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# Flexible Dieting and Metabolic Adaptation During Weight Loss: A Comprehensive Review

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Metabolic Adaptation During Weight Loss

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### Abstract

The purpose of this research project is to acquire knowledge on the metabolic adaptation that occurs during weight loss. Metabolic adaptation is a phrase often used among the fitness community as a way to describe the fluctuations in metabolism that occur during a caloric deficit. Metabolic changes that take place during weight loss favor decreased energy expenditure resulting in the down-regulation of metabolic rate. Metabolic rate is summarized by total daily energy expenditure, which has several components that collectively influence the amount of calories that an individual burns in a day. During a caloric deficit that is required for weight loss, a number of mechanisms are manipulated that function to reduce the effects of weight loss by promoting metabolic adaptation. The research included in this project is designed to learn about the mechanisms that characterize metabolic adaptation.

*Keywords:* metabolic adaptation, weight loss, metabolic damage, diet

### Metabolic Adaptation During Weight Loss

Metabolic adaptation is frequently and inaccurately referred to as metabolic damage. This phrase is most often used among the fitness community as a way to describe the changes that take place within the metabolism when an individual consumes a very low caloric intake over a long period of time. Many people who are new to the fitness lifestyle are vulnerable to falling into traps of fad diets and diet myths. The influence of social media and advertising often has negative effects on individuals who lack knowledge on proper ways to lose weight or live a healthier lifestyle. Frequently, this results in these individuals consuming very low calories because they cut out certain foods or entire food groups from their diet. While this is unhealthy for a variety of reasons, a detrimental effect is the significant impact that eating low calories has on metabolic rate and thermoregulation. In general, the body adapts to a very low caloric intake and will down-regulate as a way to counteract these effects. The same results are noticed in professional bodybuilders, fitness competitors, or members of the fitness community who go through very strict dieting phases in preparation for bodybuilding competitions or photo shoots. Often times these individuals must restrict their calories significantly in order to achieve a very low body fat percentage to be competitive on stage. The preparation for bodybuilding competitions can last 20 weeks or longer, which provides the body with a significant timeframe to adapt to low calories. Metabolic adaptation can happen to anybody who intentionally or unintentionally consumes very low calories over an extended period of time.

### Endocrine System and Metabolism

The endocrine system plays a significant role in metabolic adaptation. There are several hormones that are involved in metabolic rate and regulation. These hormones play a role in the regulation of body composition, energy intake, and energy expenditure. Thyroid hormones, specifically  $T_3$ , are directly related to metabolic rate. Hypothyroidism, or low-circulating thyroid hormone, contributes to a low metabolic rate and hyperthyroidism contributes to a high metabolic rate, which is more commonly referred to as a fast metabolism. A diagnosis of a hypothyroidism or hyperthyroidism is not the only condition in which these hormone levels vary. During a caloric deficit that is needed for weight loss, there will be fluctuations in these hormone levels (Trexler, E.T., A.E. Smith-Ryan, and L.E. Norton, 2014). A controlled clinical trial called POUNDS LOST aimed to explore the relationship between thyroid hormone levels, body weight, and resting metabolic rate (RMR). In general, this study found a positive relationship between  $T_3$  level and body weight, RMR, and other metabolic parameters. Thyroid hormones regulate RMR through increasing ATP production; however, the mechanisms associated with the metabolic changes that were observed during this study are not well known. Essentially, as body weight decreases  $T_3$  levels also decrease and results in a reduced metabolic rate (G Liu, L Liang, G A Bray, L Qi, F B Hu, J Rood, F M Sacks, Q Sun, 2017).

Leptin, also known as the “hunger hormone,” is secreted from fat cells distributed throughout the body. Leptin decreases in short-term energy restriction and lower body fat levels. This means that during a caloric deficit, there is a

decrease in serum leptin, which is also noted in lower body fat percentages. When weight loss occurs and body fat is reduced, the size of the fat cells decrease and there is a reduction in the total amount of leptin that is secreted and circulating in the body (Robinson, S. L., Lambeth-Mansell, A., Gillibrand, G., Smith-Ryan, A., & Bannock, L., 2015). When leptin is released into the blood, it travels to the hypothalamus, where it delivers a message that indicates how much fat storage is available and the body will then respond based on that message. If there is low leptin, the body recognizes that there is reduced fat storage and it will slow the metabolism in order to conserve energy. The normal range of serum leptin is approximately 3.7 to 11.1 ng/mL (Robinson, S. L., et al., 2015). Individuals who undergo intense dieting phases, such as bodybuilding competitors, experience a significant decrease in leptin levels. One study reported that a professional bodybuilder on a six-month diet for contest prep had a leptin level of 1.36 ng/mL by the end of his diet. Similar findings were reported in thyroid hormone concentration (Robinson, S. L. et al., 2015). These reductions are responsible for the decrease in metabolic rate that contributes to metabolic adaptation during weight loss.

Insulin also plays a role in metabolic rate and energy availability through regulating macronutrient metabolism and muscle protein breakdown. Insulin levels predominately decrease due to an improved insulin sensitivity when weight is reduced (Maclean, P.S., et al., 2011). However, the mechanism of these hormones in the response to weight reduction is more complex than previously thought. As adipocytes decrease in size during weight loss, not only is there less leptin secreted, the smaller cells become more insulin sensitive and require less insulin to carry out

the same metabolic role (Maclean, P.S., et al., 2011). It may seem that because there is a decline in body mass and a subsequent decline in leptin and insulin, the relative relationship between the hormones and body capacity will cause no metabolic changes. However, this is not the case. Thus, the slowed metabolism is manifested as a plateau in weight loss. Testosterone also plays an important role in regulating adiposity. Testosterone level is inversely correlated with fat storage. There is currently not adequate research to determine the exact role that testosterone plays in adiposity, but there are suggestions that it may repress adipogenesis (Maclean, P.S., et al., 2011). Ghrelin is the orexigenic hormone, which has a stimulating effect on the appetite. Ghrelin increases during a period of calorie restriction and decreases in well-fed states. However, studies show these hormones are lower than what is expected for the amount of fat mass that is lost after weight loss occurs (Maclean, P.S., et al., 2011). This means that the brain receives signals that the body is in a state of low energy and the metabolic adaptations that occur are aimed at preserving body fat and reversing the effects of weight loss.

In summary, there is a down-regulation of several hormones involved in regulating metabolic rate during a caloric deficit. Research shows there is a decrease in leptin, insulin, testosterone, and thyroid hormones with subsequent increases in cortisol and ghrelin. Evidence supports that these hormone levels remain in this fashion during maintenance of a low body fat percentage even after the period of active weight loss has ended. The body's response to the changes in hormone levels that occur during and after weight loss is reflected in the arcuate nucleus (ARC) portion of the hypothalamus. Much like the hormonal changes discussed previously,

the changes that take place in the hypothalamus function to reduce the effects of weight loss by promoting metabolic adaptation (Maclean, P.S., et al., 2011).

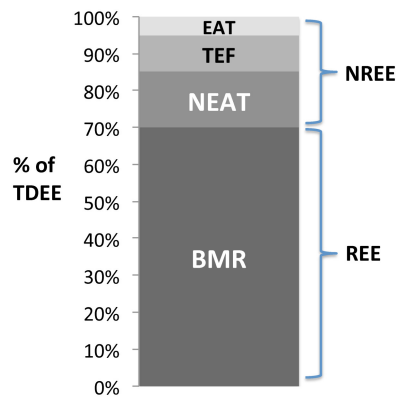
### Metabolic Adaptation and TDEE

Weight loss through a caloric deficit leads to adaptive thermogenesis, increased mitochondrial efficiency, and hormonal alterations favoring decreased energy expenditure. Ultimately, an individual who is experiencing metabolic adaptation, which manifests as a plateau in weight or fat loss, results in a proposed threat to dietary adherence and predisposes individuals to rapid weight gain. (Trexler, et al., 2014). The changes that take place within the body lead to a slowed metabolic rate, which can be summarized by changes in total daily energy expenditure (TDEE).

Individual metabolic rate is measured by TDEE. This is the total number of calories burned in a day. TDEE is the sum of basal metabolic rate (BMR), exercise activity thermogenesis (EAT), thermic effect of food (TEF), and non-exercising activity thermogenesis (NEAT). These components can be divided into two separate groups: BMR and NREE, or non-resting energy expenditure. BMR is the number of calories burned at rest. NREE includes EAT, TEF, and NEAT. EAT is the amount of calories expended during exercise. TEF is the number of calories required to digest and absorb food. NEAT is the number of calories burned through movement during daily life, which includes calories expended during activities of daily living including housework as well as unintentional movements such as fidgeting. These three components summarize NREE. BMR, also referred to as resting energy expenditure



(REE) and NREE make up TDEE. An individual's TDEE is essentially defined as his or her metabolic rate (Maclean, P.S., et al., 2011).



*Figure 1. Components of total daily energy expenditure (TDEE). BMR = basal metabolic rate; NEAT = non-exercise activity thermogenesis; TEF = thermic effect of food; EAT = exercise activity thermogenesis; REE = resting energy expenditure; NREE = non-resting energy expenditure (Maclean et al., 2011).*

During and after weight loss there is a decrease in TDEE. BMR is reduced, which is the largest component of TDEE, due to the reduction in metabolically active tissue. During a period of energy restriction, the TDEE typically decreases more significantly than the degree of body mass. This drop in TDEE is referred to as adaptive thermogenesis. The reason for this is that the body essentially goes into “starvation mode” where it seeks to preserve body weight by decreasing the overall rate of metabolism (Trexler, et al., 2014). This adaptive thermogenesis explains weight loss plateaus often experienced during a prolonged caloric deficit as well as the tendency to gain weight after weight loss.

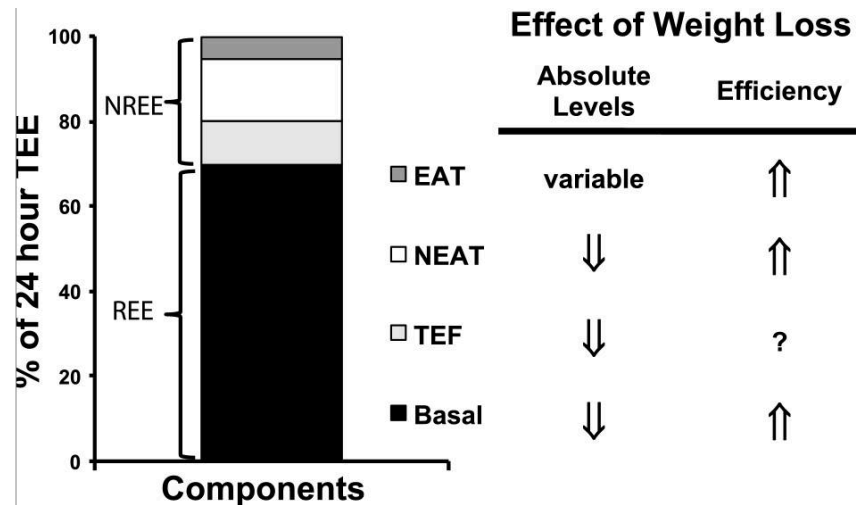


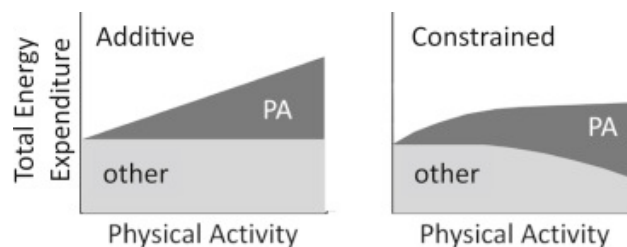
Figure 2. “Impact of weight loss on the components of total energy expenditure (TEE). Energy-restricted weight loss impacts every component of energy expenditure. The absolute levels of resting energy expenditure (REE) decline from a loss of metabolic mass and enhanced metabolic efficiency. Nonresting energy expenditure (NREE) declines, unless the level of physical activity and its associated exercise activity thermogenesis (EAT) are substantially increased. This increase must overcome the decline in the TEF that results from lower energy consumption and a decline in nonexercise activity thermogenesis (NEAT) related to loss in overall mass. Increased energetic efficiency of EAT, NEAT, and potentially TEF contribute to the overall decline in NREE.” (Mclean, P.S., et al., 2011).

A reduced body mass results in a reduction in energy expenditure, which contributes to metabolic adaptation. One reason is that weight loss is associated with a decrease in lean body mass, so less tissue is contributing to basal tissue maintenance, resulting in a reduced basal metabolic rate. A second reason that energy expenditure is decreased during and after weight loss is that there is loss of total mass that is required to move during physical activity. This results in a reduced

NREE. A third component to this is that a decrease in fat mass will reduce overall energy expenditure by altering metabolic efficiency (Trexler, et al., 2014). These mechanisms have an affect on basal metabolism and energy expended during physical activity, resulting in an increase in skeletal muscle efficiency, which is discussed in more detail below. Skeletal muscle work efficiency impacts both non-exercise and exercise activity thermogenesis, leading to a reduced NREE when activity level is kept constant (Maclean, P.S., et al., 2011). When body tissue is decreased, there is an overall reduction in energy output and thus, fewer calories burned in a certain time period.

### Metabolic Adaptation and Physical Activity

A significant component of metabolic rate is physical activity. Generally it is believed that there is a positive correlation between level of physical activity and TDEE. Two different models have been created to represent the effect of physical activity on metabolic rate. These include the Additive and Constrained models and are shown below:



*Figure 3. The Additive and Constrained models of physical activity in relation to total daily energy expenditure. The Constrained model is a more accurate depiction of the effect of physical activity on total energy expenditure. There is a plateau in total*

*energy expenditure that occurs as physical activity increases, which is represented by the Constrained model. (Pontzer, H., Durazo-Arvizu, R., Dugas, L., Plange-Rhule, J., Bovet, P., Forrester, T., Lambert, E., Cooper, R., Schoeller, D., Luke, A., 2016).*

The Additive model, which is the original version, describes that as physical activity increases, TDEE is increased in a linear and dose-dependent fashion. However, studies have shown that there is a more complex relationship between physical activity and metabolic rate than what the Additive model represents. The Constrained model has since been adapted from the Additive model and is based on studies that show the metabolic adaptation that occurs with increasing amounts of physical activity. Studies measuring total energy expenditure and physical activity in a large adult sample show that there is a plateau in total energy expenditure as physical activity gets above moderate levels and activity intensity was found to be inversely related to total energy expenditure. It also appears that body fat percentage and activity intensity are primarily responsible for metabolic response to physical activity (Pontzer, H. et al., 2016). To describe this phenomenon using a realistic example, populations that are generally more physically active such as farmers and hunter-gatherers have similar total daily energy expenditures compared with more developed populations with far less daily physical activity (Pontzer, H. et al., 2016). This suggests that physical activity and metabolic rate is an adaptive mechanism that contributes to overall metabolic adaptation.

During weight loss there is also a decrease in exercise activity thermogenesis, which is the amount of calories that are expended during exercise. Part of this is due to that fact that there is less energy required to move a body that is lower in body

mass. However, this is not the only factor that plays a role in why there is less energy expended during exercise for a person in a caloric deficit. Skeletal muscle work efficiency is the ratio of power generated to calories consumed (Rosenbaum M, Vandenborne K, Goldsmith R, Simoneau JA, Heymsfield S, Joannisse DR, Hirsch J, Murphy E, Matthews D, Segal KR, Leibel RL, 2003). Research shows that the changes in skeletal muscle work efficiency after weight loss or gain opposes the maintenance of the altered body weight. In individuals with a low body fat percentage, there is an increase in skeletal muscle efficiency. This means that these individuals expend more energy and power relative to the calories they consume compared to individuals who are at a higher body weight. Weinsier et al. (2000) found that participants with reduced body weight were able to increase time spent in physical activity without increasing calories expended in the physical activity. It was also found that net mechanical efficiency was increased in weight-reduced subjects. The reason these findings are significant in the discussion of metabolic rate is that skeletal muscle efficiency plays a significant role in metabolic rate and adaptation during weight loss or weight gain (Rosenbaum M, et al., 2003). The skeletal muscle work efficiency is a significant indicator for NREE, or non-resting energy expenditure, which is an important component of metabolism. In addition to this, skeletal muscle itself contributes to individual metabolic rate.

Metabolic rate in the kidney and brain have very little variability throughout the day. Skeletal muscle metabolism, however, will increase significantly during exercise and physical activity. Total oxygen uptake during this time is primarily shifted to the muscles, which can account for up to 90% of oxygen uptake. At a

resting state in non-obese individuals, skeletal muscle can account for about 20 to 30% of total oxygen uptake (Zurlo F, Larson K, Bogardus C, Ravussin E, et al., 2016). This indicates that skeletal muscle metabolism is an important component to whole body resting metabolic rate. A study explored the relationship between energy expenditure over 24 hours for whole-body energy expenditure and skeletal muscle metabolism, assessed by forearm resting oxygen uptake. This study sought to prove that skeletal muscle plays a role in individual variability in metabolic rate. Subjects in this study were fed at maintenance consisting of 50% carbohydrates, 30% fats, and 20% proteins. The study found that adjusted BMR and SMR rates – which were adjusted for individual differences in FFM, fat mass, age, and sex – were significantly related to forearm resting oxygen uptake. This indicates that resting muscle tissue metabolism may explain variability in resting metabolic rate. This is important because in non-obese individuals, skeletal muscle accounts for an average of 40 to 50% of total body weight (Zurlo F, et al., 1990). The study concluded that resting muscle metabolism is positively associated with differences in resting energy expenditure and represents a significant indicator of individual variation in energy expenditure. The importance of this study is that skeletal muscle plays an important role in individual metabolic rate and metabolic adaptation during weight loss.

Several factors may play a role into why skeletal muscle efficiency changes in response to weight loss or gain. As previously discussed, during weight loss there is a subsequent reduction in thyroid and leptin levels. In addition to metabolic effects, thyroid hormones affect the proportions of fast and slow-twitch muscle fibers. Slow-

twitch muscle fibers require few calories to generate power per muscle contraction compared with fast-twitch fibers. Because thyroid hormone increases skeletal muscle glycolytic capacity, a reduction in this hormone may cause changes in the recruitment of muscle fibers types, favoring the use of slow-twitch muscle fibers. This may contribute to an increase in skeletal muscle efficiency in weight loss (Rosenbaum M, et al., 2003). These findings in general provide insight into the role of skeletal muscle in metabolic adaptation.

#### Changes in Mitochondrial Efficiency that Occur During Weight Loss

Mitochondrial efficiency is another component of metabolic rate and metabolic adaptation during weight loss. In aerobic metabolism, which is the favorable way our body produces energy, our cells use ATP that is derived from stored and ingested energy substrates. During this process there is movement of protons across the inner mitochondrial membrane. This process produces ATP when protons are transported by ATP synthase, which is a proton channel similar to uncoupling proteins (UCP) (Trexler, et al., 2014). Protons can leak across the membrane of the mitochondria through a mechanism referred to as uncoupling respiration. During this process, energy substrate oxidation and oxygen consumption occurs without yielding ATP. This leaking of protons accounts for about 20 to 30% of BMR rates in rats. Calorie restriction reduces this proton leaking, thus reducing the rate of BMR. In brown adipose tissue (BAT), UCP-1 and UCP-3 concentrations are high, which play a significant role in energy expenditure and uncoupled thermogenesis. UCP-3 has a positive correlation with body mass

index, indicating that as BMI decreases, UCP-3 will decrease (Trexler, et al., 2014). However, the research on this topic as it relates to humans is not fully understood.

Energy restriction has shown to decrease BAT activation and UCP-1 expression. Uncoupled respiration is also affected by leptin and thyroid hormone levels. When thyroid and leptin levels increase, there is an increase in BAT activation. The opposite occurs for glucocorticoids like cortisol. Thyroid hormone level has a positive correlation with proton leaking. As thyroid hormone decreases, like during weight loss, uncoupling proteins are decreased and there is less proton leaking. The combination of decreased thyroid hormone and leptin, and increased cortisol that is associated with energy restriction may play a role in uncoupled respiration in BAT (Trexler, et al., 2014). In summary, these mechanisms contribute to the metabolic adaptations that occur during weight loss.

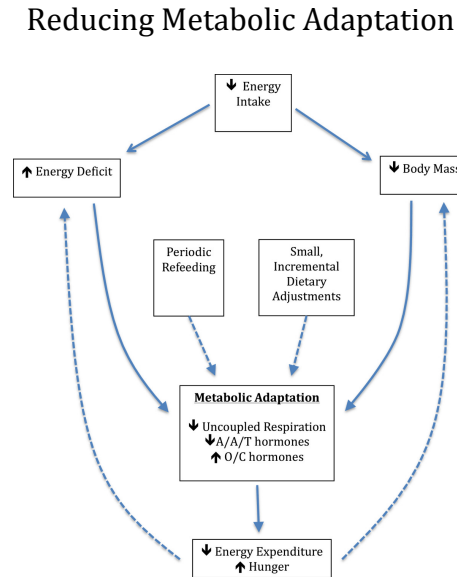
### Summary

Johannsen, D.L., et al. (2012) describes a study that explored the effects of diet restriction and vigorous exercise on resting metabolic rate (RMR). A group of 16 obese individuals with a body fat percentage of about 49 participated in a 30-week program that included a 90-minute per day, 6 day a week aerobic exercise training combined with a calorie restriction. The study measured RMR using a calorimetry. The results of 30 weeks of this program resulted in a down-regulation of metabolic rate by approximately 400 calories per day. Another study measured the metabolic rate of a natural bodybuilding competitor during a contest prep. While this is an extreme form of dieting and not applicable to the average individual,



it shows that if there is a prolonged caloric deficit created by an exercise training program and a caloric restriction, there will be metabolic adaption manifested by a decrease in total daily emergency expenditure.

In summary, metabolic rate and energy expenditure appear to be influenced by the changes that occur in proton leaking, expression of UCP, and the levels of circulating hormones during weight loss. These changes make it more difficult to continue losing weight and increase the likelihood of weight regain when a caloric restriction has ended. It should be noted that these tests have only been done on rats and the direct correlation to humans is not guaranteed. However, it provides insight into the metabolic processes that occur during weight loss and the mechanisms associated with metabolic adaptation.



*Figure 4. A theoretical model of metabolic adaptation and potential strategies to attenuate adaptations. A/A/T hormones = Anabolic, Anorexigenic, and Thermogenic hormones; O/C hormones = Orexigenic and Catabolic hormones. Dotted lines represent inhibition (Trexler, et al., 2014).*

The metabolic changes that take place during a caloric restriction can be summarized by changes that favor energy conservation of body weight and prevention of further weight loss. The degree of metabolic changes and adaptation is positively correlated with the size of the caloric deficit. Fitness competitors and people who must undergo strict dieting should do so in a slow and progressive manner to minimize the adaptations that occur. Beginning a dieting phase by gradually reducing calories instead of initially cutting calories in a drastic manner can prolong metabolic adaptation from occurring. This method also promotes sustainability in terms of continuing to decrease calories as the body adapts without reaching a calorie restriction that is too severe too quickly. As weight loss begins to plateau as the metabolism slows and adapts to lower calories, energy intake or

expenditure should be adjusted to “re-open” the energy deficit. In other words, a further decrease in calories, an increase in energy expenditure or often a combination of both, are required to further the calorie deficit in order to continue losing weight (Trexler, et al., 2014).

### Refeeds

A popular dieting method that is heavily utilized in the fitness community is termed refeeding. Trexler, et. al. (2014) defines a refeed as “a brief overfeeding period in which caloric intake is raised slightly above maintenance levels, and the increase in caloric intake is predominately achieved by increasing carbohydrate consumption.” The goal of incorporating refeeds one to two times per week is to temporarily increase serum leptin and boost metabolic rate. Leptin, which is discussed earlier, has been shown to increase temporarily during and shortly after a refeed, specifically in response to carbohydrates. Administering leptin has also shown to decrease the adaptations associated with a prolonged caloric restriction. However, there is little research that explores the true impact of refeeds on metabolic rate. Dirlewanger et al (2000) reported a 7% increase in TDEE, which equates to an additional 138 kcal burn in a day after carbohydrate overfeeding. These findings are though not significant enough to fully conclude that refeeds will prevent metabolic adaptation, they may suggest that it can slow the rate of metabolic adaptation. If anything, these refeeds may promote sustainability during a dieting phase by giving individuals one or two days a week to look forward to a day of increased food intake.

### Carb Cycling

Carb cycling during a dieting phase is a method that incorporates a pattern of refeeds on a weekly basis. There are currently not sufficient studies that explore the benefits of a carb cycle diet to a non-carb cycle diet. However, carb cycling has been widely used in the fitness industry as a more sustainable and potentially beneficial method to dieting. A carb cycle is a structured and consistent way to incorporate refeeds that involves making an adjustment to carbohydrate intake daily through a cycle of low carb, medium carb, and high carb days. Some cycles may only contain low carb and high carb days and the pattern of each of these differs based on individual response. For example, there may be a cycle that is: low, low, high, low low, high, or a cycle that is low, low, low, high, low, low, low, high. In order to determine what cycle works best, it will depend on the progress the individual has made in their diet, how long they have been dieting for, how much fat they wish to lose and in what time period, as well as many other individual characteristics.

Training and Nutrition podcast features John Gorman, Dr. Chad Kerksick, Tyler Fisher, and Sal Frisella along with other highly respected guests in the fitness industry. John Gorman is a diet and fitness coach well known to the fitness community. Dr. Kerksick is an exercise and sports nutrition researcher who has publications in the topics of sports supplements, sports nutrition, weight loss, and muscle physiology and recovery. An episode on this podcast discusses their research and experience with carb cycling with many of their clients. Like refeeds, carb cycling is a method to reduce metabolic adaptation during a dieting phase. They discuss the reason for implementing a carb cycle, which is highly

individualized, but generally used as a method to counteract the body's tendency to adapt to a low caloric intake that is necessary when weight loss is the goal. For instance, if a caloric deficit of 500 calories is initiated and an individual is consuming 1,500 calories versus their maintenance of 2,000 calories, there will be an initial weight loss period, but eventually the metabolism will adapt to this caloric intake and weight loss will plateau.

There is no specific method to introducing a carb cycle. Some fitness and nutrition coaches will initiate a carb cycle immediately when introducing a caloric deficit. Others may use this method only towards the end of a dieting phase in order to get the body to respond quicker by an initial drop in calories, followed by introducing a carb cycle when the body begins to adapt as evidenced by a plateau in weight loss. These people may be in a situation where their calories are getting too low, but aren't progressing as efficiently.

General guidelines on when to introduce a carb cycle have been used by many coaches and independent people in the fitness industry. A common method used is the 10 times bodyweight rule. For instance, a girl who weights 120 pounds and has dropped her calories to 1,200 may introduce a carb cycle to avoid dropping calories below 10 times her bodyweight. Too often in the fitness industry there are coaches who require their clients to consume far too few calories than what is healthy or needed to achieve weight loss. The carb cycle will introduce days of low calories through a low carb intake, but will replenish the body with essential nutrients and energy on high carb days.

A different method to introducing a carb cycle includes initiating immediately when entering a caloric deficit. To do this, a common method is to dedicate maintenance calories as the high carb day, two days per week. The caloric deficit will be created through the remaining days as low days or a combination of low and medium carb days. A general guideline to determining medium carb days is to take 15% of maintenance calories, then subtract this amount of calories in carbs by dividing this amount by four and subtracting it from maintenance carb grams. For a low carb day, this same method is used, but an additional 5 to 10% reduction in calories from carbs is used.

A benefit to implementing a carb cycle initially when beginning a diet is to avoid having six days of a deficit, with only one refeed, or high carb day, or none at all. This is more difficult to maintain when individuals are required to push through six days of lower carbs and calories. Additionally, when the high carb day comes around once a week, it takes a few days for the body to adjust to the excess calories, making it more difficult to track progress as the body may retain water in an unpredictable manner. High carb days function to boost leptin levels. Incorporating a high carb day only once a week will result in six days of metabolic adaptation with no boost in leptin levels. Fatigue is also inevitable during a diet; however, when introducing more frequent high carb days there will be an increase in energy levels and more optimal performance in the gym. Two high carb days a week has shown to improve adherence to diets because individuals have more frequent refeeds to look forward to as a way to push them through the lower carb days.

There are disadvantages to inconsistent caloric and carb intake during a dieting phase. One of these disadvantages is that it is more difficult to track intake during this period because each day may require a different intake. A simple solution to this is dropping carbs from one or two meals a day for medium and low carb days, respectively. For example:

High carb day: carbs in all 6 meals

Medium carb day: carbs in 4 meals

Low carb day: carbs in meals 1 and 2, or 1, 2, and 3.

Other macros during a carb cycle can be manipulated or kept consistent. Some people prefer to decrease fat intake during a high carb day in order to further the caloric deficit. Likewise, increasing fat intake during a low carb day will increase caloric intake. This may work for some individuals, but the goal is to create a caloric deficit for fat loss. A simpler method is to keep fat and protein intake consistent and create the caloric deficit strictly by adjusting carb intake.

There is not sufficient research that supports the implementation of refeeds or a carb cycle in order to prevent metabolic adaptation. However, in comparison to no temporary increase in calories, a carb cycle may provide individuals with the added benefit of provisionally regulating hormone levels during a diet phase. Additionally, carb cycling may provide individuals with weekly perseverance to continue on a diet and thus lead to a more successful weight loss.

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