

# Maintaining a Healthy Weight is Not Easy, But it is Possible:

## A Review of Factors Associated with Long-Term Weight Loss Success

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### OBESITY: US AND GLOBALLY

The adult obesity rate in the United States now exceeds 35% in five states and is over the 30% mark in another 25 states.<sup>1</sup> West Virginia tops the list with the highest obesity rate at 37.7% of adults, and Colorado's adult obesity rate is the lowest at 22.3%.<sup>1</sup> Children in the US are closely following in their parents' footsteps with statistics from the 2016 National Survey of Children's Health (NSCH) indicating that combined overweight and obesity rates in children and teens aged 10-17 range between 20–38% depending on the state of residence.<sup>1</sup>

The World Health Organization's statistics show similar trends in overweight and obesity levels across the globe, where most of the world's population now lives in a country in which overweight and obesity kill more people than underweight.<sup>2</sup> This trend has led to a worldwide obesity rate that has tripled since 1975.<sup>2</sup> In 2014, nearly 30% of the global population, more than 2.1 billion people, were estimated to be overweight.<sup>2</sup> A 2017 review published in the *International Journal of Environmental Research and Public Health* indicates that **if this rate of overweight incidence continues, nearly half of the world's adult population will be overweight or obese by 2030.**<sup>3</sup>

### Financial Burden of Obesity

The financial burden incurred from overweight and obesity is an additional strain on the infrastructure of governments and on individuals and families. It is estimated that in 2008, the medical care costs associated with obesity in the US were \$147 billion.<sup>4</sup> Globally, the economic impact of obesity is tremendous, estimated to total \$2.0 trillion US dollars or 2.8% of the global gross domestic product (GDP) in 2014.<sup>3</sup>

### Health Burden of Obesity

The list of potential detrimental health outcomes associated with obesity and overweight is long, including but not limited to:<sup>4-5</sup>

Hypertension	Osteoarthritis
Dyslipidemia	Non-alcoholic fatty liver disease (NAFLD)
Type 2 diabetes (T2D)	Sleep apnea and breathing problems
Coronary heart disease	Body pain and difficulty with physical functioning
Stroke	Fertility issues
Gallbladder disease	Low quality of life
Coronary heart disease	Mortality
Certain cancers (endometrial, breast, colon, kidney, gallbladder, and liver)	Mental illness such as clinical depression, anxiety, and other mental disorders

### OBESITY TRENDS BOOST BUSINESS BUT NOT MOTIVATION

The commercial weight loss program segment of the US market was worth \$2.77 billion in 2016 and is forecasted to grow 9.4% to \$3.03 billion in 2017.<sup>6</sup> Interestingly, although there continues to be an increase in prevalence of overweight and obesity in the general population combined with an increase in spending in the weight loss market, **the actual number of people who have reported trying to lose weight has dropped.**<sup>6-7</sup>

A recent *JAMA* article found that during the time period 1988 – 1994, nearly 56% of overweight and obese adults analyzed had tried to lose weight in the past year.<sup>7</sup> This percentage dropped to 47% between 1999 and 2004 and increased slightly to 49% from 2009 to 2014.<sup>7</sup>

The study concludes that this reduction in individuals attempting to lose weight may be due to several factors including:<sup>7</sup>

- “Normalizing” of overweight and obese body types within current day society
- High failure rate of most weight loss attempts

## CHALLENGES ASSOCIATED WITH SUCCESSFUL LONG-TERM WEIGHT LOSS

Lifestyle modifications and changing habits can be difficult to maintain. As people age, in the case of alcohol, drug addiction, smoking and gambling, 80-90% end up moderating or stopping the unhealthy behavior.<sup>8</sup> This is not the case with lifestyle changes related to weight loss, where on average, only 20% of people maintain their weight loss in the long term.<sup>8</sup> In light of the fact that weight loss attempts are declining, in large part due to the high long-term failure rate, further understanding specific factors known to create successful long-term adherence to healthy behaviors and lifestyle modifications is needed.

Long-term weight loss attrition rates range from 10% to more than 80% depending on the type of intervention employed.<sup>9</sup> In addition, the definition and measurement of “obesity treatment attrition” has still not been clearly defined; this ambiguity creates a gap in understanding the emerging trends in recent studies and utilizing that information to create effective interventions.<sup>10</sup> What *is* more clearly defined, however, are certain factors that have been associated with higher weight loss *attrition* rates.

These include:<sup>11-13</sup>

- Younger age
- Smokers
- Higher baseline BMI
- Fewer years of education
- No health insurance
- Lower attendance in group sessions when offered in first 6 months
- History of previous attempts of losing 50–79 pounds

Conversely, there are common factors associated with *successful* long-term weight loss that have been identified in observational and randomized studies.<sup>14</sup>

These factors associated with success can be divided into several categories:<sup>13</sup>

### Behavioral Factors

- High levels of physical activity
- Eating a low-calorie, low-fat diet
- Frequent self-monitoring of weight

### Cognitive Factors

- Reduced disinhibition
- Satisfaction with results achieved
- Confidence in being able to lose weight without professional help

### Personality Traits

- Low novelty seeking

### Patient-Therapist Interactions/Therapeutic Alliance

- Maintaining adherence to weight loss lifestyle modifications
- Long-term self-help groups
- Face-to-face or web-based interventions

It is well known that overweight and obesity are the result of a complex set of interactions including genetic, behavioral, and environmental factors. With the staggering increase in overweight and obesity globally over the past several decades, genetics most likely plays a less significant role in the epidemic than do behavioral/lifestyle changes and current environmental factors.

The next section will review behavioral/lifestyle and environmental factors which can affect the success of long-term weight loss maintenance. These include: eating habits,<sup>15</sup> physical activity,<sup>16</sup> behavioral modifications,<sup>17</sup> support systems,<sup>18</sup> the gut microbiota,<sup>19</sup> and various dietary patterns<sup>20-28</sup> including low-carbohydrate and low-fat approaches; intermittent fasting; and low-carb ketogenic approaches.

## FACTORS RELATED TO SUCCESSFUL LONG-TERM WEIGHT LOSS

### Modifying habits around the act of eating

A large part of long-term weight loss maintenance is the adherence to a calorie deficit state; this deficit can result from increased expenditure (i.e. physical activity) as well as a reduction in intake (i.e. less calories from food/beverage).

Lifestyle factors which have been shown to perpetuate weight gain through excessive calorie intake include:

### Eating habits that may promote overweight and weight regain:<sup>15</sup>

1. Eating few or no meals at home
2. Opting for high-fat, calorie-dense foods

3. Opting for high-fat snack foods from strategically placed vending machines or snack shops, combined with allowing insufficient time to prepare affordable, healthier alternatives

4. Consuming meals at sit-down restaurants that feature excessive portion sizes or “all-you-can eat” buffets

#### **Simple changes to modify the eating environment and support successful, sustainable weight loss:**

1. Prepare meals at home and carry bag lunches
2. Learn to estimate or measure portion sizes
3. Learn to recognize fat content of dishes
4. Eliminate smoking and reduce alcohol consumption
5. Substitute low-calorie alternatives for high-calorie foods
6. Modify travel routes to avoid favorite food shops

#### **PHYSICAL ACTIVITY PERPETUATES WEIGHT LOSS RESULTS<sup>16</sup>**

Once initial weight loss goals are met, physical activity remains an important part of a long-term weight loss maintenance plan, reducing the risk of weight regain. A 30-month study following 202 overweight adults found that those with exercise expenditure greater than 2500 calories/week had less than half the weight regain when compared to those whose exercise expenditure was less than 2500 calories/week (2.9 vs. > 6 kg weight regain). Another study with a 33-year follow-up found that men who maintained > 150 minutes/week of physical activity regained 5.6 kg compared to the less active men who averaged a 9.1 kg weight regain. This trend was even more significant among the women who were followed in the study (3.8 vs. 9.5 kg). **Overall, the research literature would suggest that physical activity ranging between 150-300 minutes/week is helpful in reducing the risk of weight regain.**<sup>16</sup>

#### **WEIGHT LOSS WITH A COMBINATION OF BEHAVIORAL MODIFICATIONS<sup>17</sup>**

Results from a 10-year observational study were published in the *American Journal of Preventive Medicine* and followed 2886 participants (78% female) with a mean age of 48 years. Participants were from the National Weight Control Registry (NWCR) who had lost at least 30 pounds and maintained that weight loss for at least one year. It was found that > 87% of these individuals had maintained at least a 10% weight loss at the 5- and 10-year follow-up time points, and a larger initial weight loss and longer duration of maintenance were

both associated with better long-term outcomes.

**Factors found to increase risk of a greater weight regain included reduction in leisure-time physical activity, decrease in dietary restraint, and fewer times checking one’s weight. Additionally, an increase in percentage of caloric energy from fat was associated with a greater weight regain.** The study concluded that long-term weight-loss maintenance is possible but that it requires adherence to sustained behavioral change.<sup>17</sup>

#### **SUPPORT GROUPS ENCOURAGE LONG-TERM WEIGHT LOSS MAINTENANCE<sup>18</sup>**

A recent article gathered data from a 5-year retrospective observational study of 10,693 participants, of which 2777 were available for analysis at the 5-year time point. The study was undertaken to determine the efficacy of a long-term, medically-supervised weight management program delivered through various Kaiser Permanente Northern California Medical Centers. The program consisted of 3 phases: Complete Meal Replacement for 16 weeks; Transition Phase from 17-29 weeks and Lifestyle Maintenance Phase from 30-82 weeks. Over the 5 years, participants were actively engaged in weekly, closed small group sessions. The average age of participants was 51.1 years, and 72.8% were women. Results from this study showed that weight loss between 5.0-9.9% occurred in 16.3% of participants, and weight loss of ≥ 10.0% occurred in 35.2% of participants. Overall, there was a statistically and clinically significant 5.8% weight loss from baseline at the 5-year time point indicating that **the combination of weight loss behavioral and lifestyle modifications side-by-side with weekly group sessions is an effective approach to long-term weight loss maintenance.**<sup>18</sup>

#### **GUT MICROBIOTA AND WEIGHT LOSS MAINTENANCE<sup>19</sup>**

It has been found that the gut microbiota composition of lean and obese individuals varies. Some studies indicate that a higher ratio of *Firmicutes* favors an increase in energy extraction from food, thus increasing risk of weight gain and obesity. In contrast, a ratio higher in *Bacteroidetes* has been observed in lean individuals. It has also been hypothesized that certain bacterial strains can be modified through dietary interventions, while other strains may be more genetically determined. One particular study looking at successful weight reduction over a two-year period found elevated *Akkermansia* quantity in fecal samples of individuals who had maintained long-term weight

loss. This study also noted an association between metabolic co-morbidities and a higher *Firmicutes/Bacteroidetes* ratio.<sup>19</sup>

Data on weight loss maintenance and the potential role of the gut microbiota is in its infancy. More research is needed to determine the full impact and best approaches for targeted microbiota interventions to favor long-term weight loss management.

## DIETARY MODIFICATIONS

Optimal dietary advice is challenging, as the “best dietary approach” varies depending on the individual and should take into account their unique needs and individual makeup, including but not limited to:

- Personal health and wellness goals; starting baseline health status and weight; age, gender, nationality; the composition of each individual’s unique gut microbiome; availability of community and family support resources; stress levels and quality of sleep; mental well-being; time and resources available to focus on sustainable lifestyle modifications; genetic makeup and individual SNPs; financial resources required and available for long-term changes in diet and behaviors, etc.

Although weight loss programs and approaches are highly individual, the literature does point out some dietary pattern similarities associated with long-term benefit. Several approaches to weight loss, including low-fat, low-carb, intermittent fasting and ketogenic diets, are explored in more detail below.<sup>20-28</sup>

### Low-fat vs. low-carb in long-term weight loss<sup>20-23</sup>

An in-depth systematic review and meta-analysis published in *Lancet* examined the effects of low-fat diet interventions vs. other diet interventions on long-term weight change in over 68,000 adults.<sup>20</sup> During the actual weight loss phases, low-carbohydrate interventions led to significantly greater weight loss than the low-fat interventions, whereas the low-fat interventions led to a greater weight reduction *only* when compared to a usual diet. **Results from this review did not support the superiority of low-fat diets over other dietary interventions for long-term weight loss.**<sup>20</sup>

While low-carbohydrate dietary approaches for long-term weight loss and maintenance has been demonstrated, the best macronutrient to replace the carbohydrates is less well understood. Results from a large epidemiological cohort study comprised of

individuals aged 35-70 years and from 18 countries confirmed the connections between a low-carbohydrate, healthy fat diet with long-term reduced risk of chronic disease and mortality.<sup>21</sup> The *Lancet* study followed over 135,000 individuals for a median period of 7.4 years, tracking their diets with validated food frequency questionnaires. The study examined primary outcomes of total mortality, major cardiovascular events (fatal cardiovascular disease, non-fatal myocardial infarction, stroke, and heart failure) and multiple secondary outcomes including all myocardial infarctions, stroke, cardiovascular disease mortality, and non-cardiovascular disease mortality. The data were analyzed to determine the associations between intake of total carbohydrates, total fat, and specific fat types with risk of cardiovascular disease and mortality incidence.<sup>21</sup>

The study found that high total carbohydrate intake (> 60% of total energy) was associated with an increase in total mortality and non-cardiovascular disease mortality. In contrast, a higher fat intake was associated with lower risk of total mortality, non-cardiovascular disease mortality, and stroke; this finding conflicts with current public health recommendations to keep total daily fat intake < 30% of energy and saturated fat < 10% of energy. The authors indicate that **individuals with high carbohydrate intake might benefit from a reduction in carbohydrate intake and replacement with a comparable increase in healthful fat consumption, emphasizing polyunsaturated acids in particular.**<sup>21</sup>

Another recent study published in *Nutrients* found that the macronutrient ratio may not be the only important dietary pattern component to consider in long-term weight loss maintenance. The results from this study found that the **inflammatory properties of a diet play a major role in weight regain after weight loss in overweight and obese adults.**<sup>22</sup> Focusing on reducing inflammatory foods (processed foods and foods high in saturated fat and sugar) and increasing **anti-inflammatory choices (fruits, vegetables, legumes, nuts, seeds, and whole grains) on a regular basis** may be a valuable approach in maintaining weight loss over a long period of time.<sup>22</sup>

The DE-PLAN project (Diabetes in Europe: Prevention Using Lifestyle, Physical Activity and Nutritional Interventions) is a translational research study that sought to identify predictive factors of long-term weight reduction maintenance in patients during

a type 2 diabetes prevention program.<sup>23</sup> They followed a group of weight loss participants for three years.

The study results indicate that individuals who maintained weight loss over an extended period of time continued to partake in the same healthy behaviors that they participated in during the initial weight loss phase, including **increasing intake of fruits and vegetables, decreasing fat consumption, reducing saturated fat intake, and engaging in regular physical activity.**<sup>23</sup>

#### **Intermittent fasting**<sup>24-25</sup>

Intermittent fasting (IF) has become a popular method for weight loss recently. Multiple approaches have supporting evidence for sustainable, long-term weight loss, including alternate day fasting, whole day fasting and time restricted feeding.<sup>24</sup> A review which analyzed 40 different studies found IF efficacious for weight loss, with an average weight loss of 3-5 kg over a 10-week period, although IF was *not* found to be superior to continuous energy restriction for weight loss.<sup>24</sup> One particular study followed 100 participants for 1 year; the first 6 months focused on weight loss, while the second 6 months tracked weight loss maintenance.<sup>25</sup> Participants were randomized into 1 of 3 groups: alternate-day fasting (IF) (25% of energy needs on fast days; 125% of energy needs on alternating "feast days"), calorie restriction (75% of energy needs every day), or a no-intervention control.<sup>25</sup> At the end of the year, it was found that IF individuals had similar long-term weight loss maintenance as continuous energy restriction, but the IF group experienced a higher drop-out rate than the conventional calorie restriction groups.<sup>25</sup> **Although IF may be an effective method for weight loss and maintenance, the research to date does not indicate its superiority over traditional, calorie restriction approaches.**<sup>25</sup>

#### **Low-carbohydrate ketogenic diet**<sup>26-28</sup>

Another dietary approach that has gleaned considerable popularity recently is the ketogenic diet. In a 2016 ketogenic diet study, a group of 45 obese patients were randomized to 24 months of either a low-calorie ketogenic diet (LCK) or a standard low-calorie diet.<sup>26</sup> After 24 months, participants on the LCK diet sustained greater reductions in body weight, waist circumference and overall body fat mass when compared to the low-calorie diet participants.<sup>26</sup>

The study concluded that **adherence to a LCK diet was supportive of a reduction in total body weight and visceral fat, both important chronic disease risk factors related to obesity.**<sup>26</sup>

Another ketogenic diet study investigated the impact of a low-calorie diet on weight loss maintenance over a 12-month period, finding that the **LCK group experienced greater reductions in weight, hemoglobin A1C (HbA1C), and medications than those who followed a moderate-carbohydrate, calorie-restricted, low-fat diet** over the same time frame.<sup>27</sup> Other interventions recommended for both groups included regular physical activity, obtaining sufficient sleep and practicing regular behavioral adherence strategies based on positive affect and mindful eating.<sup>27</sup>

Although short- and long-term weight loss appear to be a benefit of LCK diets in some studies, a recent review published in the *European Journal of Nutrition* questions the overall health advantages associated with the totality of literature on LCK diets (this study referenced LCK diets as low-carbohydrate, high-fat diet or "LCHF"). Observations from the review include:<sup>28</sup>

- Any diet type resulting in reduced energy intake results in weight loss and related favorable metabolic and functional changes
- Short-term LCHF studies report both favorable and unfavorable effects
- Sustained adherence to a ketogenic LCHF diet appears to be difficult. A non-ketogenic diet supplying 100–150 g carbohydrate/day, under good control, may be more practically sustainable
- There is lack of data supporting the long-term efficacy, safety and health benefits of LCHF diets, therefore clinical recommendations should be judged in this light
- For those at high risk of developing type 2 diabetes, lifestyle modifications (including a relatively carbohydrate-rich diet) result in long-term prevention of progression to type 2 diabetes and are generally seen as safe

As indicated in the review summarized above, not all studies reviewing the LCK diet demonstrate long-term weight loss benefits,<sup>28</sup> which **underscores that there is no "one diet fits all" solution.**

## **CONCLUSIONS**

Overweight and obesity are a tremendous problem, globally impacting individuals, families, countries, economies, and long-term viability of the health of humanity. Approaches for reducing this epidemic are multi-factorial and, when reviewed for efficacy must consider long-term sustainability and safety.

**Individual assessments and personalized lifestyle intervention approaches should be the main focus of an effective, safe, long-term weight loss program.**

Important factors in such a program include:

- Reduced processed carbohydrate intake
- Balanced and healthy fat intake
- Reduced caloric intake
- High nutritional density
- High fiber intake
- Diversified and balanced beneficial gut bacteria
- Regular physical activity
- Community/network support (in-person, phone/internet based, group sessions)
- Stress reduction and modification
- Adequate resources for long term application and maintenance of lifestyle and behavioral changes (financial, availability/access, etc.)
- Other factors including sleep health and mental well-being

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