical approach

Figure 7: 3-step approach



### 1. Define historical prevalence trend:

A Markov Model traced the evolution of obesity prevalence across demographic groups (using over 500,000 empirical observations). This was used to calibrate the System Dynamics model based on measured historical data.

### 2. Model societal benefits of weight loss:

The System Dynamics Model interlinks obesity drivers with socio-economic indicators, and outputs the shifts in these variables based on the three weight loss scenarios.

### 3. Validate results:

Fixed-effects regressions were conducted to test the effect of BMI on socio-economic indicators, such as GDP. The dataset used for this analysis encompasses eleven countries (selected to encompass different levels of development and geographies)—United States, United Kingdom, United Arab Emirates, Kingdom of Saudi Arabia, Singapore, Iceland, Switzerland, Morocco, Pakistan, Chile, and Slovenia—over the period 2000–2016, capturing a timespan during which obesity and its associated economic implications have become increasingly salient. All key variables displayed statistically significant results, supporting the validity of the System Dynamics model results.

## d. Contextualizing with citizen voice

### 1. Sentiment analysis:

Advanced natural language processing techniques were utilized to conduct a sentiment analysis on over 300,000 social media posts. This analysis identified public attitudes, opinions, and emotions related to obesity and weight loss initiatives, providing valuable insights into societal perceptions and acceptance of various interventions.

### 2. Contextualize with citizen voice:

A sentiment analysis assessed changes in patients' quality of life associated with weight loss. This step linked the SD results to real-world patient experiences.

**Adopting a citizen-centric perspective helps contextualize the findings of the analysis, recognizing that obesity has life-long impacts, which may affect individuals differently based on their demographic characteristics.** To capture this variety in perspectives, 5 main cohorts of interest were developed. These archetypes include both nationals (youth and core working age) as well as male expatriates (core working age) and were selected based on their significant contribution to the socio-economic fabric of the UAE. Together these 5

cohorts make up 66% of the adult population suffering from obesity in the UAE, while contributing to more than 70% to the GDP. Reducing obesity among these cohorts in the UAE is highly impactful for society, and especially relevant to

government stakeholders, including the Ministry of Human Resources and Emiratization, Ministry of Family and Ministry of Health and Prevention.

## Figure 8: Citizen Archetypes



Mariam is an **18-year-old Emirati woman** who lives in **Sharjah**. She is about to graduate high school. However, she's faced challenges with **obesity since childhood**, which has taken a toll on her **mental health** and academic results. She may not be able to attend university.



Hamdan is a **28-year-old National**, from **Al Ain** with a **BMI of 35**. He suffers from **Type 2 diabetes** as well. Although he has been married for 3 years, he has not yet been able to conceive a child.



Shyama is a **47-year-old National** from **Dubai**, with a **BMI of 37**. She was recently diagnosed with **hypertension** and now complains of **joint pain**. Due to her condition, she's had to quit her job as a customs agent.



Ali is a **55-year-old expatriate** who **drives a taxi in Dubai** and is battling with the **consequences of unhealthy eating**. His **BMI has climbed to 34**. Every day is a struggle, and doctors have warned that he is at risk of strokes.



Aditya, a **42-year-old Indian IT professional** in **Abu Dhabi**, struggles with obesity and has a BMI 33 due to his sedentary lifestyle and work stress. His weight has led to pre-diabetes and sleep apnea, **affecting his job performance** and causing him to miss out on a recent promotion. He doesn't have a comprehensive healthcare plan and is considering **moving back to India**, to manage his healthcare expenses.

# Benefits of weight loss: Estimated impact across socio-economic indicators

## Weight loss interventions lead to a positive impact across society

If the UAE were to start significantly reducing obesity rates with the introduction of innovative weight loss solutions, prevalence could reduce from 33% (current UAE prevalence) to 18% by 2031 (see Table 1 for details on each scenario). Reducing obesity prevalence yields substantial socioeconomic benefits. Drawing from the scientific literature, five socioeconomic themes impacted by weight loss were identified. The relationships between obesity reduction and socioeconomic factors were modeled to assess the broader societal impact of weight loss (see Figure 4 and Figure 6 for details on the socioeconomic indicators and their links):

- **As people lose weight, they become more active and more productive, the economy may expand:**

A growing, more productive, workforce could drive GDP growth, increasing by up to \$51 billion or 1.5 percentage points per year, with GDP reaching as high as \$790 billion by 2031, nearing the \$800 bn target of the “We The UAE” vision for 2031. Even with moderate weight loss, GDP growth may increase by \$21 billion or 0.7 percentage points year-on-year, with GDP reaching \$760 billion by 2031. With changing investment and consumption patterns, industries related to health and wellness will expand<sup>46</sup>.

- **With a lower burden of disease and chronic illnesses, healthcare costs may drop, and life expectancy can increase:**

Decreasing health issues, and consequent reductions in medical treatments, hospitalizations, and long-term care associated with obesity-related illnesses, may reduce the healthcare expenditures by up to \$1.5 Bn from 2025 to 2031, with \$338 Mn saved in 2031 alone. With fewer health complications, the average person's life expectancy may increase by up to 2.4 years.

- **More people are potentially employed, and more children are born:**

More people enter and remain in the workforce, expanding the workforce by anywhere between 5,000

to 17,000 people. Men and women's reproductive health may improve as obesity decreases, which may lead to up to an additional 75,000 births, of which 24,000 are Emiratis, by 2031.

- **A more educated country:**

Dropout rates may decline from 14.0% to 12.6%, and enrolments in university bachelor's programmes may increase by more than 2,000 students.

- **Improved security capacity:**

As the military and police have restrictions based on weight, losing weight could allow more than 5,700 additional Emirati youth to become eligible for military and police service.

## The model suggests particularly high benefits among Emirati national. Women also experience significant improvements across health and societal indicators

### Societal gains for Emirati nationals:

Emirati nationals who suffer from a 47% obesity rate, are most likely to gain from weight loss interventions. Emirati nationals could account for 25% of all additional births by 2031, and 42% of all additional bachelors' enrolments by 2031.

### More women join the workforce:

Emirati women currently experience higher rates of obesity and have lower workforce participation. Supporting initiatives that promote overall well-being and accessibility to employment opportunities can lead to a significant workforce expansion. Of the potential 17,000 new workforce participants, over half—9,000—could be Emirati women.

### More productive Emirati workforce:

The Emirati labour force may become more productive, with between 5 days to 12 days of additional work per year per worker who was previously living with obesity, gained depending on the level of intervention.

Table 1: Results overview

Category	Indicator (by 2031)	Measure	Status Quo (2024)	Base Scenario (2031)	Moderate Intervention (2031)	Accelerated Intervention (2031)
<b>Scenarios</b>	Adoption of weight loss interventions	Adoption among adults living with obesity	3%	0%	15%	57%
 <b>Health</b>	Prevalence of Obesity	%	32.8%	31.9%	27%	18%
	Healthcare costs	\$ Bn	4.38	4.48	(0.14)	(0.37)
	Life expectancy	Years (adults living with obesity)	75.5	75.5	+0.3 years	+2.4 years
	QALY savings	Healthy Life Years (adults living with obesity)	53.4	53.4	+1.5 years	+6.8 years
 <b>Economy</b>	GDP	\$ Bn	545	739	+21	+51
	GDP growth rate	%	5.1%	4.3%	+0.7% points	+1.5% points
	Productivity savings	Days per year per adult previously living with obesity	260	260	+2	+5
	Government revenue (VAT only)	\$ Bn	12	15.3	+0.9	+2.1
	Consumption	\$ Bn	226	306	+17	+42
	Individual income	\$	49,040	52,057	+358	+722
 <b>Society</b>	Total births	#	99,290	91,530	+2,289	+7,778
	Additions to workforce	#	7.2 Mn	9.1 Mn	+5,403	+16,638
	Women in the workforce	#	1,456,000	1,820,000	+4,128	+12,744
	Youth in the workforce	#	1,800,000	2,275,000	+2,700	+8,319
 <b>Education</b>	Bachelor's enrolment	#	250,000	253,000	+667	+2,027
	Students dropping out	#	35,000	35,280	(1,200)	(3,000)
 <b>Security</b>	Security Talent Pool	% of healthy weight young Emirati males	57,360	56,570	+1,700	+5,730

## Regional Analysis:

*Dubai, Abu Dhabi, Sharjah could see the most economic gains, while Northern Emirates might experience the most societal gains*

### Obesity prevalence in Dubai, Abu Dhabi and Sharjah:

Compared to other emirates, Dubai and Sharjah have the lowest prevalence of obesity at 26% and 29% respectively. In the moderate intervention scenario, the prevalence could reduce to 22% in Dubai and 24% in Sharjah, and in the accelerated scenario, obesity prevalence may fall to 14% in Dubai and 16% in Sharjah. Abu Dhabi, on the other hand, has a much higher obesity prevalence at 42%<sup>47</sup>, driven by the larger population of Emiratis living in areas such as Al Ain and Liwa. Abu Dhabi could see prevalence of obesity drop to 35% in the moderate intervention scenario and 23% in the moderate intervention scenario.

### Obesity prevalence in Northern Emirates:

The northern emirates of Umm al Quwain, Fujairah, Ajman and Ras Al Khaimah face high prevalences of obesity, ranging from 43% in Umm al Quwain to 46% in Ajman and Fujairah. These high rates of obesity may be driven by a large share of locals living in these Emirates, and a low number of expatriates compared to the other Emirates. Weight loss interventions could lead to obesity prevalence reducing to 25% in the accelerated intervention scenario and 38% in the moderate intervention scenario in the Northern Emirates.

### Significant societal gains in the Northern Emirates:

Dubai, Abu Dhabi and Sharjah also could see the highest increase in births, with 65,000 out of the additional 75,000 births taking place in these three emirates in the accelerated intervention scenario. The Northern Emirates could gain an additional 10,000 births by 2031 in the accelerated intervention scenario. However, the percentage of Emirati births is much higher in the Northern Emirates due to the higher concentration of Emirati nationals in these regions. Around 40% of the additional births in the Northern Emirates are Emiratis, while only 12% of the additional births in Dubai, Abu Dhabi and Sharjah are Emiratis. This may promote the formation of new Emirati families, which is one of the key priorities for the recently set up Ministry of Families.

### Higher economic gains in Dubai, Abu Dhabi and Sharjah:

Out of the potential \$51 Bn increase in overall GDP in 2031 in the accelerated intervention scenario, 93%, or \$48 Bn, may be contributed by Dubai, Abu Dhabi and Sharjah, while the other 4 emirates contribute the remaining increase of \$3 Bn. This disparity may be due to Dubai, Abu Dhabi and Sharjah housing a larger concentration of businesses, industries, and a more extensive workforce.



## HEALTH: UAE REVALENCE OF OBESITY PROJECTED TO DROP TO 18% BY 2031

**Achieving and maintaining a healthy weight brings numerous positive benefits to individuals' health and overall well-being:**

### Lower risk of chronic illnesses:

Weight loss significantly reduces the likelihood of developing chronic conditions such as type 2 diabetes, heart disease, hypertension, and certain cancers<sup>48</sup>.

### Improved mobility and physical function:

Shedding excess weight alleviates joint pain and decreases the risk of early-onset osteoarthritis. Enhanced mobility enables individuals to engage in physical activities more comfortably, promoting a more active and dynamic lifestyle<sup>49</sup>.

### Increased life expectancy:

Maintaining a healthy weight is associated with a longer life expectancy. By reducing the risk of life-threatening diseases like cardiovascular disease and stroke, weight loss contributes to a healthier and longer life<sup>50</sup>. This extended lifespan may allow individuals to remain active in their communities, and

spend more quality time with their families, including the possibility of meeting future generations.

### Enhanced Mental Health:

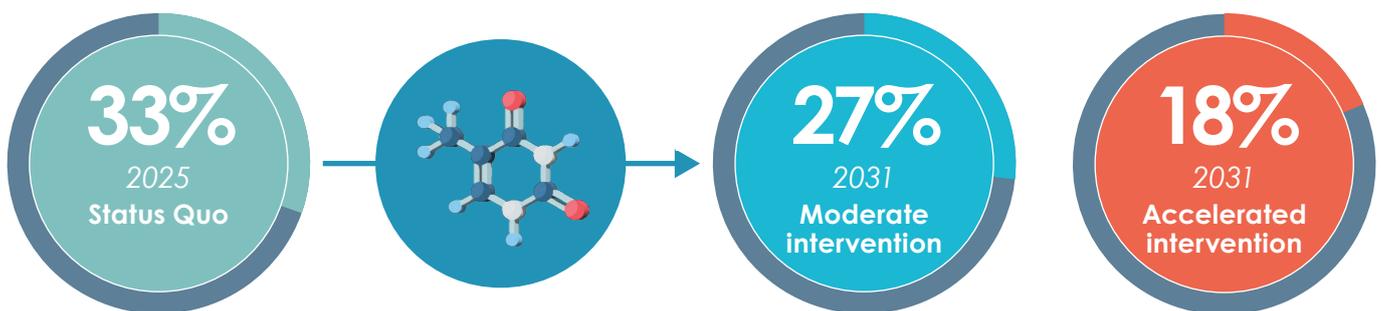
Weight loss positively impacts mental health by reducing the incidence of depression, anxiety, and low self-esteem<sup>51</sup>.

**Addressing obesity may lead to reduced healthcare expenditures for treating obesity and its related comorbidities. Consensus on the positive health implications of losing weight are observed through a sentiment analysis of social media channels.**

"I've noticed a significant reduction in dislocations, and I have much greater mobility post weight loss"

"Losing weight been a game-changer for my diabetes management. My blood sugar levels are much more stable" - Whiteshield Sentiment Analysis

**Figure 13: Reduction in obesity prevalence (2025-2031)**

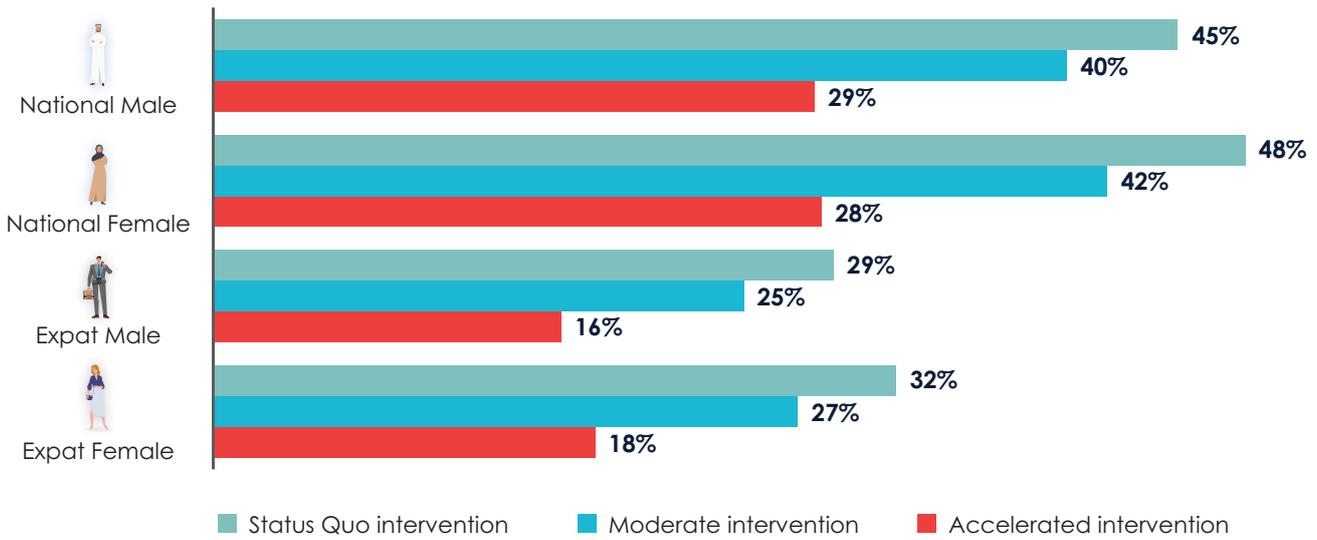


### Obesity prevalence reduces to 18% by 2031

In recent years, obesity prevalence has remained stable in the UAE, hovering near 32% of adults, and is projected to maintain this rate in coming years. This can partly be explained by the sustained inflow of young foreign workers, which tend to have a lower BMI than average.

Innovative weight loss solutions could shift the trend, as they have demonstrated high efficacy, allowing patients to achieve weight loss goals. This efficacy is reflected by the significant projected reduction in prevalence of obesity in the System Dynamics model employed for this report, with over one million adults estimated to transition out of obesity by 2031 in the most aggressive intervention scenario (see Table 1 for details on each scenario).

**Figure 14: Prevalence of obesity - 2031**



With an accelerated intervention scenario, the prevalence of obesity in the adult population, which currently stands at 33%, could drop to 18% by, and to 27% in the moderate intervention scenario.

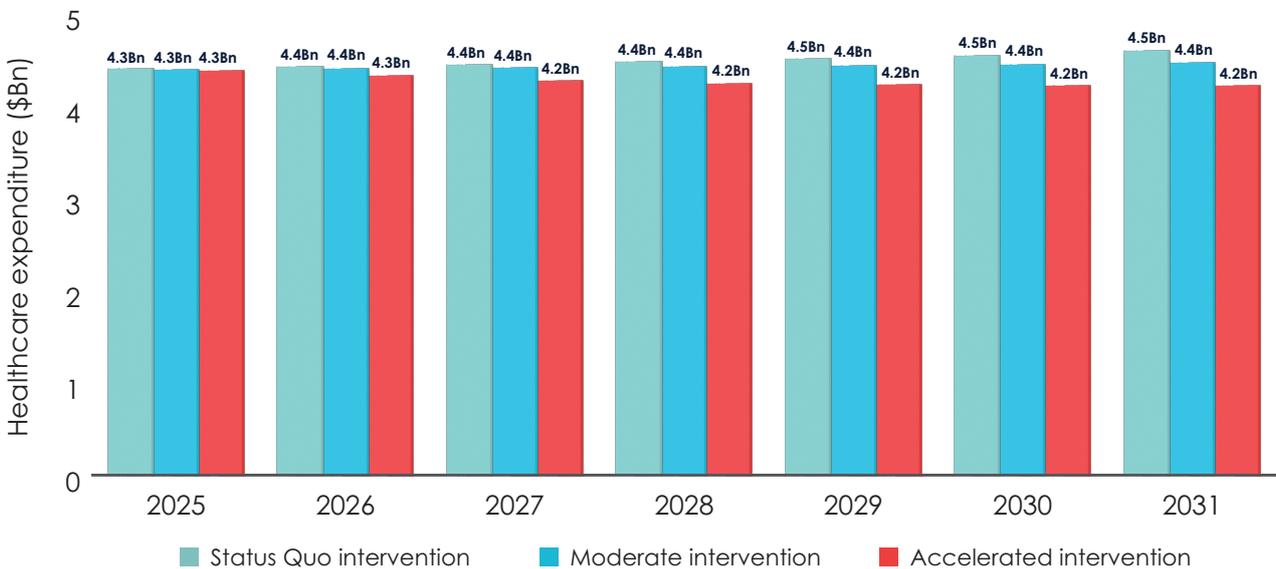
The impact is greatest for Emiratis, as prevalence may shift from 47% in 2024 to 29% by 2031 in the accelerated intervention scenario, a 38% decrease from 2024. This translates to nearly 206,000 Emiratis no longer suffering from

obesity by 2031. In the moderate intervention scenario, the prevalence may reduce more modestly to 41%.

For adult expatriates, the prevalence could drop from 31% to 17% in the accelerated intervention scenario, which translates, to 960,000 adults transitioning out of obesity. In the moderate intervention scenario, the prevalence of obesity among expatriates could reduce to 26%.

**Figure 15: Healthcare expenditure**

Weight loss helps save the UAE \$1.5 Bn of public healthcare expenditure in the accelerated intervention scenario, \$0.4 Bn in the moderate intervention scenario



**Healthcare expenditure savings estimated to amount to \$1.5 Bn cumulatively by 2031**

Obesity imposes a substantial financial burden on government and private healthcare systems, diverting critical resources from other health services. Based on model results, the UAE healthcare system may spend \$4.4 Bn in 2025 on healthcare costs related to obesity. This expenditure is projected to maintain its current levels, reaching \$4.5 Bn by 2031. However, with weight loss, these costs are expected to drop to \$4.1 Bn in 2031, saving the healthcare system over \$1.5 Bn cumulatively from 2025 to 2031 in the accelerated intervention scenario, of which \$377 Mn are saved in 2031 alone. The moderate intervention scenario could lead to cumulative savings of \$400 Mn, \$140 Mn of which are in 2031. **This significant cost reduction not only alleviates the healthcare budget but also enables the reallocation of funds towards preventive care and other important health**

**initiatives, ultimately enhancing the effectiveness of the national healthcare system.**

**Life expectancy could increase by 2.4 years**

Weight loss significantly contributes to the preservation and extension of individuals' life expectancy. Individuals suffering from obesity may lose up to 8 years of life expectancy.

**According to estimates of this study, based on scientific literature on the topic, an accelerated intervention scenario of weight loss could add 2.4 years of life expectancy on average to each resident who previously lived with obesity by 2031, and 0.3 years of life in the moderate intervention scenario.**

The key driver behind this increase in life expectancy is the reduction of obesity-related comorbidities, such as diabetes, or even cancer. By losing weight, an individual previously living with obesity could live a longer and healthier life.

***“I’m pre-diabetic with a BMI of 32+ (it was 37+ 3 months ago) [...] I need to take action now to be healthy so I can live longer and not get diabetes.” - Whiteshield Sentiment Analysis***



Consider the case of Ali, the 55-year-old expatriate from Pakistan who drives a taxi in Dubai. With weight loss, he has gained more peace of mind over his health, significantly reducing his risk of developing chronic conditions such as type 2 diabetes, hypertension, and cardiovascular diseases. He finds himself more energetic, engaging in activities with his friends on the weekends and is not worried about what his next visit to the doctor may reveal.

**Weight loss is estimated to save up to 6.8 years of healthy life**

Weight loss not only adds years to life but also improves the quality of those years, as measured by Quality-Adjusted Life Years (QALYs). By reducing obesity-related comorbidities, weight loss interventions substantially increase Quality-Adjusted Life Expectancy (QALE)<sup>52</sup>, ensuring individuals spend more of their extended lifespan in good health. **According**

**to this study’s modelled estimates, in the accelerated intervention scenario, 6.8 years of healthy life are gained on average for each individual previously living with obesity.**

In the moderate intervention scenario, the gain is 1.5 years of healthy life by 2031. This highlights how weight loss not only prolongs life expectancy but also enhances everyday functioning, mental well-being, and overall quality of life.

Table 3: Health indicators

Category	Indicator (by 2031)	Measure	Status Quo (2024)	Base Scenario (2031)	Moderate Intervention (2031)	Accelerated Intervention (2031)
 Health	Prevalence of Obesity	%	32.8%	31.9%	27%	18%
	Healthcare costs	\$ Bn	4.38	4.48	(0.14)	(0.37)
	Life expectancy	Years (adults living with obesity)	75.5	75.5	+0.3 years	+2.4 years
	QALY savings	Healthy Life Years (adults living with obesity)	53.4	53.4	+1.5 years	+6.8 years

*From a health perspective, Emiratis of all ages, and expatriates in the working age group benefit the most from weight loss*

## Analysis by Key Demographics

### Nationality:

- Obesity prevalence decrease may occur more strongly for Emirati nationals than expatriates. For nationals, the prevalence of obesity is estimated to drop from 47% to 29% and for expatriates, the prevalence could drop from 31% to 19%.
- The higher drop in obesity prevalence in Emirati nationals can be explained by the fact that Emirati nationals have a higher obesity rate to begin with.

### Age

- The most significant weight reduction estimated from this study's model in terms of the absolute

number of people that may overcome obesity is seen in the working age group of people aged 30-59. The obesity prevalence could reduce from 36% to 20%. This leads to around 920,000 working age professionals overcoming obesity and becoming more productive in their employment, adding a significant boost to GDP. The prevalence of obesity in people aged 18-29 could drop from 18% to 10%, enabling around 140,000 youth to overcome obesity.

This implies a healthier and more active workforce, leading to an increase in individual and business income, more government revenues and lower public healthcare spending.



## ECONOMY: GDP COULD GROW BY 1.5 PERCENTAGE POINTS BY 2031

### *Weight loss reshapes individuals, and the economy by boosting productivity and GDP growth*

- **Boosted productivity:**

Weight loss minimizes obesity-related health issues, such as type 2 diabetes, resulting in fewer medical appointments and absenteeism. Healthier individuals can maintain consistent work performance, thereby increasing overall productivity within the workforce<sup>53</sup>.

- **Increased energy and efficiency levels:**

Improved health from weight loss elevates employees' energy levels, reducing instances of presenteeism—where individuals are present at work but operate at lower efficiency. This leads to higher quality output and greater overall workplace effectiveness.<sup>54</sup>

- **More employment opportunities:**

Weight loss alleviates physical limitations and enhances self-confidence, empowering individuals to pursue and secure employment more actively. This not only broadens personal career prospects but also contributes to a more dynamic and diverse labour market<sup>55</sup>.

At the national level, improved productivity translates to increased business revenues. In turn, this enables companies to distribute higher wages and hire more employees. These newly added workers, and improved salaries, boost consumer spending, creating a cycle of economic growth. Governments also benefit from higher tax receipts, such as VAT and corporate taxes, which can be reinvested in public services and infrastructure (see Figure 6 for a detailed view on the relationship between socioeconomic indicators).

The deep link between economic factors and weight loss is demonstrated by a large body of studies, specifically on productivity losses<sup>56</sup>, but is also recognized by policymakers.

For example, in the United Kingdom a new scheme was put in place to offer innovative weight loss solutions to unemployed people living with obesity<sup>57</sup>. The intended effect of the weight loss solution is to enable these people to re-enter the workforce by improving their physical and mental condition.

The positive effects of weight loss on workplace productivity are supported by testimonies from patients, collected through a sentiment analysis of over 7,000 comments across social media platforms:

**“Post weight loss, I feel more energized and focused at work now!”**

**“After I lost weight, I could focus better at work now that my blood sugar is under control”**

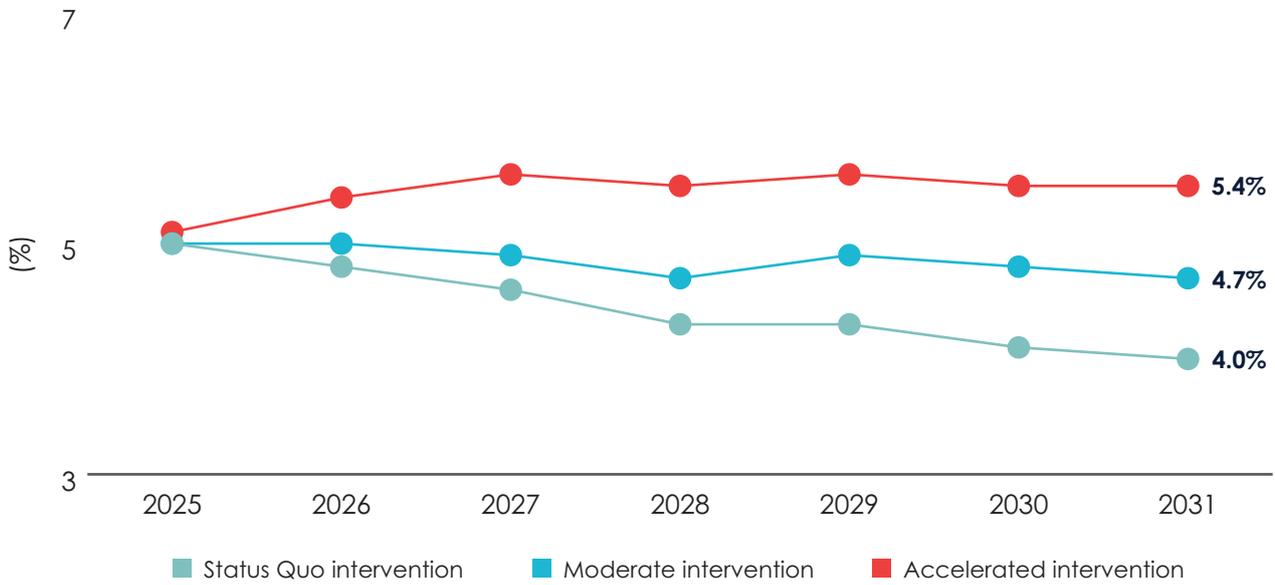
- Whiteshield Sentiment Analysis

***This study's model estimates GDP to grow by up to an additional \$51 Bn in 2031, with up to an additional 1.5 percentage point growth from UAE baseline GDP growth***

As novel modern obesity care medications gain adoption, obesity prevalence decreases, unlocking greater productivity across the population. This increase in weight loss could drive an additional 0.7 to 1.5 percentage points of GDP growth in 2031, as compared to the International Monetary Fund (IMF) baseline GDP projections. These results from the System Dynamics model employed in this study are also consistent with the results from the Fixed Effects model, which links a 1% decrease in BMI to a GDP increase of 0.5% (see the Methodology and Appendix sections for more details).

Improved GDP growth reflects a broader shift in individuals' economic contributions.

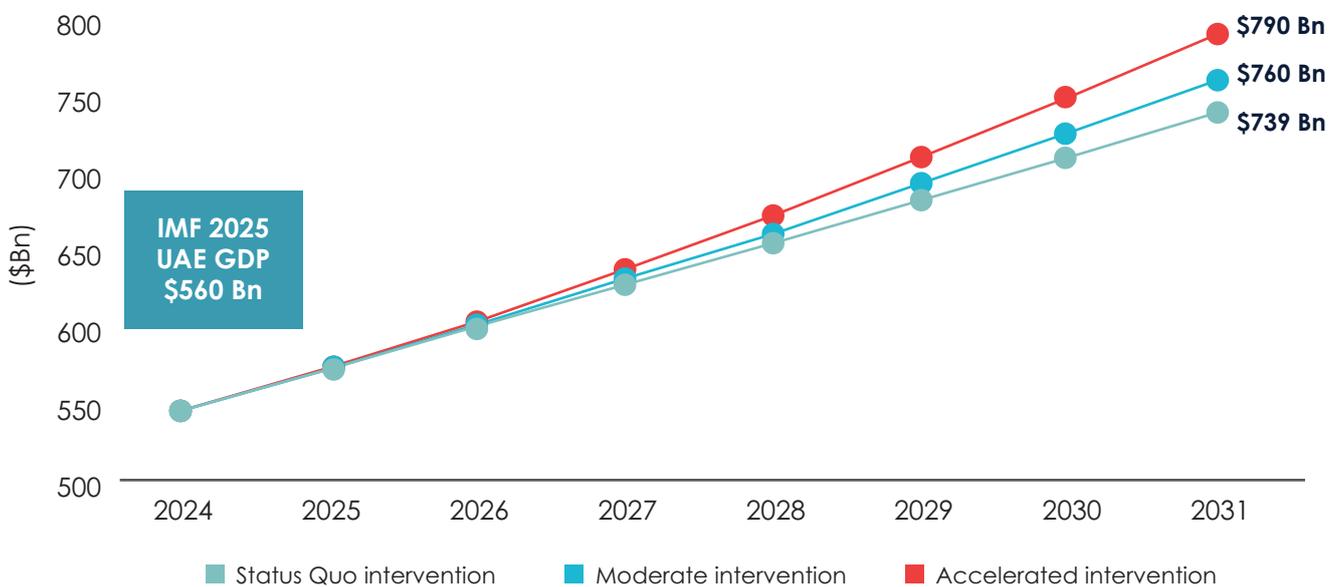
**Figure 8: GDP growth rate (2025-2031)**



The increase in GDP growth would boost the UAE's GDP up to \$790 Bn by 2031. This equates to an estimated GDP gain of between \$22 Bn and \$51 Bn in 2031 and helps push the UAE closer to its GDP target of \$800 Bn by 2030. Current growth estimates by the International Monetary Fund place GDP in 2030 closer to \$711 Bn<sup>58</sup>, while the model estimates the UAE's GDP to reach \$749 Bn by 2030 in the accelerated intervention scenario.

To contextualize these numbers' magnitude, the World Obesity Federation estimates the annual impact of obesity on the UAE's economy at \$12 Bn per year, which is \$84 Bn cumulatively between 2025 and 2031, due to healthcare costs and productivity losses alone<sup>59</sup>.

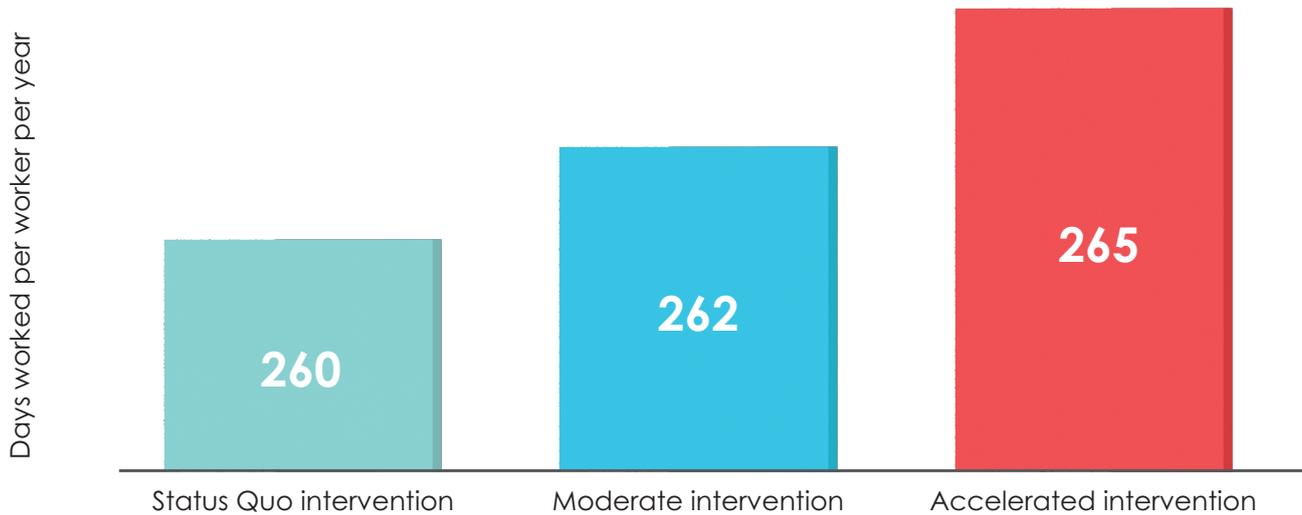
**Figure 9: UAE GDP (2025-2031)**



**Worker productivity is estimated to increase, equivalent to adding 5 additional days of work per year per worker previously living with obesity by 2031**

Additional GDP growth is in part driven by productivity improvements, due to lower absenteeism rates among employees, who after having overcome obesity, are able to perform more efficiently and take fewer days off from work.

**Figure 12: Productivity savings**



This increased productivity is equivalent to adding over 5 days of additional workdays per worker previously living with obesity per year in the accelerated intervention scenario

and 2 more day per worker per year in the moderate intervention scenario.



Consider the example of Aditya, a 42-year-old IT worker, whose BMI had reached 33 due to his sedentary lifestyle and stress. By reducing his BMI to 27, his health has improved significantly—specifically, the early signs of kidney issues, often exacerbated by obesity, have subsided<sup>60</sup>. Previously, Aditya required frequent doctor visits and sometimes missed work due to pain and discomfort caused by these health challenges. Now, he is healthier, more focused, and able to fully engage with his team, taking fewer sick days.

#### **VAT receipts estimated to increase by \$2.1 Bn by 2031**

Economic growth, fueled by increasing productivity, more employment, and increasing consumption and business revenues, will yield more Value Added Tax (VAT) revenues. In the accelerated intervention scenario, the government could collect an additional \$2.1 Bn in revenue in 2031 alone, and in the moderate intervention scenario, the government could collect \$900 Mn in additional revenues in 2031.

#### **Shift in consumption projected towards sectors focusing on fitness and healthy foods**

As citizens experience positive health benefits and gain purchasing power, overall consumption is projected to grow at a rate of 6.3% per year between 2024 and 2031 in the accelerated intervention scenario, as compared to a 5.2% growth in the moderate intervention scenario. In the status quo scenario, consumption will only grow by 4.4% per year. This difference in consumption growth translates to a

\$42 Bn overall increase in consumption in the accelerated intervention scenario in 2031, and a \$17 Bn increase in the moderate intervention scenario.

This growth in consumption is likely to benefit specific sectors, such as fitness, healthy foods, and household goods<sup>61</sup>. Preliminary analyses suggest that within categories like food, the shift is likely to focus on healthier alternatives rather than a complete departure from the segment<sup>62</sup>.

Some industries may face challenges, particularly smaller pharmaceutical or medical device companies that provide specialized solutions for obesity-related comorbidities, such as chronic kidney conditions<sup>63</sup>. As the prevalence of these health issues decreases, demand for such treatments may decline, impacting these niche providers. Additionally, demand for new clothing is likely to increase as people lose weight.

**“I’ve lost 30 kilo [...] over the last 9 months. 110 kilo to 80kg. I feel like a new person. I’ve changed clothing size twice”**

- Whiteshield Sentiment Analysis



Consider Shyama, a working-age Emirati woman from Dubai whose BMI had climbed to 37, due to which she had to quit her job as a customs agent. With weight loss, she now feels more confident in her appearance and suffers less from knee pain, enabling her to become more physically active. Motivated to join a new fitness class, she purchases new sportswear, as her old outfit is now too large. At the same time, her improved health inspires a shift in her lifestyle: she buys fewer fast-food meals, instead opting for organic products at the supermarket. Her newfound interest in home cooking also leads her to invest in new cookware to fuel her passion.

**Individual income estimated to increase by \$772 per year for each individual previously living with obesity**

With improved productivity and boosted GDP growth, individual earnings go up. By 2031, individual income could increase by \$772 per year in the accelerated intervention

scenario and \$358 in the moderate intervention scenario. This translates to an additional \$4,500 in additional income over the period of 2025-2031 for each individual who previously lived with obesity in the accelerated intervention scenario. In the moderate intervention scenario, this increase is around \$2,100.



Take the example of Mariam, the 18-year-old Emirati female from Sharjah, who had been struggling with obesity since childhood. Previously unemployed, like 15% of Emirati women currently are, Mariam struggled with self-confidence and preferred to stay at home, risking further health and economic decline. By losing weight, she has regained her self-confidence, recently completed her higher education, and even got a job.

All economic indicators are positively impacted by weight loss, noticeably GDP growth rate and employment numbers

**Table 4: Economy indicators**

Category	Indicator (by 2031)	Measure	Status Quo (2024)	Base Scenario (2031)	Moderate Intervention (2031)	Accelerated Intervention (2031)
 <b>Economy</b>	GDP	\$ Bn	545	739	+21	+51
	GDP growth rate	%	5.1%	4.3%	+0.7% points	+1.5% points
	Productivity savings	Days per year per adult previously living with obesity	260	260	+2	+5
	Government revenue (VAT only)	\$ Bn	12	15.3	+0.9	+2.1
	Consumption	\$ Bn	226	306	+17	+42
	Individual income	\$	49,040	52,057	+358	+722

### Analysis by Key Demographic

**Weight loss has a stronger positive impact on Emiratis, especially women:**

#### Nationality:

Of the additional days gained due to boosted productivity, Emirati workers previously living with obesity could gain the most, with 12 days per worker per year gained in the accelerated intervention scenario and 5 days per worker per year gained in the moderate intervention scenario. This is primarily due to Emiratis experiencing a higher average prevalence of obesity.

#### Gender:

Women's individual income, on average, increases more than men's income. While women previously living with obesity could gain an addition \$958 per year in 2031 in the accelerated intervention scenario, and \$434 in the moderate intervention scenario, men may gain \$696 in the accelerated intervention scenario and \$327 in the moderate intervention scenario. This difference is primarily driven by higher baseline obesity rates among women and the resulting greater gains in workforce participation, productivity, and reduced absenteeism once weight loss initiatives are adopted. As women see larger relative health improvements, they experience correspondingly larger increases in individual income over time.



## SOCIETY: SURGE IN EMIRATI BIRTHS WITH AN ESTIMATED 24,000 ADDITIONAL NEWBORNS BY 2031

**Addressing obesity enhances societal well-being and supports national priorities in the UAE**

### Enhanced fertility and family growth:

By reducing obesity rates, more individuals can overcome obesity-related infertility causes, allowing them to conceive and carry pregnancies to term successfully<sup>64</sup>. This leads to an increase in birth rates, contributing to the growth of the Emirati population.

### Increased workforce participation and advancement:

Weight loss positively impacts the participation and advancement of women and youth in the workforce<sup>65</sup>.

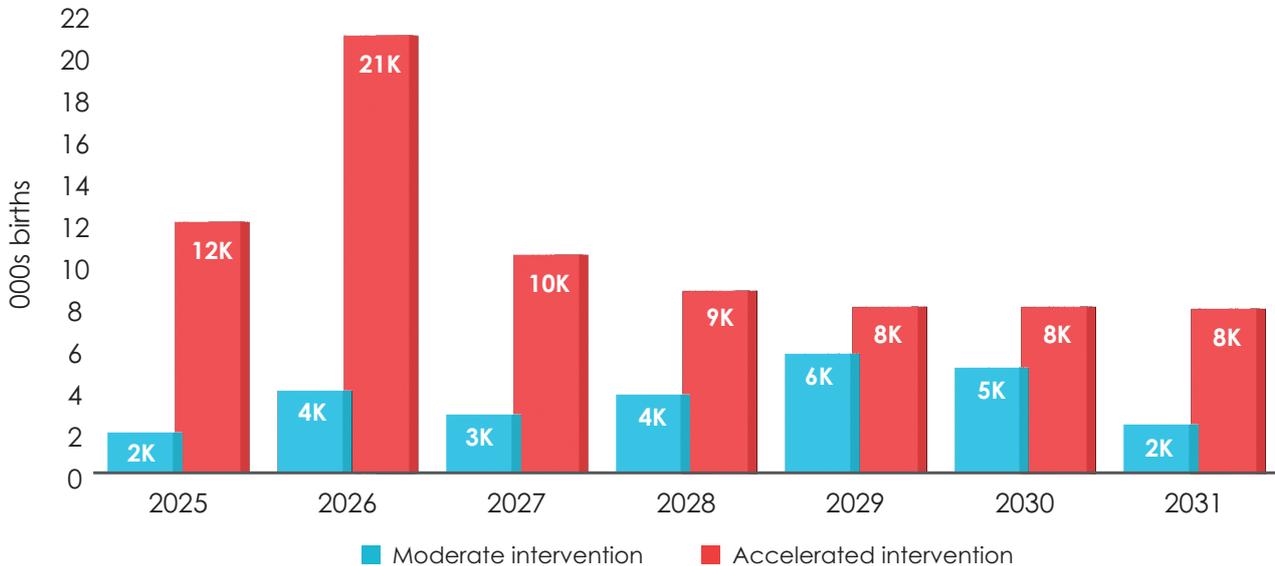
Healthier employees experience fewer chronic illnesses and maintain better mobility, enabling them to perform job duties more effectively and sustain consistent employment.

The UAE government has prioritized increasing the number of Emirati families and enhancing workforce participation. The recent establishment of the new 'Ministry of Families' highlights this commitment, providing support to foster family growth for Emiratis.

### Weight loss could increase the total number of births in the UAE and empower women and youth to become a part of the workforce

**Figure 16: Additional births (2025-2031)**

With Weight loss helps overturn a negative trend in births, as it allows more people to become fertile; 75,000+ additional births occur in the UAE in the high adoption scenario, 25,000+ in the moderate adoption scenario



### An estimated 23,000 additional Emirati births take place in the accelerated intervention scenario

At the present pace, an increasing number of people are estimated to experience infertility every year, which contributes to a loss of live birth rate. **Obesity is linked to**

several conditions which may contribute to infertility, for both men and women, such as hormonal imbalance or a loss of periods<sup>66</sup>. Additionally, obesity can have significant impact on mental health<sup>67</sup>, potentially reducing social interactions, and by extent, willingness to start a family.

However, weight loss at the population level could lead to a reversal of this trend, with people averting infertility and increasing birth rates. With weight loss, young adults transitioning out of obesity may see their perspective on

the future brighten. They may have more ease finding employment, feel more self-confident, more willing to meet a partner and marry, and ultimately more willing and able to start a family.

**“I was diagnosed with ovarian failure and no more periods, now I am getting my periods back” - Whiteshield Sentiment Analysis**

In the UAE specifically, this is reflected in studies evaluating the clients of a fertility clinic, where a disproportionate share

of patients lived with obesity<sup>68</sup>.



Consider the case of Hamdan, the 28-year-old Emirati from Al Ain. He was suffering from obesity with a BMI of 35, and was unable to have children. With weight loss, his BMI has now reached a healthy 24. He no longer finds himself in joint pain and muscle aches, his overall health drastically improved. He was later able to conceive for the first time.

Cumulatively, between 2025-2031, in an accelerated intervention scenario of weight loss, whereby over one million adults could transition out of obesity, **an additional 75,000 births would be estimated to take place, as compared to the status quo scenario.** Out of which, 31%, or 24,000, are Emirati. This is equivalent to around 6,000 new Emirati families being

created. In the moderate intervention scenario, 25,000 additional births take place, out of which 8,000 are Emirati births. This is a vital boost to the local population and is one of the key priorities of government ministries, with programs such as Dubai Social Agenda 33 launched to support the increase of Emirati families in the emirate.

**Figure 17: Additional births - Emiratis and expatriates**

**+75,000** In the accelerated intervention scenario, more than 75,000 additional births take place by 2031

**Additional births - Emiratis and expatriates**



**+24,000**  
Emirati births



**+51,000**  
non-Emirati births



### **17,000 new workers could become a part of the workforce**

The link between employment and weight loss is supported by academic studies, specifically observing that adults living

with obesity are more likely to be unemployed<sup>69</sup>. This link is further attested by first-hand accounts emerging from the sentiment analysis.

***“I have [gained] 30 kilos as I no longer can do many sports activities I used to do, causing me also to be depressed [...] [Weight loss] will improve my life considerably [...]. I can’t even find a job full-time as I cannot handle it”***

*- Whiteshield Sentiment Analysis*

With improved health and reduced bias towards adults living with obesity among employers, citizens would have a greater capacity to seek and secure employment. This could result in an estimated 17,000 additional individuals entering the workforce, 11,000 of which would be Emirati workers, cumulatively between 2025 and 2031 in the accelerated intervention scenario. In the moderate intervention scenario, 3,000 additional Emirati workers are estimated to join the workforce by 2031.

### **9,000 Emirati women are estimated to join the workforce by 2031**

Unemployment rates as well as obesity rates are higher for women in the UAE than their male counterparts, yielding a stronger benefit of weight loss for women.

Reducing obesity will empower women to take up employment opportunities in the public and private sector. There is an estimated addition of 9,000 Emirati women in the workforce in the accelerated intervention scenario and 3,000 additional Emirati women in the moderate intervention scenario by 2031. In terms of expatriate women, there is an

estimated increase of 4,000 women in the workforce in the accelerated intervention scenario and 1,000 women in the moderate intervention scenario.

### **More than 8,000 youth are estimated to join the workforce, 5,000 of them are Emirati**

Youth suffering from obesity face a double challenge, in completing higher education and securing employment. Obesity is linked with reduced educational outcomes and employment opportunities<sup>70</sup>. Helping these individuals overcome obesity would be an especially important contribution to UAE society.

**A well-employed youth contributes to higher productivity, drives innovation, and supports the expansion of key economic sectors.** Additionally, engaging young individuals in the workforce reduces dependency ratios and fosters a dynamic economy capable of adapting to global market changes. Weight loss is estimated to add close to 8,000 youth to the workforce, 5,000 of which are Emirati youth. In the moderate intervention scenario, this increase in the workforce is around 2,700 youth, 1,800 of which are Emirati.



**Remember Shyama who had to quit her job as a customs agent? Losing weight loss will enable her and 10,000+ more women to become a part of the workforce. Out of the 17,000 newly employed Emiratis by 2031, more than half of them are women.**

Table 5 : Society indicators

Category	Indicator (by 2031)	Measure	Status Quo (2024)	Base Scenario (2031)	Moderate Intervention (2031)	Accelerated Intervention (2031)
 Society	Total births	#	99,290	91,530	+2,289	+7,778
	Additions to workforce	#	7.2 Mn	9.1 Mn	+5,403	+16,638
	Women in the workforce	#	1,456,000	1,820,000	+4,128	+12,744
	Youth in the workforce	#	1,800,000	2,275,000	+2,700	+8,319

### Analysis by Key Demographics

*Significant estimated societal gains for Emiratis, 6,000+ new families could be created, 11,000 could enter the workforce:*

#### Nationality:

- 24,000 additional Emirati births are estimated to take place due to reducing obesity in the population, along with 51,000 non-Emirati births.
- Additionally, a reversal in the declining number of births in the UAE begins thanks to reduced infertility linked to obesity
- **This translates to a change in the total fertility rate from 1.44 children per woman in the status quo scenario to 1.64 children per woman in the accelerated intervention scenario**

- Out of the 8,000 youth added to the workforce by 2031, around 65%, or 5,000 are Emirati youth, in the accelerated intervention scenario. Even though Emiratis form only 8% of the workforce, they suffer from a much higher prevalence of obesity (25.8%), compared to expatriate youth (17.3%). Weight loss benefits are therefore especially visible in Emiratis.
- The impact of additional jobs created is also disproportionate across different demographic cohorts. For Emiratis, who suffer from a high prevalence of obesity, reducing weight enables 11,000 individuals to join the workforce in the accelerated intervention scenario, especially for women, making up the majority of those joining the workforce. The impact of weight loss on employment in expatriates is much smaller, as most of them are already absorbed in the workforce. Still, losing weight enables an additional 6,000 expatriates to enter the workforce by 2031.



## EDUCATION: 2,000+ ESTIMATED ADDITIONAL HIGHER EDUCATION GRADUATES

**Addressing obesity can significantly improve educational attainment, as studies highlight a positive relationship between healthy weight and academic performance<sup>71</sup>:**

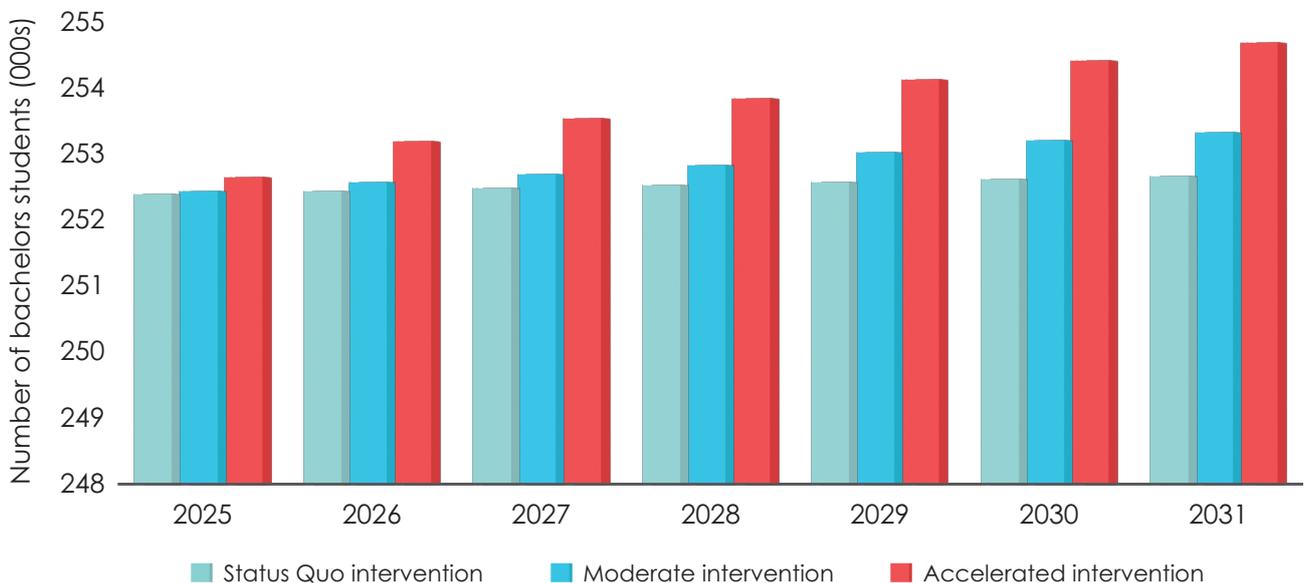
- Obesity is linked to chronic systemic inflammation<sup>72</sup>. Inflammation in brain tissue can worsen memorization skills<sup>73</sup>. Although confounding variables may be at play, students living with obesity have been found to have higher dropout rates<sup>74</sup>.
- By mitigating obesity-related health issues and boosting self-confidence, weight loss interventions help students remain committed to their studies. This can decrease the dropout rate in the UAE, ensuring that more individuals

complete their education and are prepared to contribute to the workforce.

Increasing educational outcomes in the UAE is a priority for the UAE government, which has laid down a National Strategy for Education 2030. Reducing obesity could increase the number of students pursuing higher education, helping achieve the objectives of this strategy as well as helping the UAE become future-ready.

**Weight loss could lead to an increase in the number of bachelor's degrees graduates, as well as average years of schooling, and a reduction in dropout rate.**

**Figure 18: Additional bachelors program enrolments (2025-2031)**



**2,000 additional students could enroll in bachelor's programs in the UAE by 2031**

Without weight loss interventions, growth of students obtaining a bachelor's degree in the UAE is constrained. As young adults start to lose weight, however, their self-esteem is positively impacted, and they are more likely to complete their studies, or enroll in higher education<sup>75</sup>. This is partly due to a physiological mechanism, as obesity is linked

to neuroinflammation, which may lead to a decrease in the capacity of the brain to memorize information, negatively impacting academic results.

Due to these mechanisms, in the accelerated intervention scenario, 2,027 additional students are estimated to enroll in a bachelor's program, and in the moderate intervention scenario, 667 students enroll in a bachelor's program cumulatively, by 2031.

These additional students in higher education will be equipped with the necessary technical and practical skills to drive the economy in both public and private sectors. Around 42% of these students would be Emirati nationals, following Dubai Statistics Center data on university enrollment<sup>76</sup>. Weight loss would contribute to enabling additional students to enroll in higher education. By 2031, in the accelerated intervention scenario, 851 additional Emirati students could enroll, and 280 in the moderate intervention scenario.

**Dropout rate could reduce to 12.64%, preventing 3,200 students from dropping out of college by 2031**

There is also an estimated reduction in the average dropout rate among those living with obesity. At present, the dropout rate for higher education students stands at 14.0%, due to factors such as disengagement, self-esteem issues, and greater absenteeism<sup>77</sup>. With weight loss interventions, the



Losing weight allows promising students like Mariam, who was previously at risk of not being able to enroll in university, to improve their academic performance and muster the self-confidence needed to join university and pursue a degree.

average dropout rate is estimated to reduce to 12.6% in the accelerated intervention scenario and 13.5% in the moderate intervention scenario by 2031. Taken cumulatively, this is equivalent to 3,200 students in the accelerated intervention scenario and 1,300 students in the moderate intervention scenario being prevented from dropping out of college by 2031.

**Table 6 : Education indicators**

Category	Indicator (by 2031)	Measure	Status Quo (2024)	Base Scenario (2031)	Moderate Intervention (2031)	Accelerated Intervention (2031)
 Education	Bachelor's enrolment	#	250,000	253,000	+667	+2,027
	Students dropping out	#	35,000	35,280	(1,200)	(3,000)

### Analysis by Key Demographics

**Weight loss contributes to a significant boost for Emirati and women graduates**

#### Nationality:

- There may be an increase of 900 Emirati nationals graduating from bachelors' programs compared to 1,200 expatriate students, in the accelerated intervention scenario by 2031. In the moderate intervention scenario, there is still an increase of 300 Emirati graduates compared to 400 expatriate graduates by 2031.
- This is an important result as highly skilled Emirati graduates are more likely to be able to gain employment in the private sector, which is one of

the key goals of Ministry of Human Resources and Emiratization<sup>78</sup>.

#### Gender:

- Out of the 2,000 additional graduates, in the accelerated intervention scenario, 1,100 are projected to be women, implying a significant increase in female participating in higher education in the UAE.
- This rise can be attributed to improved health outcomes and greater academic engagement among women following weight loss interventions, as well as evolving societal and policy support that encourages women's educational attainment in the UAE.

## SECURITY: ESTIMATED INCREASE OF 5,700+ IN THE SECURITY TALENT POOL BY 2031

### **Addressing obesity among young Emirati males presents significant opportunities to enhance national security**

#### **Enhanced recruitment and retention:**

By reducing the current obesity prevalence of 23% among Emirati youth, more young Emirati males will meet the physical fitness standards required for mandatory national military service. This increase in eligible candidates strengthens the military and police recruitment efforts and ensures a more robust and capable workforce.

#### **Improved military readiness and reduced injuries:**

Weight loss initiatives contribute to higher overall fitness levels among military personnel, ensuring that a greater number are medically ready to deploy when needed. Additionally, reducing obesity decreases the likelihood of musculoskeletal

injuries by approximately 33%, resulting in a more resilient and injury-resistant force<sup>79</sup>.

**Reducing obesity enables Emirati males to become military ready. The UAE not only strengthens its armed forces but also enhances its overall national security.**

#### **5,700+ Emirati males estimated to overcome obesity by 2031**

Weight loss among young Emirati males has a direct impact on their eligibility for defense and law enforcement roles. Cumulatively, between 2025 and 2031, weight loss could enable an additional 1,700 to 5,700 additional Emirati males to become eligible for military service and eventually increase their capacity to join the police force, depending on the level of the weight loss intervention scenario.

**Figure 19: Military fit personnel (2025-2031)**

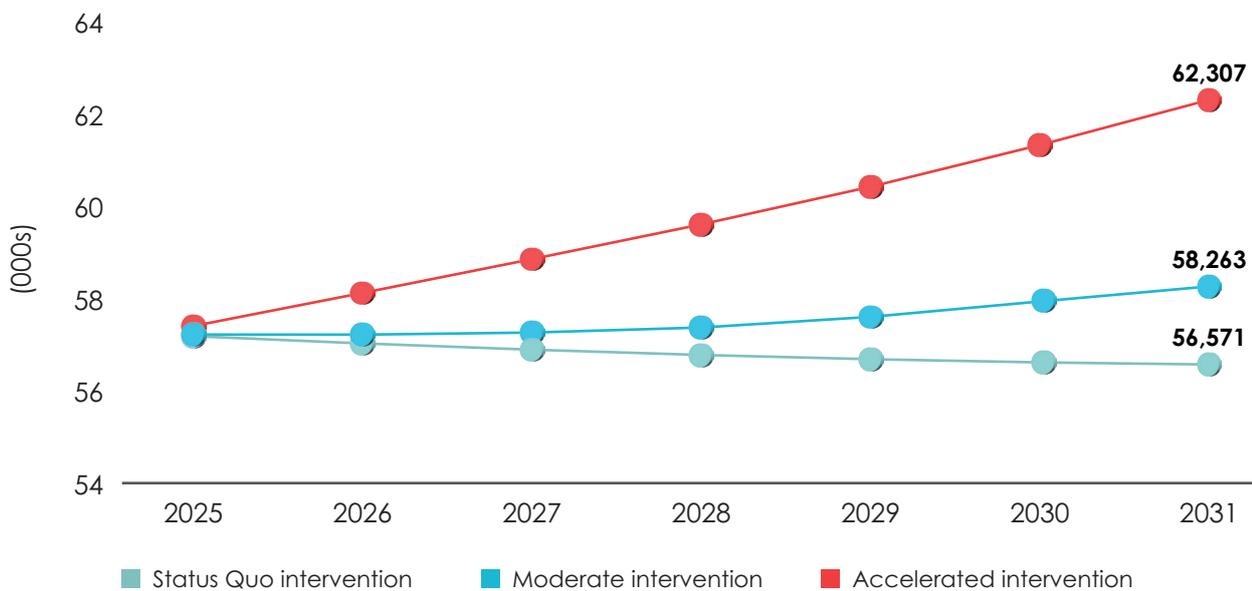


Table 7: Security indicator

Category	Indicator (by 2031)	Measure	Status Quo (2024)	Base Scenario (2031)	Moderate Intervention (2031)	Accelerated Intervention (2031)
 Security	Security Talent Pool	% of healthy weight young Emirati males	57,360	56,570	+1,700	+5,730



# Conclusion

Reducing obesity prevalence from 32% to as low as 18% by 2031 could have a transformative impact on the UAE. The benefits of tackling obesity extend far beyond personal

health; they ripple across society, fuelling economic growth, easing pressure on healthcare systems, and improving overall quality of life.



More adults living without obesity means a larger, more productive workforce. This workforce would boost the economy, with GDP growth projected to increase by up to 1.5 percentage points.



Adults transitioning out of obesity would also require fewer hospital visits, reduced healthcare costs, and could live longer, healthier lives.



Obesity-related infertility causes could decrease and potentially lead to additional births



Educational outcomes could also improve, as students transitioning out of obesity may be better able to focus, perform academically, and stay in school. This, in turn, strengthens the UAE's future talent pipeline, ensuring a more skilled and capable workforce for generations to come.



Additionally, national security stands to benefit, as a greater share of the population could meet fitness standards required to be a part of the mandatory military services, and regular armed and security forces.

## Tackling obesity requires bold, people-first solutions.

Innovative weight loss interventions, such as GLP-1 are already reversing obesity trends in countries like the US, where adoption is at an all-time high<sup>90</sup>.

The UAE has led extensive, and successful, efforts to slow the progression of obesity in the country. Providing access to

innovative weight loss medication can reverse the obesity trend in the country and shape the UAE into a global leader in obesity management.

Implementing weight loss interventions is fundamentally about people. It enables UAE citizens to lead a healthier, longer, and more fulfilling life. The ripple effects of better health extend far beyond the individual, contributing directly to the ambitions of **'We the UAE 2031'**.

# Appendix

## GLOSSARY

**Table: Glossary**

S.No.	Term	Definition
1	Obesity	A person who has a body mass index (BMI) greater than 30
2	Markov model	A mathematical model that describes a system which transitions between a finite set of states or probabilities over time
3	System dynamics	A computational model used to understand, analyze, and simulate the behavior of complex systems over time. The primary goal is to capture the dynamic relationships and feedback effects that influence the system's behavior
4	Sentiment analysis	A computational technique used to determine and extract the emotional tone or sentiment expressed in a piece of text, such as a sentence, paragraph, or document
5	Baseline	The prevalence of obesity among a specific cohort without any interventions
6	Moderate intervention	Weight loss interventions cover 15% of the target population by the end of the period of study
7	Accelerated intervention	Weight loss interventions cover 57% of the target population by the end of the period of study
8	QALY	Quality Adjusted Life years; the average life years where an individual lives a healthy life, free from any diseases
9	GLP-1 RA	A class of medications that mimic the action of the endogenous incretin hormone glucagon-like peptide-1 (GLP-1) to regulate glucose metabolism and have multiple benefits beyond glycemic control, including weight loss, cardiovascular protection, improved lipid profiles, reduced inflammation etc, often used in the treatment of Type 2 diabetes and obesity
10	GDP	The total final value of all goods and services produced with a country during a specific time period

## METHODOLOGY

### Data

Data collection focused on gathering socio-economic and health statistics to establish the historical baseline of the UAE's population. Key data points such as obesity prevalence, demographic population breakdown, shifts in the population, were collected based on best available data from national statistics agencies and supranational entities such as the World Health Organization (WHO). These factors, particularly obesity prevalence, were broken down by age, gender, and citizenship (expatriate or local citizen).

Population data, including male and female counts by age group, were obtained from the United Nations' demographic studies. Citizenship data were sourced from national statistical agencies. Other factors, such as employment rates, student numbers, and income, were derived from either national

statistical agencies or relevant government entities (e.g., the Ministry of Education).

Historical obesity and overweight prevalence data were drawn from United Nations studies, selected for their large sample sizes and robust methodologies. National studies often suffer from sampling biases (e.g., participants refusing to be weighed). However, to obtain obesity prevalence rates specific to each demographic cohort, national health surveys were consulted and normalized against overall population prevalence values. To the authors' knowledge, no currently published study or data provides an accurate and detailed breakdown of the nation's obesity prevalence across demographic groups, making the data set used in this report uniquely close to real-world obesity prevalence in the UAE.

To ensure the study's validity and relevance, the authors conducted a comprehensive literature review covering obesity and related socio-economic indicators. Priority was given to local studies with large samples and strong

methodologies. When national data were unavailable, suitable proxies were employed, including data from neighbouring countries such as Saudi Arabia and other Arab nations such as Egypt.

**Table: Data sources**

Category	Indicator (by 2031)	Measure	Current status (2024)	Source
<b>Economy</b>	GDP	\$Bn	545	International Monetary Fund
	GDP growth rate	%	5.1%	International Monetary Fund
	Productivity savings (Labor Force)	Hours per employee per year	260	8 hours a day x 5 days a week x 52 weeks a year
	Government revenue	\$Bn	12	Ministry of Finance (Corporate Tax Revenue statistic)
	Consumption	\$Bn	226	World Bank
	Individual income	\$	49,040	International Monetary Fund
<b>Health</b>	Prevalence of obesity	%	32.8%	World Health Organization and United Nations
	Health care cost	\$Bn	4.38	Sum of public and private healthcare spending, Public healthcare spending - World Obesity Federation, Private C healthcare spending-Whiteshield Analysis
	Life expectancy	Years	75.5	Lancet Study, CIA World Factbook
	QALY savings	Healthy life years	53.4	Lancet Study, GCC Statistical Center
<b>Society</b>	Total births	#	99,290	United Nations
	Additions to workforce	#	7.2 Mn	World Bank
	Women in the workforce	#	1,456,000	World Bank
	Youth in the workforce	#	1,800,000	World Bank
<b>Education</b>	Bachelors' enrolment	#	241,999	Federal Competitiveness and Statistics Centre, UAE
	Students dropping out	#	35,000	Ministry of State for Higher Education and Advanced Skills
<b>Security</b>	Security Fit Pool	# of healthy weight young Emirati mates	57,360	World Health Organization and United Nations

## System Dynamics Model

The System Dynamics (SD) model was initially developed through a conceptual phase, mapping causal relationships among variables informed by an extensive literature review of obesity and its socio-economic dimensions. The model was developed in Stella, a specialized modeling software, drawing on benchmarks from established SD models of obesity. Obesity and its progression can be approached through two primary frameworks: a physiological perspective, where weight changes reflect variations in caloric intake and expenditure, and a social-dynamic perspective, where shifts in self-perception influenced by social factors alter body mass index (BMI). The latter approach was employed here, and weight loss solution impact was subsequently introduced as a dependent variable. This modeling strategy represents a deliberate departure from a solely physiological view of obesity, allowing for a more comprehensive understanding of the condition's socio-economic underpinnings.

To the author's knowledge no other study comprehensively studies the societal benefits of weight loss using a System Dynamics model. This novel approach for the topic provides new and unique insights on the topic.

The following sections describe different parts of the SD model.

## 1 – Population Dynamics

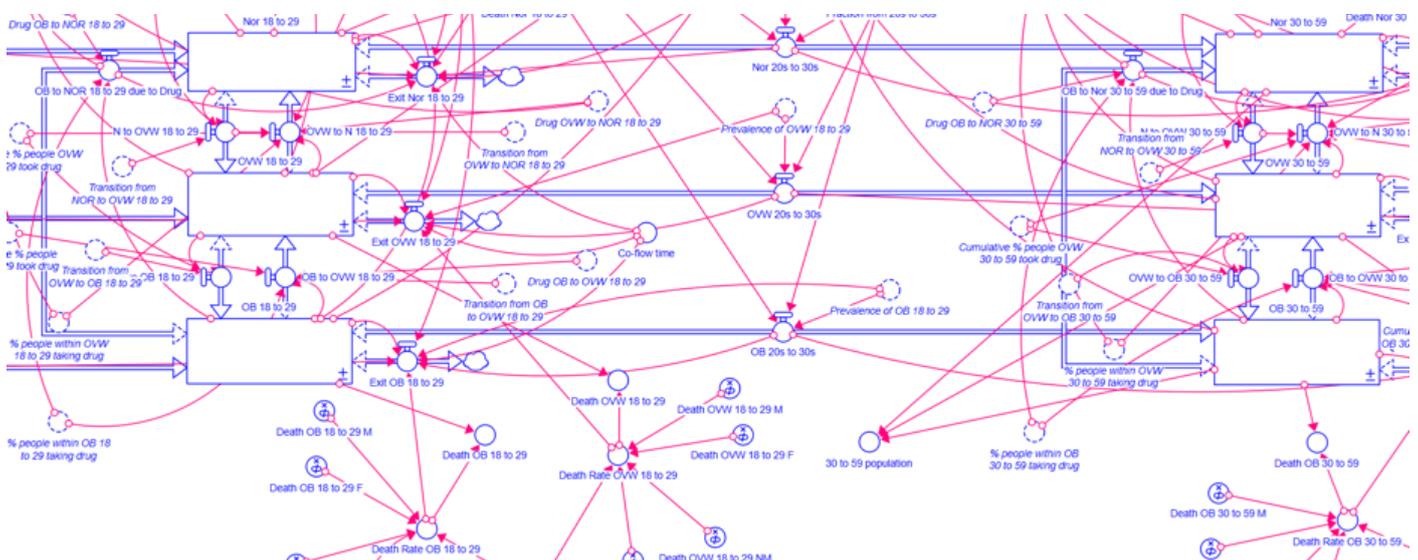
To best capture the impact of weight loss across society, the UAE's population was divided long 4 main cohorts based on gender (Male, Female) and Nationality (National, Expatriate). Within each cohort the population is further segmented across four age groups: Children (under 18 years old), Youth (18 to 29 years old), Core working age (30-59 years old), retired (60 years and above). This segmentation allowed the authors to separately examine the impact of weight loss and the challenges specific to each demographic cohort.

Each year, individuals transition from the under-18 group into the 18–29 group, from which a portion subsequently moves into the 30–59 group, and then into the above-60 group, before eventually exiting the system after a delay. Over time, the relative proportions of these age groups evolve, and these changes are incorporated into the model as exogenous inputs.

Each age category features an exogenous mortality rate further stratified by BMI category. Thanks to the use of empirical data on mortality rates per demographic cohorts as inputs for the System Dynamics model, the model accurately depicts changes in death rates over time, and more importantly enables a comparison between different impact scenarios.

The model and its outputs focus on the adult population, and therefore the under 18 category is not discussed in this report.

**Figure 20: Sample view of population dynamics model in Stella**



The use of this aging chain allows for a deeper understanding of obesity prevalence trends over time within a defined population. It offers a more comprehensive perspective on how related economic indicators evolve, rather than presenting a static snapshot of the current situation.

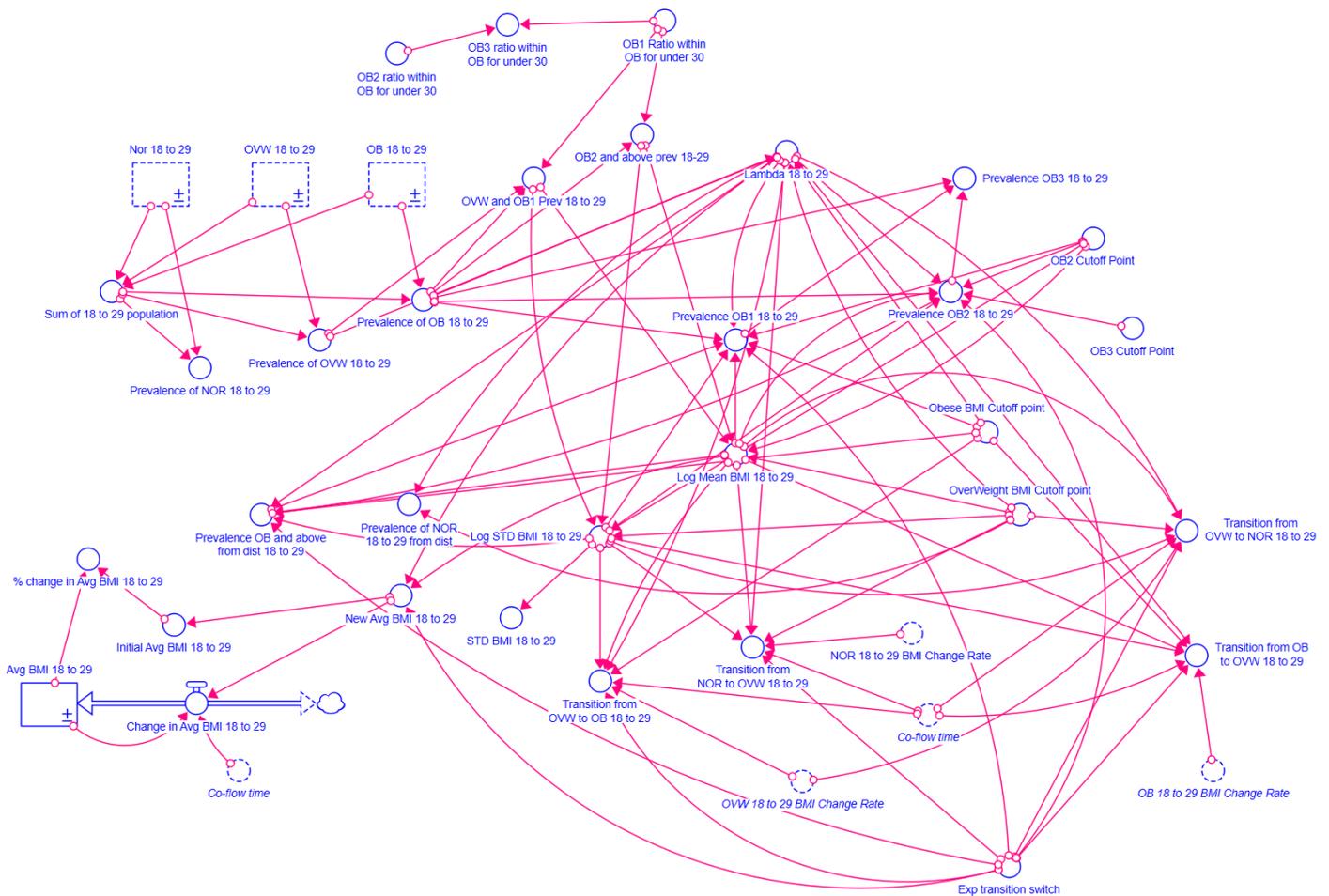
## 2 – BMI Dynamics

This module forms the core of the model, driving all changes. The model distinguishes among three primary

BMI categories—Healthy, Overweight, and Obesity. When necessary, the Obesity category is further divided into three sub-categories of BMI (Obesity type I, II, and III).

Combining the three main age categories (18–29, 30–59, above 60) with the three primary BMI categories results in nine distinct BMI dynamics. The BMI change rates (Section 2.1) and the transition probabilities (Section 2.2) are drawn from several published studies referenced throughout this explanation.

**Figure 21: Sample view of BMI Dynamics from the System Dynamics model in the Stella software**



**2.1 – BMI change rates (logic mainly driven from Crielaard et al., 2020; Fallah-Fini et al., 2013)**

For each of the nine sub-groups, the following steps outline the BMI dynamics per time period:

1. Consider a representative individual—an “average” member of the sub-group. The individual’s BMI is influenced by group norms (socio-cultural factors) and personal attributes (wage and education).
2. A gap exists between this individual’s current BMI and an ideal BMI, defined by both individual and group factors. The inclination to reduce this gap is affected by personal characteristics (wage and education).
3. Based on this gap and the intent to close it, the representative individual’s BMI changes each time period.
4. After registering the change, the BMI resets to its original value, and the process repeats in the next time period.

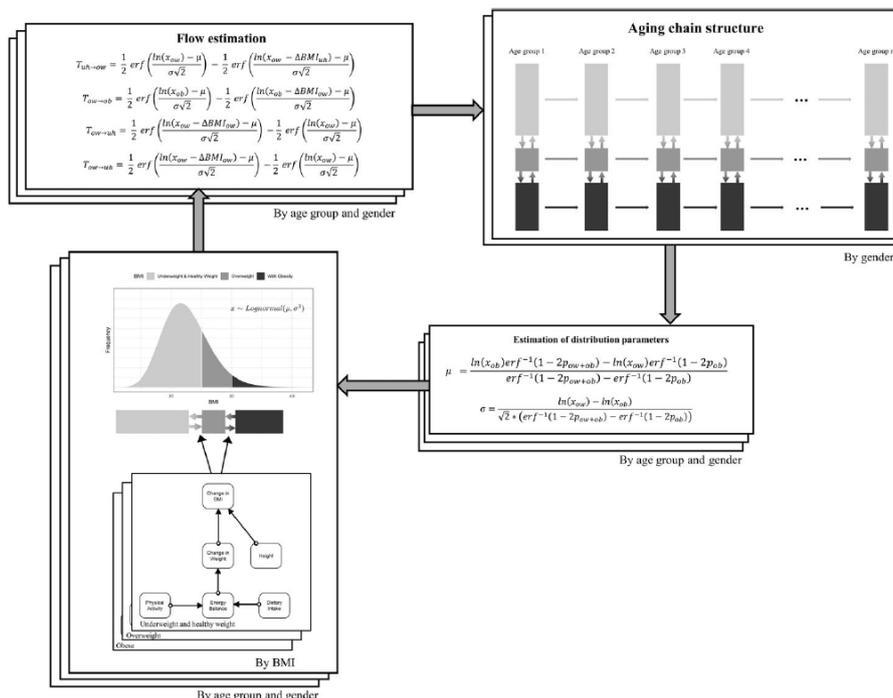
**2.2 Transition probabilities (logic mainly from Chiu et al., 2023)**

Once BMI change rates are determined for each of the nine sub-groups—specifically, the three BMI change rates per age category—transition probabilities between BMI categories can be calculated.

Empirical data indicates that the BMI distribution for the 18–29 age group resembles an exponential distribution, while the 30–59 and above-60 groups follow a lognormal distribution. For the 18–29 group, the key exponential parameter (Lambda) is determined by the combined Overweight (OVW) and Obese (OB) categories. For the lognormal distributions (30–59 and above 60), the lower cutoff corresponds to the Overweight BMI threshold, and the upper cutoff corresponds to the OB2 BMI threshold.

Each time period, the mean and standard deviation of the BMI distribution within each age category are updated based on BMI change rates and category prevalences. As the distribution shifts—moving left or right depending on changes—transition probabilities are recalculated accordingly. This process updates BMI category prevalences after each time period.

Additionally, this part of the SD model was calibrated using empirical weight transition data, spanning over half a million weight transitions across age groups and genders. This data was derived from large-scale longitudinal studies led in the United States, namely the Health and Retirement Study, as well as the National Longitudinal Study of Adolescent to Adult Health. While these studies are led in the United States, the large sample pool, similar obesity prevalence between the United States and UAE, and immutable psychological factors such as gender and age, make the data relevant for use in calibration.



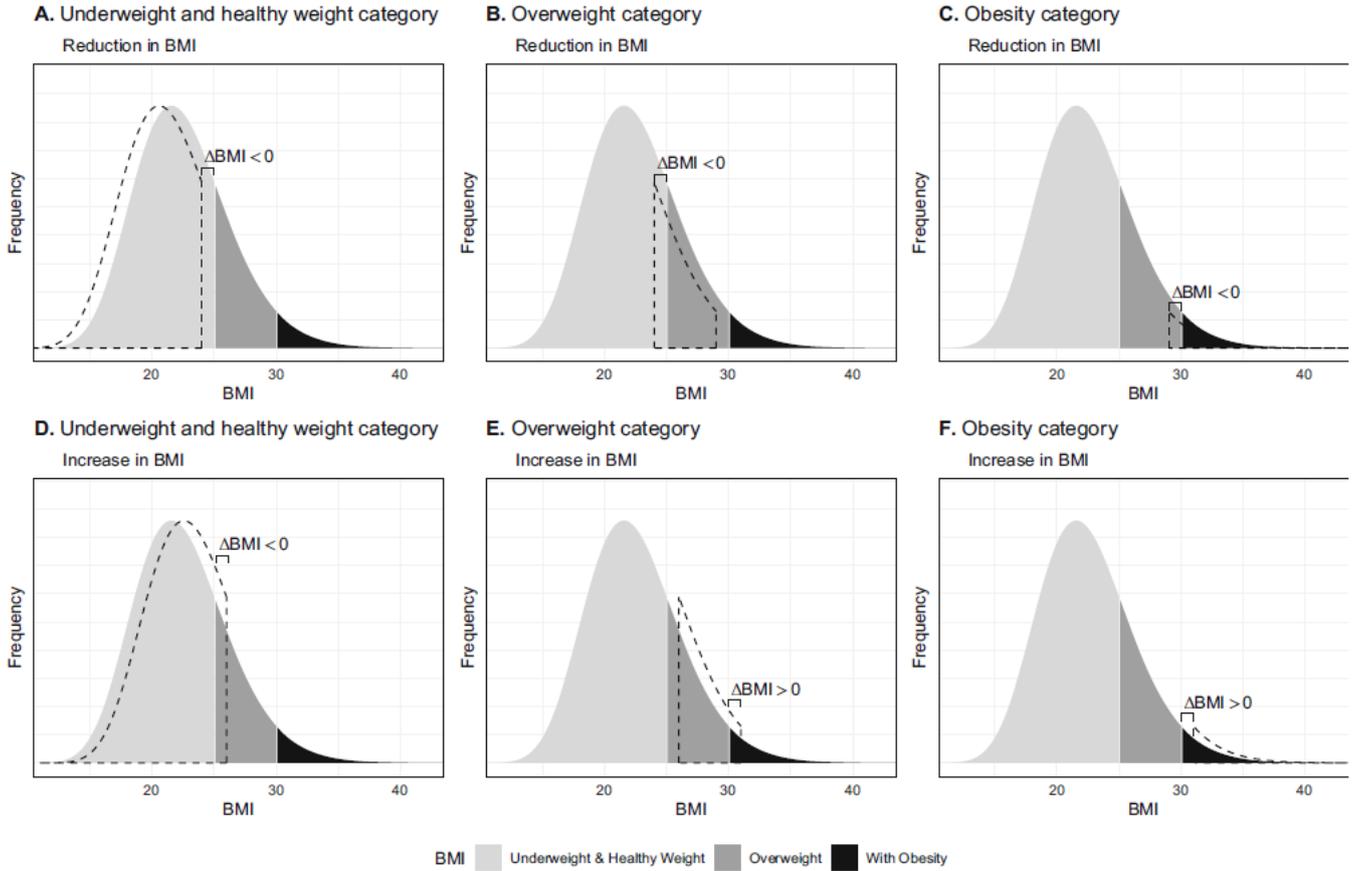


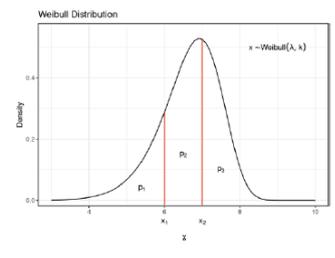
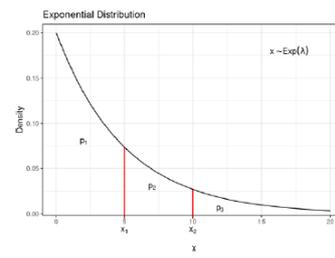
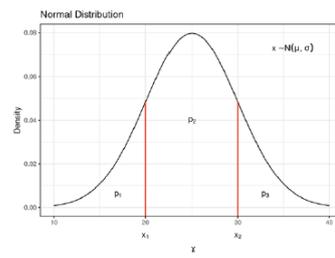
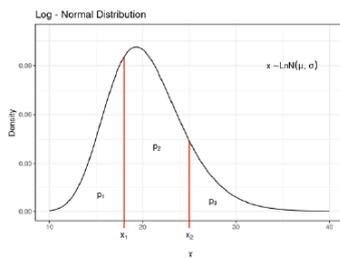
Figure 22: Transition probabilities

Log-Normal

Normal

Exponential

Weibull



Distribution parameters<sup>a</sup>

$$\mu = \frac{\ln(x_2) \operatorname{erf}^{-1}(1-2(p_2+p_3)) - \ln(x_1) \operatorname{erf}^{-1}(1-2p_3)}{\operatorname{erf}^{-1}(1-2(p_2+p_3)) - \operatorname{erf}^{-1}(1-2p_3)}$$

$$\sigma = \frac{\ln(x_2) - \ln(x_1)}{\sqrt{2}(\operatorname{erf}^{-1}(1-2(p_2+p_3)) - \operatorname{erf}^{-1}(1-2p_3))}$$

Flow between segments

$$T_{1-2} = \operatorname{erf}\left(\frac{\ln(x_1) - \mu}{\sigma\sqrt{2}}\right) - \operatorname{erf}\left(\frac{\ln(x_1 - \Delta x) - \mu}{\sigma\sqrt{2}}\right)$$

$$T_{2-1} = \operatorname{erf}\left(\frac{\ln(x_1 + \Delta x) - \mu}{\sigma\sqrt{2}}\right) - \operatorname{erf}\left(\frac{\ln(x_1) - \mu}{\sigma\sqrt{2}}\right)$$

$$T_{2-3} = \operatorname{erf}\left(\frac{\ln(x_2) - \mu}{\sigma\sqrt{2}}\right) - \operatorname{erf}\left(\frac{\ln(x_2 - \Delta x) - \mu}{\sigma\sqrt{2}}\right)$$

$$T_{3-2} = \operatorname{erf}\left(\frac{\ln(x_2 + \Delta x) - \mu}{\sigma\sqrt{2}}\right) - \operatorname{erf}\left(\frac{\ln(x_2) - \mu}{\sigma\sqrt{2}}\right)$$

$$\mu = \frac{x_2 \operatorname{erf}^{-1}(1-2(p_2+p_3)) - x_1 \operatorname{erf}^{-1}(1-2p_3)}{\operatorname{erf}^{-1}(1-2(p_2+p_3)) - \operatorname{erf}^{-1}(1-2p_3)}$$

$$\sigma = \frac{x_2 - x_1}{\sqrt{2}(\operatorname{erf}^{-1}(1-2(p_2+p_3)) - \operatorname{erf}^{-1}(1-2p_3))}$$

$$T_{1-2} = \operatorname{erf}\left(\frac{x_1 - \mu}{\sigma\sqrt{2}}\right) - \operatorname{erf}\left(\frac{x_1 - \Delta x - \mu}{\sigma\sqrt{2}}\right)$$

$$T_{2-1} = \operatorname{erf}\left(\frac{(x_1 + \Delta x) - \mu}{\sigma\sqrt{2}}\right) - \operatorname{erf}\left(\frac{x_1 - \mu}{\sigma\sqrt{2}}\right)$$

$$T_{2-3} = \operatorname{erf}\left(\frac{x_2 - \mu}{\sigma\sqrt{2}}\right) - \operatorname{erf}\left(\frac{(x_2 - \Delta x) - \mu}{\sigma\sqrt{2}}\right)$$

$$T_{3-2} = \operatorname{erf}\left(\frac{(x_2 + \Delta x) - \mu}{\sigma\sqrt{2}}\right) - \operatorname{erf}\left(\frac{x_2 - \mu}{\sigma\sqrt{2}}\right)$$

$$\lambda = \frac{-\ln(p_3)}{x_2}$$

$$T_{1-2} = \exp(-\lambda x_1)(\exp(\lambda \Delta x) - 1)$$

$$T_{2-1} = \exp(-\lambda x_1)(1 - \exp(\lambda \Delta x))$$

$$T_{2-3} = \exp(-\lambda x_2)(\exp(\lambda \Delta x) - 1)$$

$$T_{3-2} = \exp(-\lambda x_2)(1 - \exp(\lambda \Delta x))$$

$$k = \frac{\ln(-\ln(p_2+p_3)) - \ln(-\ln(p_3))}{\ln(x_1) - \ln(x_2)}$$

$$\lambda = \frac{x_1}{(-\ln(p_2+p_3))^{1/k}}$$

$$T_{1-2} = \exp\left(\frac{-kx_1}{\lambda}\right) [\exp\left(\frac{k\Delta x}{\lambda}\right) - 1]$$

$$T_{2-1} = \exp\left(\frac{-kx_1}{\lambda}\right) [1 - \exp\left(\frac{k\Delta x}{\lambda}\right)]$$

$$T_{2-3} = \exp\left(\frac{-kx_2}{\lambda}\right) [\exp\left(\frac{k\Delta x}{\lambda}\right) - 1]$$

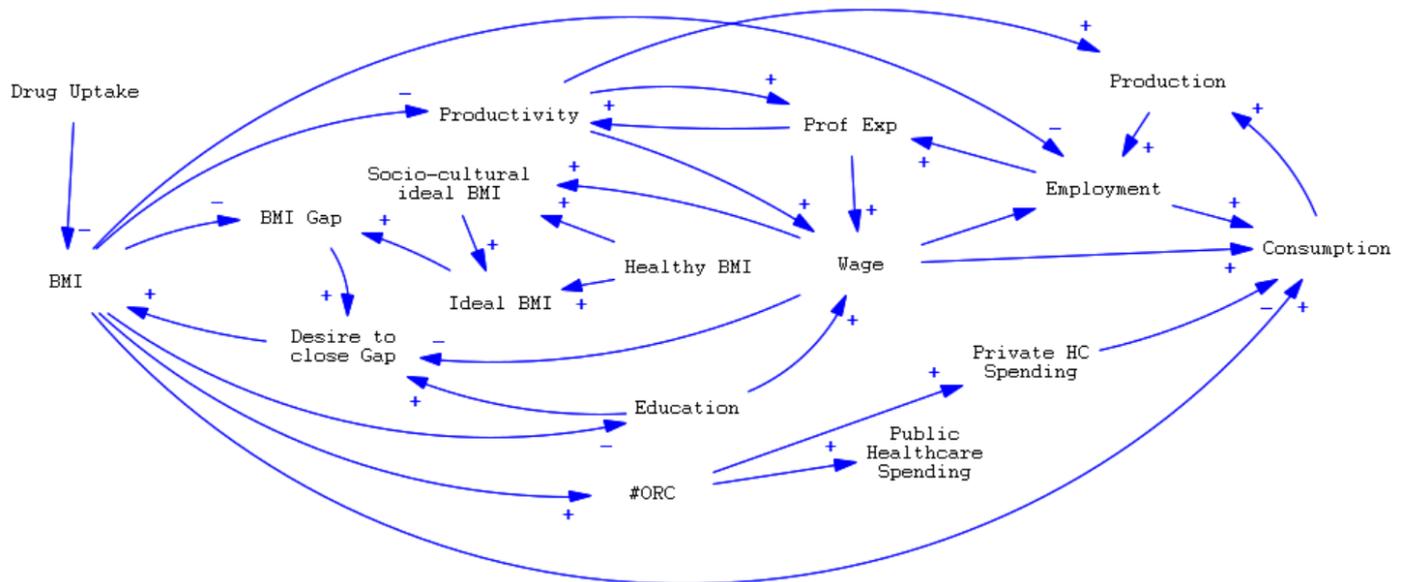
$$T_{3-2} = \exp\left(\frac{-kx_2}{\lambda}\right) [1 - \exp\left(\frac{k\Delta x}{\lambda}\right)]$$

### 3 – Socio-Economic Indicators

BMI dynamics influence a range of socio-economic

indicators. Some are explicitly modeled with feedback loops, while others are treated as exogenous. The following indicators are linked through a causal loop diagram:

**Figure 23: Relationships between socio-economic indicators**



- **Employment:** Influenced by labor force participation, production, and wages, each of which is in turn influenced by BMI dynamics.
- **Wage:** Affected by worker productivity, education, and experience, all of which are tied to BMI.
- **Education:** Shaped by BMI.
- **Productivity:** Determined by BMI and experience.
- **Experience:** Depends on productivity and employment levels.
- **Production:** Influenced by labor productivity and consumption.
- **Consumption:** Driven by employment, wage levels, BMI, and private healthcare spending.
- **Healthcare (HC):** The number of obesity-related conditions (ORC) per person depends on BMI and age category. Private and public healthcare spending also responds to BMI and age distributions.
- **Gross Domestic Product (GDP):** Influenced by three main components—household consumption, government expenditure, and capital formation—all of which are

functions of production, consumption, and public spending.

Infertility, QALY (quality-adjusted life years), extra calorie intake, mental health, and life expectancy are primarily exogenous, though their values depend on endogenous BMI prevalence.

Each socio-economic indicator is associated with specific BMI values. For example, unemployment rates are distributed across different BMI levels based on academic research that highlights variations in unemployment between weight categories. When the data from the literature lacks granularity, a mathematical equation is used to extrapolate unemployment rates across BMI values. For instance, if the data indicates that unemployment rates increase exponentially with BMI, a best-fit exponential equation is applied to accurately assign unemployment risk ratios to each BMI level. This data is then applied to the actual unemployment rate of each demographic cohort. To clarify with an example (all data points discussed in this example are purely illustrative): Research might show that individuals with a BMI of 35 (mid-point of obesity class I) are twice as likely to be unemployed compared to those with a BMI below 25 (healthy weight). If the average BMI in a group is 30

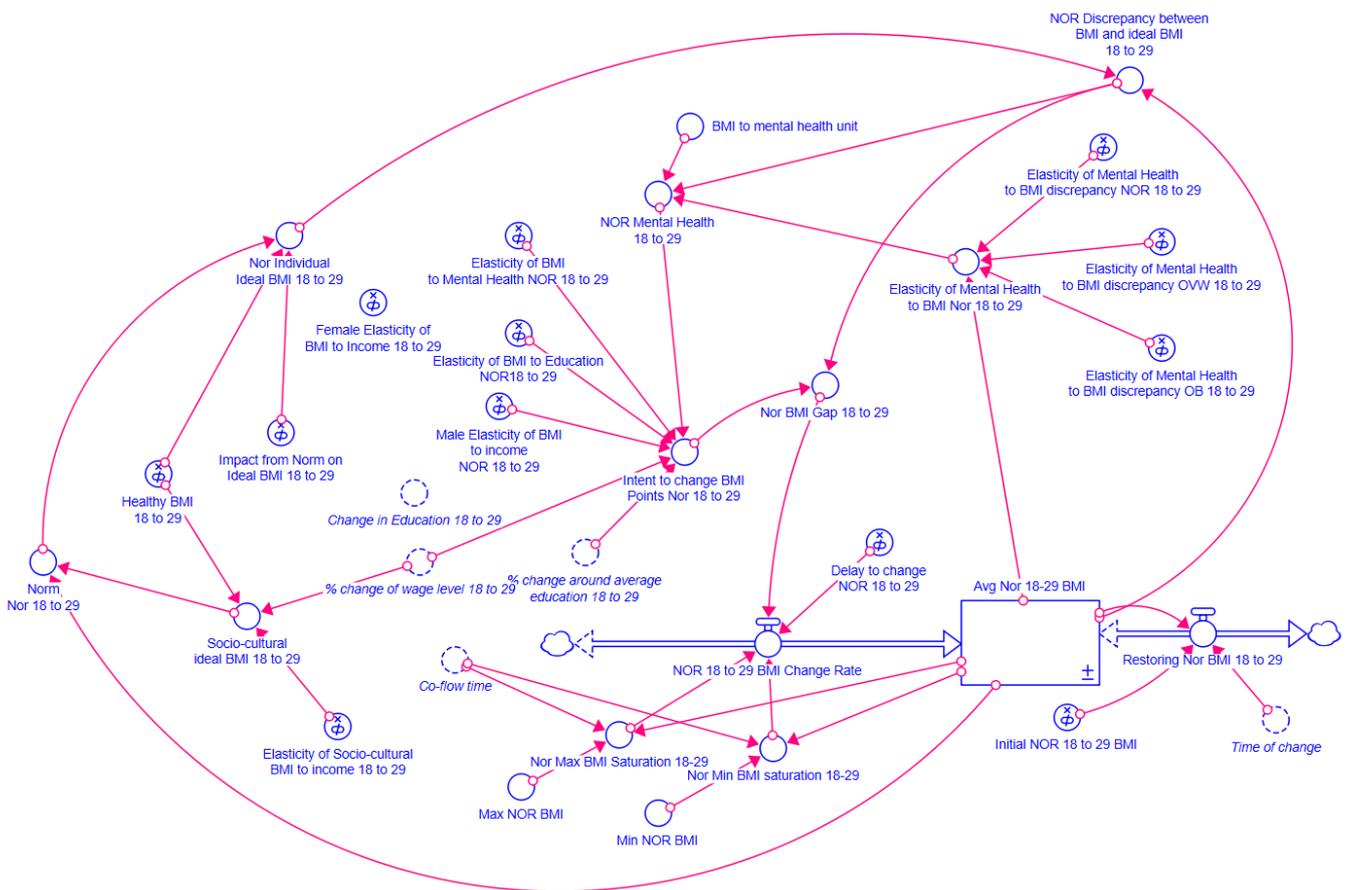
(overweight range), then unemployment risk ratios would be adjusted accordingly:

- A risk ratio above 1 would be applied to individuals living with obesity (BMI  $\geq 30$ ). Meaning that they are more likely to be unemployed than average.
- A ratio below 1 would be applied to individuals in the healthy weight (BMI  $< 25$ ) and overweight (BMI 25–29.9) categories. Meaning that they are less likely to be unemployed than average.

This approach ensures that unemployment risk is accurately aligned with both BMI categories and real-world demographic data. By applying this process to all socio-economic indicators, using the most detailed information available from the literature, the model delivers precise insights into how these variables change with BMI.

This approach allows for a nuanced understanding of differences across demographic groups and impact scenarios, closely reflecting real-life conditions.

**Figure 24: Sample view of the socio-economic dynamics from the System Dynamics model in the Stella software**





## Fixed effect regression analysis

The authors employed a fixed-effects panel regression model to examine the relationships between Body Mass Index (BMI), demographic, and environmental factors as independent factors and Gross Domestic Product (GDP) as a dependent variable. The dataset encompasses eleven countries—United States, United Kingdom, United Arab Emirates, Saudi Arabia, Singapore, Iceland, Switzerland, Morocco, Pakistan, Chile, and Slovenia—over the period 2000–2016, capturing a timespan during which obesity and its associated economic implications have become increasingly salient.

This econometric analysis was led to further ensure the validity of the findings resulting from the System Dynamics model. The objective of this analysis was to confirm the direction of the relationship between GDP and BMI, rather than finding an exact value for the relationship. This relation was selected for the analysis as GDP is a common measure capturing the overall output of society, and therefore the knock-on effects of obesity reduction or increase.

Key variables include the log-transformed Body Mass Index ( $\log\_BMI$ ), serving as a central explanatory factor, along with several controls. These controls are Gender\_encoded (capturing gender-specific effects), log-transformed population ( $\log\_Pop$ ) to account for scaling effects, unemployment rate as a labor market indicator, and log-transformed healthcare expenditure ( $\log\_HC$ ) as a proxy for healthcare system robustness. Furthermore, the model incorporates a measure of physically fit population ( $\log\_PPF$ ), corresponding to non-obese or overweight people, and demographic and environmental factors, namely life expectancy, fertility rate, and CO<sub>2</sub> emissions. A country-

specific constant term is included to represent unobserved, time-invariant characteristics.

A fixed-effects approach is employed to isolate within-country variation over time and mitigate biases that might arise from unobserved heterogeneity across countries. This method is appropriate given the structural, institutional, and cultural differences among the sampled nations, ensuring that the estimated relationships are not confounded by persistent country-level factors.

The model's within R<sup>2</sup> value of 0.8833 indicates a robust ability to explain temporal variation in GDP within countries. While the negative overall R<sup>2</sup> is not unexpected for fixed-effects models—which focus on within-country dynamics rather than between-country differences—this does not detract from the reliability of the estimates.

Among the predictors,  $\log\_BMI$  emerges as particularly influential, with a 1% increase in BMI associated with a 0.53% decrease in GDP. This result underscores the economic costs potentially linked to obesity, including multiple socio-economic variables included in the System Dynamics model. The unemployment rate exhibits a strong negative impact on GDP, reinforcing the importance of robust labor markets for economic stability. In contrast, higher healthcare spending ( $\log\_HC$ ) shows a positive correlation with GDP, suggesting that investments in health systems may enhance economic growth, potentially by improving workforce longevity and productivity. The fertility rate negatively affects GDP, whereas longer life expectancy contributes positively.

In the System Dynamics model, as demonstrated by the literature, weight loss is linked to these socio-economic indicators. The impact of these factors on GDP validates the findings of the System Dynamics model.

**Table: Model Results**

	BMI	GDP	Ratio	Comment
<b>System Dynamics Model</b>	-5.6%	+1.4%	-0.25	The system dynamics outputs a modest variation in GDP when BMI decreases significantly at the population level (2031 values)
<b>Fixed Effect regression</b>	+1.00%	-2.09%	-2.09	The Fixed Effect regression signals a strong relation between BMI and GDP, and is statistically significant

Both analyses indicate the same relationship between GDP and BMI, where an increase in BMI negatively correlates with GDP. This alignment in the direction of the relationship supports the validity of the System Dynamics model.

The difference in the magnitude of the relationship can be explained by the limited number of variables included in the fixed-effects analysis, which can exaggerate the strength of the correlation. However, the key finding remains the statistical significance of the relationship, as establishing this significance is the primary goal of the analysis.

Table : Fixed effects regression results

PanelOLS Estimation Summary						
=====						
Dep. Variable:	log_GDP	R-squared:	0.8833			
Estimator:	PanelOLS	R-squared (Between):	0.4062			
No. Observations:	374	R-squared (Within):	0.8833			
Date:	Tue, Jan 21 2025	R-squared (Overall):	0.4106			
Time:	16:50:42	Log-likelihood	519.32			
Cov. Estimator:	Unadjusted					
		F-statistic:	384.87			
Entities:	11	P-value	0.0000			
Avg Obs:	34.000	Distribution:	F(7,356)			
Min Obs:	34.000					
Max Obs:	34.000	F-statistic (robust):	384.87			
		P-value	0.0000			
Time periods:	17	Distribution:	F(7,356)			
Avg Obs:	22.000					
Min Obs:	22.000					
Max Obs:	22.000					
Parameter Estimates						
=====						
	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
-----						
log_BMI	-0.5315	0.2405	-2.2099	0.0277	-1.0046	-0.0585
Gender_encoded	0.0907	0.0199	4.5592	0.0000	0.0516	0.1298
log_Pop	0.0922	0.0173	5.3164	0.0000	0.0581	0.1263
Unemployment rate	-0.0027	0.0035	-0.7799	0.4359	-0.0097	0.0042
log_HC	0.3288	0.0179	18.329	0.0000	0.2935	0.3641
log_PFP	-0.2344	0.0476	-4.9193	0.0000	-0.3281	-0.1407
Life expectancy	0.0286	0.0044	6.5249	0.0000	0.0200	0.0373
const	22.481	0.7480	30.054	0.0000	21.010	23.952
=====						
F-test for Poolability: 884.38						
P-value: 0.0000						
Distribution: F(10,356)						

## Limitations

While this report presents evidence-based analysis and forward-looking projections on the potential impact of obesity reduction in the UAE, some limitations should be acknowledged:

1. **Data Availability and Gaps:** Although the analysis draws from the best available national and international sources, there are gaps in localized, disaggregated data—particularly around behavioural, socioeconomic, and regional variations in obesity prevalence and treatment access within the UAE.
2. **Intervention Efficacy in Local Context:** While the report references the success of interventions such as GLP-1 medications in countries like the US, the long-term efficacy, scalability, and adherence rates in the UAE context may differ due to cultural, regulatory, and healthcare system differences.
3. **Excluded Variables:** Some aspects that may influence obesity trends—such as mental health conditions, urban planning and walkability, or food system dynamics—have not been fully explored within the scope of this report due to time and data constraints.
4. **Evolving Landscape for Obesity Management:** The field of obesity research and intervention is rapidly evolving. New therapies, preventive strategies, and policy developments may emerge that could either reinforce or reshape the findings presented here.

## Disclaimer

This report has been developed for informational and analytical purposes only in an attempt to understand the socio-economic benefits of reducing obesity in the UAE. The content herein reflects independent research and modelling conducted by Whiteshield, without influence from any external parties. All policy references, intervention outcomes, and projections are based on publicly available data and expert literature. Final interpretation, local relevance, and implementation decisions remain at the discretion of relevant stakeholders and authorities.

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## United Arab Emirates

### Dubai

27, ICD Brookfield Place  
Trade Centre  
DIFC - Dubai

### Abu Dhabi

Al Bateen Tower, C6  
Bainunah, C103,  
Street 34  
Abu Dhabi

## Kingdom of Saudi Arabia

### Riyadh

Rubeen Plaza, Alsafarat  
1364, Riyadh Province  
Riyadh



### Website:

[www.whiteshield.ai](http://www.whiteshield.ai)



### Further contact details:

Tom Flynn – Partner  
Alexander Crean – Decision Support Lead