THE NASM GUIDE TO WEIGHT-LOSS SUPPLEMENTATION

Contents

Welcome!

"Fat burner"—a supplement product name that is all too familiar to consumers looking for an advantageous edge to fat loss. Generally, the products are accompanied by too-good-to-be-true before- and -after results and advertisements that play on the confirmation bias of a consumer's emotional need to feel they have to improve their physical appearance. However, the efficacy of most weight-loss supplements have not been rigorously tested, nor have they undergone evaluation by the Food and Drug Administration (FDA) for approval, and, as such, are marketed as dietary supplements under the Dietary Supplement Health and Education Act (DSHEA) of 1994.

With more than two-thirds of adults in the United States classified as overweight or having obesity, approximately 15% of U.S. adults have trialed a weight-loss dietary supplement at some point in their lives (U.S. Department of Health and Human Services, NIH Office of Dietary Supplements, 2002). With the global weight-loss market valued at close to $44 billion in the year 2022 (having grown from $33.4 billion in 2020), it is evident to see that global interest in this area of dietary supplements is growing at a rapid pace (Global Industry Analysts, Inc., 2024). In this guide, we will delve into the research of common dietary supplements used for weight loss, look at their mechanisms, and determine whether they are worth the health investment.

—Dr. Dean St. Mart, PhD

About NASM

The National Academy of Sports Medicine is the leader in educating and credentialing fitness, wellness, and performance professionals across the globe. We provide valid, up-to-date content on topics that improve the health and well-being of those they serve. We pride ourselves on creating practical content you can apply right away. Learn more about us at www.nasm.org, your favorite social media platform, or wherever you listen to podcasts.

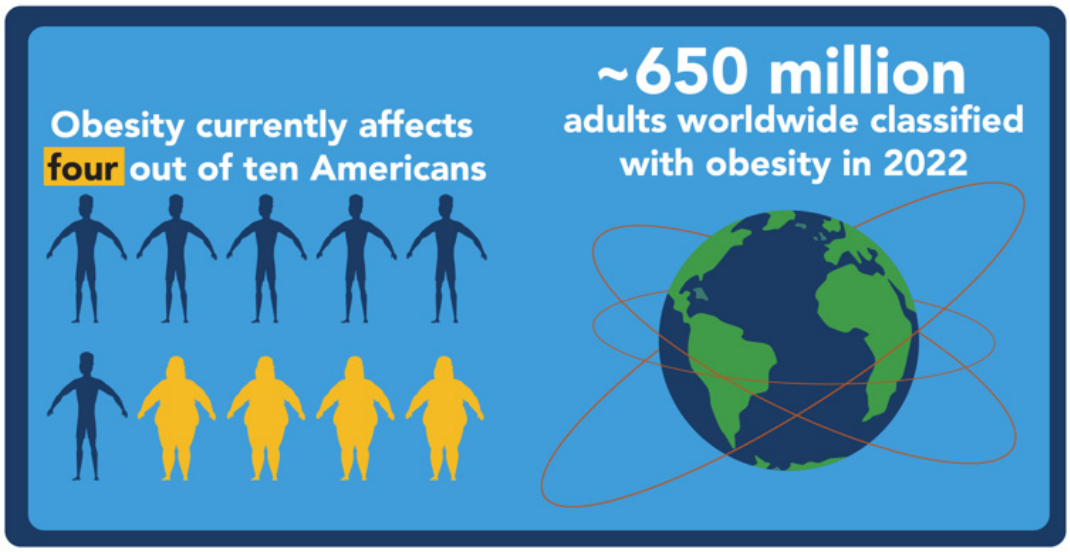
Getting the Most from This Guide

This NASM Guide to Weight-Loss Supplementation will walk you through information explaining a little bit of the "why" behind the "how" on weight-loss dietary supplements and how they might best serve your health and fitness goals. We'll make sense of the information out there so you won't have to, and we'll give you some key takeaways and actionable steps on weight-loss supplement ingredients in whichever avenue of your life might need dietary supplemental support.

Come back and use the information as a reference any time. Be sure to use the key takeaways and application strategies in whatever way makes sense for you. Don't feel obligated to put *everything* into action right away. When you're ready for a deeper dive on the topic of weight-loss dietary supplements, check out our recommended resources.

Introduction

According to the Centers for Disease Control and Prevention (CDC), obesity currently affects 4 out of 10 Americans (Centers for Disease Control and Prevention, 2022) with nearly 650 million adults worldwide classified with obesity in 2022 (World Health Organization, 2022).



However, the causes of obesity are complex, involving a dysregulation of the body's energy balance system via several mechanisms involving hormonal, metabolic, and genetic pathways, alongside a sedentary lifestyle and excess calorie consumption. Because it is a disease impacting most body systems including the heart, liver, kidneys, joints, and reproductive system, weight loss is considered beneficial due to its disease risk reduction (Mah et al., 2022). However, obesity presents challenges. Successful weight loss, which also includes successful weight-loss maintenance, is often met with limited success through sustained dieting (via calorie restriction) and increased physical activity. As such, we are often drawn to dietary weight-loss supplements that promise **thermogenic**, **lipotropic**, or **satiating** properties to support dietary and lifestyle management that leads to weight loss and maintenance.

DIGGING DEEPER

Thermogenic refers to a substance that is "heat producing". When the body burns calories, it releases heat in a process called thermogenesis.

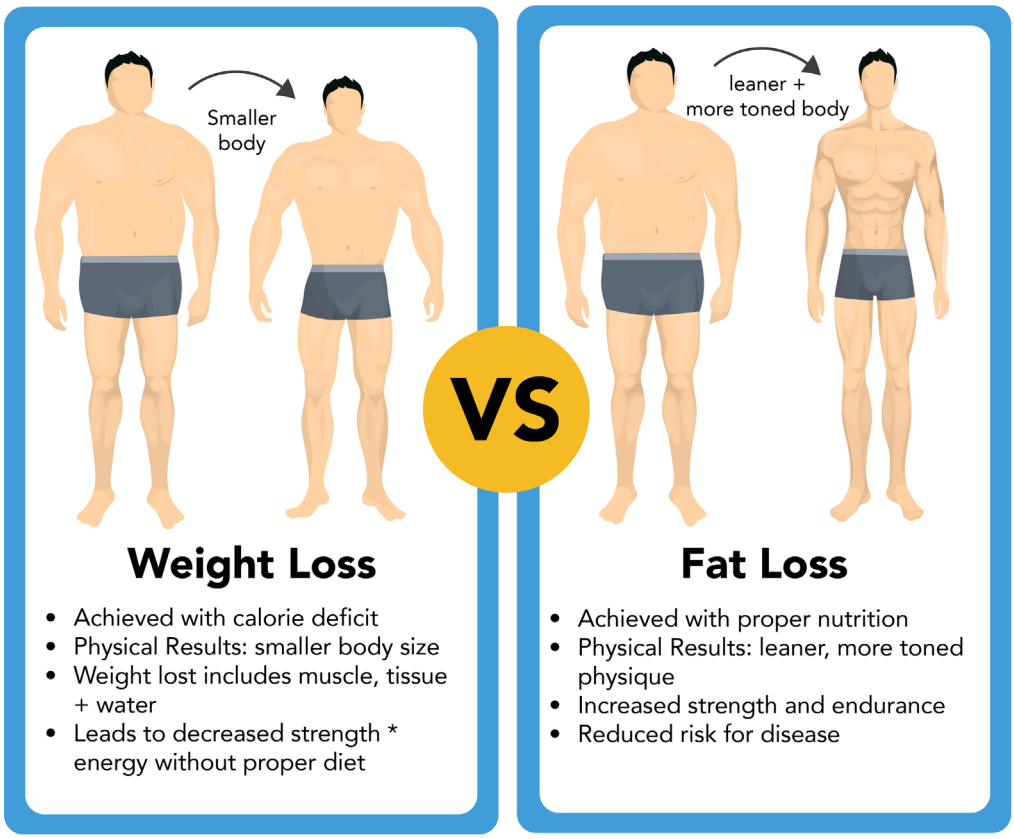
Lipotropic refers to a substance that promotes the breakdown of fat during metabolism in the body.

Satiating is the term used to describe when a food has satisfied your appetite with all that you need or all that you want of it.

Unfortunately, the deregulation of the dietary supplement industry allows for the marketing of products with limited (if any) evidence of efficacy; and with the rapid growth of the supplement industry year over year, it is unlikely that scientific evidence can evolve at a matched rate, leaving the consumer vulnerable to marketing cognitive bias. Therefore, it is of critical importance for consumers to be aware of the standing body of evidence towards the efficacy, and more importantly, the safety of weight-loss dietary supplement ingredients marketed for human consumption.

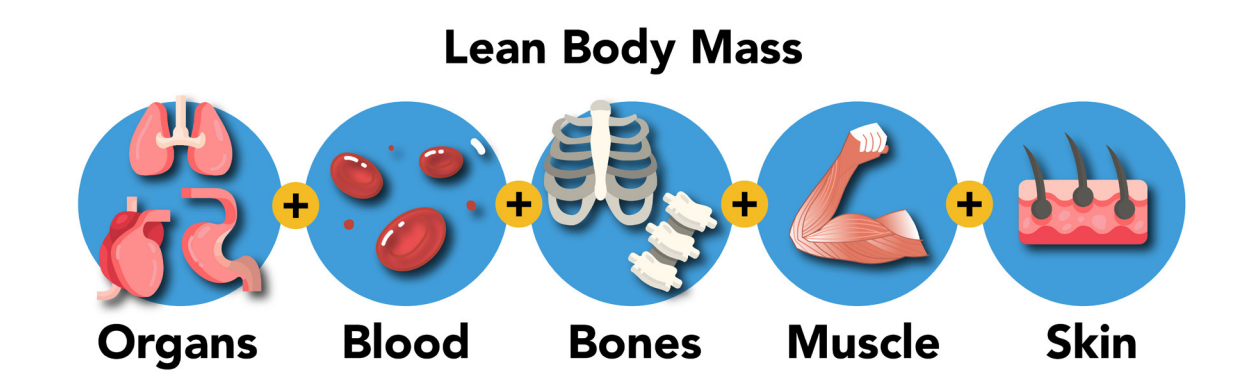
Weight Loss and Fat Loss– What's the Difference?

When considering weight loss, the term can often be confused with fat loss. Weight loss includes a total reduction in body weight, which includes both lean body mass (the weight of all organs, skin, bones, muscle mass, and water) and fat. Fat loss on the other hand is more specific in that it is the strict loss of adipose (fat) tissue, which includes both subcutaneous (under skin) and visceral (around organs) fat (**Figure: Weight Loss vs. Fat Loss**).



LEAN BODY MASS

The term lean body mass refers to the weight of all organs, skin, bones, muscle, and water within the body.

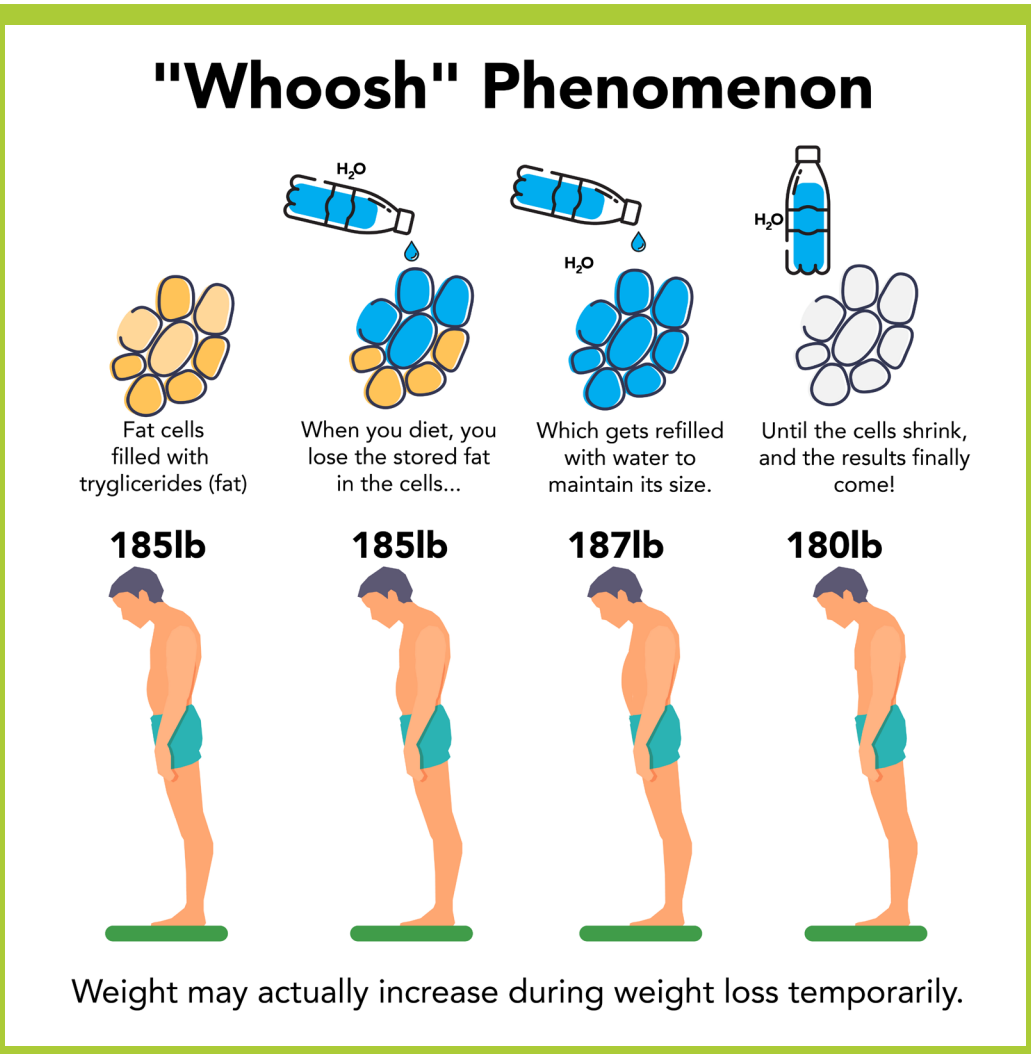


Therefore, weight-loss strategies should focus on the preservation of lean body mass while utilizing and burning body fat from a calorie deficit. Most commercial weight-loss programs focus on reducing body weight quickly within the first few weeks, resulting from the loss of lean body mass through fluid changes and water weight loss. While many associate weight loss as a primary outcome for success, the reality is that weight-loss interventions should focus on body composition changes (e.g., body part measurements decreasing, skinfold caliper measurements) to assess reductions in fat mass. Quite often when the sole focus is weight loss, the practices utilized to achieve that rapid reduction are often unsustainable (extreme calorie deficit, often including the complete removal of food groups) and the lost weight is quickly regained (Willoughby et al., 2018).

As fat cells become depleted of their fat content, water and glycerol can be brought inside the fat cell to keep its volume temporarily. This can often result in a weight loss stall and might actually lead to short-term weight gain, before a "whoosh" occurs, and the water is released resulting in dramatic weight loss. This is important to recognize and understand when weight loss can appear frustratingly slow.

DIGGING DEEPER

Lyle McDonald originally coined the term "whoosh effect" in his 2008 book The Stubborn Fat Solution. The "whoosh" effect describes the retention of water into fat cells following their depletion of triglycerides. While strictly a hypothesis, a recent study concluded that adipose tissue increased water content during weight loss in 10 obese subjects (Gansen et al., 2016; Pansini, 2021).



DIGGING DEEPER

A common myth is that sweating is synonymous with fat burning, but did you know the lungs are the main organ for weight loss?

The complete oxidation of 10 kg of human fat requires 29 kg of inhaled oxygen, producing 28 kg of carbon dioxide and 11 kg of water.

Nearly 30%, or 8.4 kg, of the carbon dioxide produced is excreted via the lungs.

The 11 kg of water produced is excreted in the urine, feces, sweat, breath, tears, or other bodily fluids (Meerman & Brown, 2014).

While some of the water produced from fat loss is indeed lost through sweat , the main mechanism by which fat is lost is through the exhalation of carbon dioxide.

Nutritional Consideration for Weight Loss

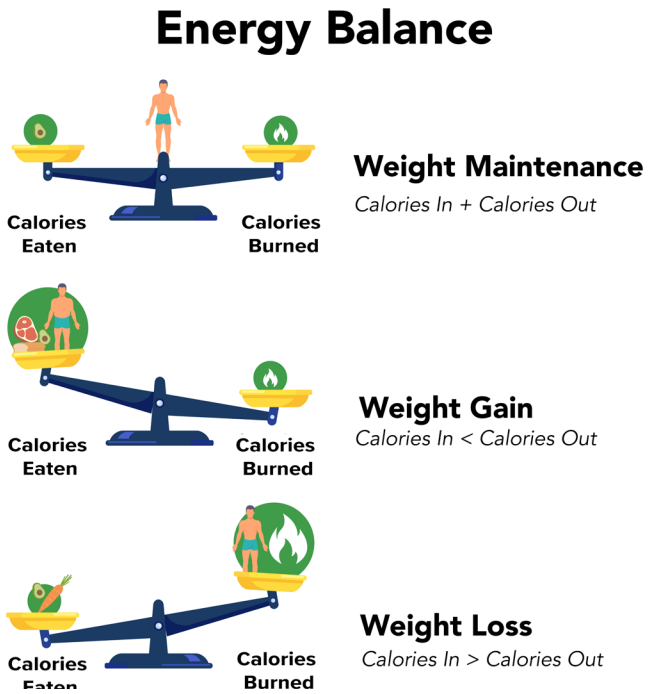
While not as tacky as a dietary supplement advertisement guaranteeing promises of immense change, the unpopular truth is that the basics of weight and fat loss begins with the mouth and dietary nutrition. In this section, we will look at the basics of energy metabolism, energy expenditure, and whether there is a best diet for weight loss.

Metabolism, Energy Expenditure, and the Calorie Deficit

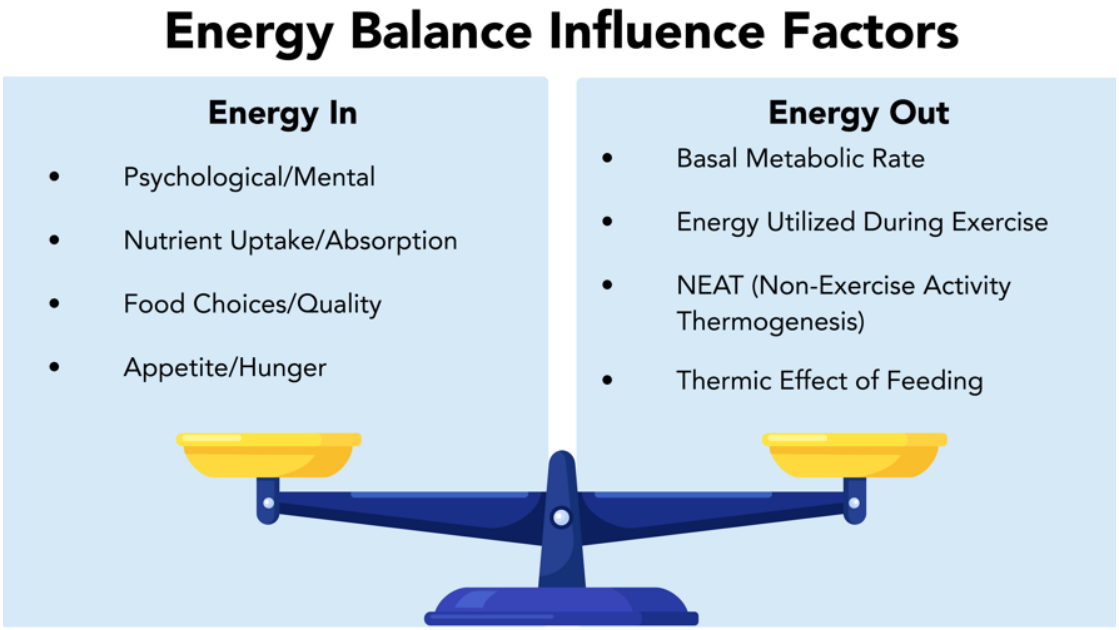
The principle of weight gain is relatively straightforward: Energy intake exceeds energy expenditure, resulting in excess energy (in the form of triglycerides) being stored in adipose (fat) tissue.

Quite often exercise is promoted as being the most important element of a weight maintenance program, but physical activity only accounts for 15 to 20% of daily energy expenditure, while food intake accounts for 100% of energy intake (Institute of Medicine (U.S.) Subcommittee on Military Weight Management).

(Institute of Medicine (US) Subcommittee on Military Weight Management)



The key component of weight loss is an energy deficit. Under the calories in, calories out (CICO) model, dietary management has focused on the concept of eat less and move more, but energy balance is a dynamic process that includes hormonal (thyroid, insulin, testosterone, estradiol, etc.) and physiological aspects such as nutrient digestion and absorption, and a degree of genetics toward energy utilization and storage (Kim, 2021) (**Figure: Energy Balance Influence Factors**).



Macronutrient Considerations–Is There a Best Diet?

When considering energy balance, reducing energy intake is by far the most direct way of creating an energy and calorie deficit. There are countless diets in existence, each with their own potential marketing bias. But whatever the name, all diets consist of reductions of proportions of protein, carbohydrate, and fat (Kim, 2021). A high protein diet might be useful to consider due to having the highest thermic effect of food (also called diet-induced thermogenesis), which is an increase in energy expenditure that results from nutrient processing and digestion. However, and unfortunately so, there is no one "best" diet for weight loss. It is important to understand that whichever diet is chosen, the end goal should focus on a sustainable method of developing habits and routines that allow for weight maintenance post-weight loss (**Table: Common Dietary Patterns** and **Table: Popular Named Diets**).

Common Dietary Patterns	
Type	**Brief description**
Calorie-Focused Diets	
Low-Calorie Diet	Consumption of 1,000 to 1,500 kcal per day. Creates a general deficit of 500 to 750 kcal per day.
Very-Low-Calorie Diet	Consumption of 600 to 900 kcal per day. Generally only maintained for a relatively short time period of time (2 weeks to 3 months). Considered for severe obesity, hypertriglyceridemia, and hypertension.
Meal Replacement Products (MRPs)	Calorie-controlled liquid shakes, useful for controlling calorie intake without placing much effort on individual meal calorie calculation or meal planning.
Food Type Diets	
Low-Fat Diet	Consumption of fat as <15% to 20% of daily calories. (Saturated fatty acids are <7% to 10% of total fat intake.)
Low-Carbohydrate Diet	Consumption of carbohydrates as <45% of daily calories or <130 g/day. Recommended as a dietary strategy for type II diabetes. Long-term results are similar to following a low-fat diet.
Ketogenic Diet	Consumption of carbohydrates as <10% of daily calories or <50 g/day.
High-Protein Diet	Increase protein intake to 30% of total daily calories or 1 to 1.2 g/kg of ideal body weight. Useful in maintaining weight loss and increasing satiety.
Mediterranean Diet	Consists of high consumption of fruits and vegetables, poultry, fish, dairy products, and monounsaturated fats, with little to no consumption of red meat. Emphasis placed on improving cardiometabolic parameters and cognitive health.

Time-Based Diets	
Intermittent Fasting	Periods of restricted feeding including: Alternate day fasting. 5:2 intermittent fasting (fasting or consuming less than 1,000 calories for 2 days each week). Daily time-restricted feeding (fasting for 16 to 18 hours a day).
	Adapted from Kim, 2021.

Popular Named Diets	
Name	**Description**
Paleo	Basic way of eating mirrored to paleolithic ancestors. Might omit dairy foods, cereal grains, starchy vegetables, as well as sugar in favor of wild, lean animal foods, non-starchy fruit, vegetables, and honey.
Low Carbohydrate-High Fat (LCHF)	Typically comprises 70 to 75% fat, 20% protein, and 5 to 10% carbs.
Vegan	Plant-based diet with strictly no animal-based products.
Blood Type	Diet based on an individual's blood type.
Dietary Approaches to Stop Hypertension (DASH)	Rich in fruits, vegetables, and lean protein, restricting fats and salt intake.

Weight-Loss Dietary Supplements

Even with the basics of weight loss, many are still drawn to the appeal of non-prescription dietary supplements to aid in weight loss. Over 30% of adults attempting weight loss have reported using dietary supplements, with the number of marketed weight-loss supplements exceeding 40% of the 776 dietary supplements identified in the FDA's Center for Drug Evaluation and Research, Tainted Products Marketed as Dietary Supplements CDER database (Tucker et al., 2018; Batsis et al., 2021). Dietary supplements appeal to the desire for a "natural, magic bullet" that is less demanding than special diets and increased physical activity (Saper et al., 2004) **(Figure: Why Overweight and Obese Patients Seek Dietary Supplements for Weight Loss)**.

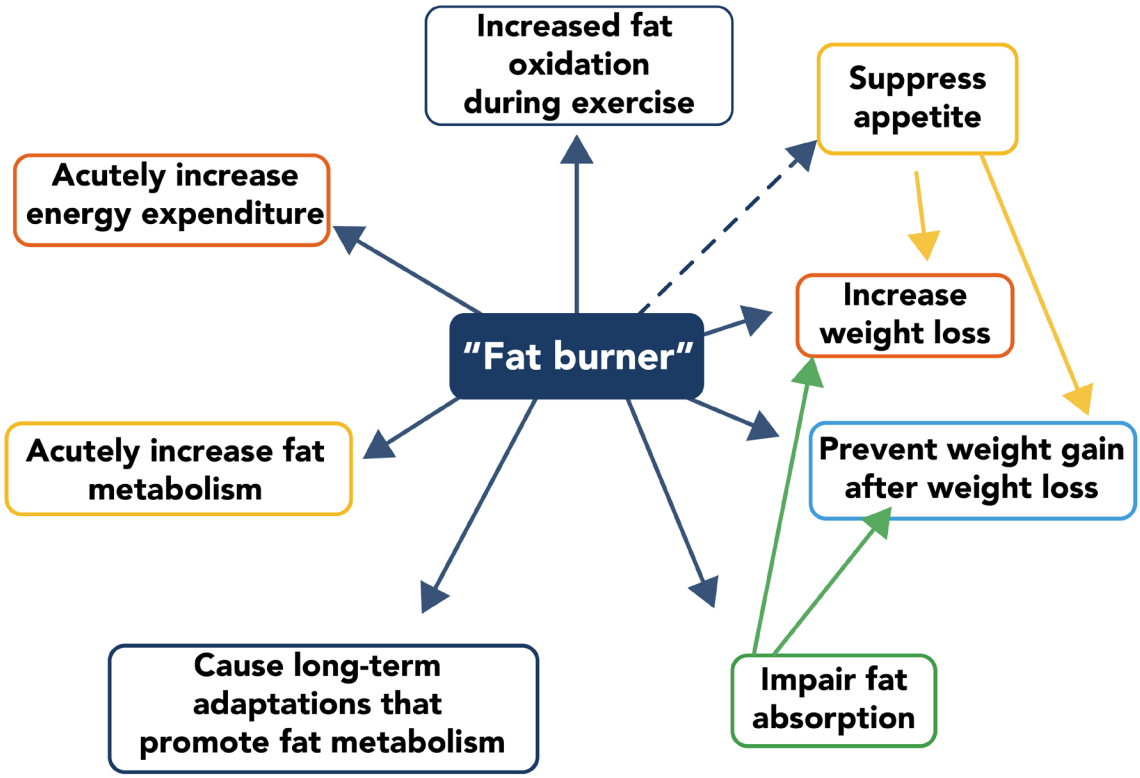
Why Overweight and Obese Patients Seek Dietary Supplements for Weight Loss

(Adapted from Saper, 2004)

How Weight-Loss Supplements Work

Weight-loss dietary supplements typically fall into one of four categories depending on their hypothesized mechanism of action (Manore, 2012):

1. Products that block the absorption of dietary fat or carbohydrates.
2. Stimulants that increase thermogenesis and lipolysis, decrease appetite, and increase energy output.
3. Products that change nutrient partitioning, effecting metabolism to increase fat oxidation or reduce fat synthesis.
4. Products that suppress appetite or give a sense of fullness.



Outside of the four standard classifications, dietary supplements for weight loss might also be designed to increase water elimination (natural diuretics) and enhance mood.

DIGGING DEEPER

Commonly phrased terms used when marketing the mechanisms of weight-loss dietary supplements can include **thermogenesis, lipolysis,** and **nutrient partitioning** to drive customer intrigue. Nutrient partitioning is the process by which an organism chooses to utilize energy for storage or utilization (e.g., oxidation for energy or protein synthesis) when an excess of energy is consumed.

A full breakdown of some popular dietary supplement ingredients by category are listed below alongside the clinical stance on efficacy (Manore, 2012) (**Table: Popular Dietary Ingredients Found in Weight-Loss Supplements**).

Popular Dietary Ingredients Found in Weight-Loss Supplements			
Supplement	**Proposed Mechanism**	**Potential Side Effects**	**Current Status**
Supplements Involving Blocking Macronutrient Absorption			
White Kidney Bean Extract	α-amylase inhibitor reduces or prevents carbohydrate digestion and absorption	GI upset, bloating	Little research to support efficacy
Chitosan	Fat binder (1 g of Chitosan binds 4 to 6 g dietary fat)	GI distress, flatulence	Minimal evidence to support efficacy
Supplements Involving Stimulating Metabolism			
Caffeine	Increased thermogenesis	High intakes (>300 mg/day) can cause insomnia, heart palpitations, anxiety	Little research to support long-term effect due to desensitization
Ephedra	Increased release of norepinephrine and epinephrine, appetite suppression	Stroke, heart problems	Banned by FDA
Green Tea	Increased thermogenesis, reduced lipogenesis, decreased fat absorption	Generally safe, but extracts have been associated with liver damage on empty stomach	Small effect on weight loss (<2 kg)
Guarana	Increased thermogenesis due to caffeine content	Similar to caffeine	No effect documented on weight loss
Yerba Mate	Increased thermogenesis due to caffeine content	Similar to caffeine	No effect documented on weight loss
Bitter Orange Extract	Contains synephrine alkaloids that are similar to ephedra, lipolytic properties	Increased heart rate, angina	No evidence to support efficacy

Yohimbe Bark Extract	Blocks alpha-adrenergic receptors, increasing norepinephrine release	GI distress, increased heart rate, anxiety	No evidence to support efficacy
Supplements Involving Nutrient Partitioning			
Calcium	High calcium diet increases fecal fat excretion	Generally regarded as safe	Might only be beneficial for those consuming a low calcium diet
Conjugated Linoleic Acid (CLA)	Reduction in fat cell differentiation	GI distress	No effect observed in humans
L-Carnitine	Increased fatty acid transport into mitochondria for utilization	Generally regarded as safe	No evidence to support efficacy
Chromium Picolinate	Potentiates the action of insulin	Doses under 200 mcg/ day generally regarded safe	Minimal evidence to support efficacy
Hydroxycitric Acid (HCA)	Might suppress fatty acid synthesis	Potential liver injury and safety concerns	Minimal evidence to support efficacy
Pyruvate	Might improve fat oxidation by improving carbon dioxide respiration rate	Large doses >5 g might cause GI distress	No data to support significant weight loss
Supplements Involving Appetite Suppression			
Soluble Fibers (e.g., Psyllium husk, beta glucans, glucomannan)	Soluble fibers hold water in GI, leading to feelings of fullness and contribute to Short Chain Fatty Acids that influence satiety hormones produced by the gut microbiome	GI upset, bloating, gas	Small decrease in weight (1 to 2 kg)
Hoodia gordonii	Appetite suppression through P57 steroidal alkaloid component	No safety data published	No evidence to support efficacy

Adapted from Manore, 2012.

Benefits of Weight-Loss Dietary Supplements

Dietary supplements for weight loss vary in their claims of mechanisms and efficacy, and the consensus is that no effective weight-loss supplements are approved by the FDA. Green tea, fiber, and micronutrient deficiencies (calcium and chromium) might help support a healthy lifestyle to compliment weight loss by reducing dietary fat absorption (and potential fat cell creation or storage), but the evidence is marginal, and no dietary supplement ultimately drives fat loss by itself (Manore, 2012).

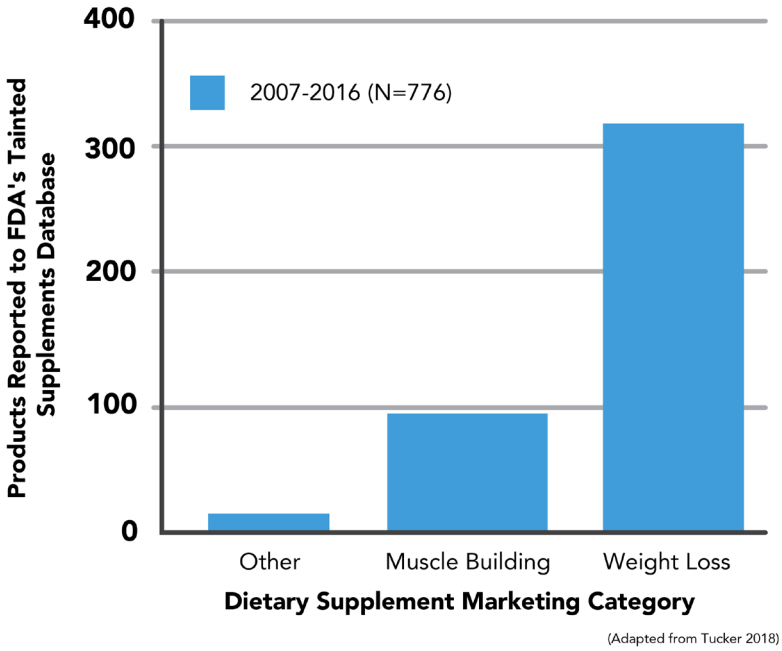
With this in mind, a food-first approach should always be considered as the main anchor for weight loss before dietary supplements. Generating healthy habits toward lifestyle and activity to support and create an energy deficit for weight loss serve as the basic foundations for successful and sustained weight-loss outcomes.

Potential Risks and Side Effects of Weight-Loss Supplements

Dietary supplements can have side effects that are often undermined by their consumers and can have the possibilities of interacting with pharmaceutical medications. Without adequate regulation, most products have ingredients that have not been tested in combination with one another. This leaves the consumer in an uncomfortable position to make their own informed decision as to whether the lack of safety data warrants their use; either based on marketing bias, abstract science, or false marketing claims. Most often reported side effects include GI distress such as bloating or flatulence, or elevated heart rate/anxiety from stimulant use.

However, more serious adverse health risks have been associated because some ingredients can interact with prescription medications. For example, glucomannan (a dietary fiber) might decrease the absorption of prescription medication in the gut if taken together, leading to reduced drug efficacy. Bitter orange extract might inhibit metabolic enzymes in the liver (known as CYPs), leading to blood levels of certain drugs elevating due to slower elimination from the body, which can have serious toxic effects or unwanted interactions.

Dietary supplement use has been associated with over 23,000 emergency department visits in the U.S. each year (Tucker et al., 2018). Individuals taking dietary supplements and medications on a regular basis should discuss their use with their health care provider (U.S. Department of Health and Human Services, NIH Office of Dietary Supplements, 2002) **(Figure: Reported Supplements to FDA's Tainted Supplements Database)**.

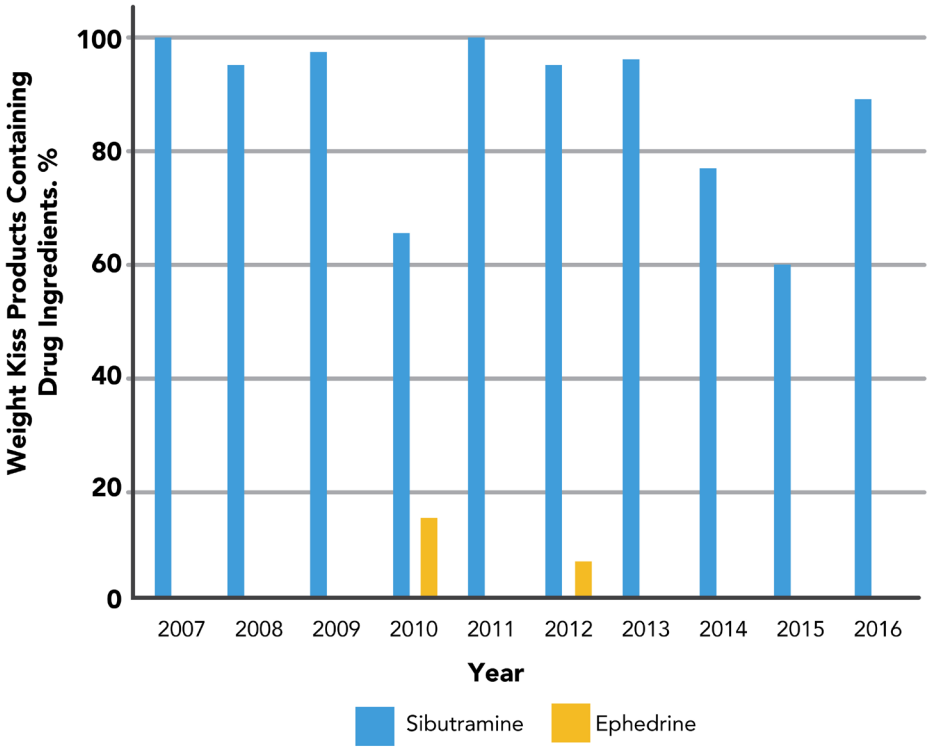


(Adapted from Tucker 2018)

Quality Control–Tainted Ingredients Risk

Weight-loss dietary supplements have been found to be tainted with, or adulterated with, prescription pharmaceutical ingredients, banned substances, or untested research compounds. In 2016, the FDA issued 36 public notifications warning consumers not to purchase specific weight-loss products because they contained a hidden drug ingredient—often sibutramine, a weight-loss pharmaceutical medication that was withdrawn from the U.S. market in 2010 because of safety concerns of increasing blood pressure (**Figure: Undeclared Ingredients Identified in 317 Weight-Loss Products From the U.S. Food and Drug Administration's Tainted Supplements Database**). Another ingredient, ephedrine, a stimulant that increases blood pressure found in the plant ephedra, was banned from dietary supplements by the FDA in 2004, yet was still being found in some weight-loss supplements (Tucker et al., 2018).

Figure: Undeclared Ingredients Identified in 317 Weight-Loss Products From the U.S. Food and Drug Administration's Tainted Supplements Database



Undeclared Ingredients Identified in 317 Weight Loss Products From the US Food and Drug Administration's Tainted Supplements Database

(Adapted from Tucker, 2018)

Overall Research Consensus Position on Using Weight-Loss Dietary Supplements

Weight-loss dietary supplements might contain a wide range of ingredients, but evidence is extremely weak on any positive outcome regardless of the combination. This is mirrored by the fact that most multi-ingredient products might overarch on evidence for one of the product's ingredients when evidence is lacking for the others. Furthermore, most of the studies on weight-loss supplements are poorly designed and lack the standards of rigorous randomized double-blind clinical trials (RCT) with appropriate populations studied. One study showcased that very few dietary supplement ingredients, when viewed under the rigorous lens of the Cochrane Collaboration's risk-of-bias tool, have very small significance toward weight change in studies with low bias risk (Batsis et al., 2021).

Conclusion

It is unfortunate, but the evidence supporting the use of dietary supplement ingredients for weight loss (reduce body weight, fat loss) is unconvincing and remains inconclusive. Successful bodyweight reduction requires a multi-factorial approach, including dietary calorie restriction, improvements to lifestyle and dietary food quality, and physical activity. However, the research on the use of dietary supplements alongside such interventions makes it difficult to ascertain the true benefit of the ingredient alone. While many supplements are generally regarded as safe, the monetary costs and marginal gain of weight-loss dietary supplements would be best foregone in favor of a sensible approach to healthy eating.

In summary:

- Deregulation of the dietary supplement industry permits marketing without stringent regulatory approval (Batsis et al., 2021).
- Use of dietary supplements among adults (with obesity) is high despite their limited evidence.
- There is weak evidence for the efficacy of dietary supplements toward weight loss.
- The interaction between lifestyle interventions and dietary supplements needs to be evaluated in future trials.

Key Takeaways

What You Can Do Now

With all the facts and evidence from this guide, we hope that you can make a more informed decision when seeking to utilize or purchase dietary supplements marketed for weight loss. With weak evidence for efficacy beyond nutritional support, here's some key points to consider on a weight-loss journey:

- Weight-loss interventions should focus on body composition changes as opposed to numerical changes on the scale. Patience is key.
- The key component of weight and fat loss is an energy deficit (calories in, calories out) achieved through a balance of food intake and energy output through physical activity.
- Food intake accounts for 100% of energy intake.
- Physical activity only accounts for 15 to 20% of daily energy expenditure.
- Dietary supplements for weight loss might help complement micronutrient deficiencies, but none directly influence weight loss by themselves.

Online Resources

Want to learn more about nutrition? Here are a few places to find reliable information and insight about nutrition and healthy eating behaviors.

- NASM's Certified Nutrition Coach Certification (NASM-CNC)
- NASM Blog
- NASM's YouTube Channel

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THANKS FOR READING!

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