OPTIMIZE MUSCULAR FITNESS GAINS WITH PERIODIZATION-SUPPORTIVE NUTRITION.

Tailoring Nutrient Intake to Exercise Goals

BY PHIL BLOCK, MS, AND LEN KRAVITZ, PHD

Techniques of exercise periodization for developing muscular fitness have been made popular by a growing body of research. Studies consistently demonstrate that periodization programs are among the most effective muscle-strengthening exercise protocols (Fleck 1999). Because of individual differences such as gender, muscle fiber percentages and genetics, no single periodization program suits everyone. However, **undulating periodization programs,** which employ frequent alterations in intensity and volume to moderate exercise stress and recovery, have recently shown particular promise for optimizing muscular fitness (Marx et al. 2001). (See "A Sample Undulating Periodization Program" on the next page.) Researchers hypothesize that the distinctive training variations and the modulation of exercise stress and recovery patterns in these programs may lead to greater muscular adaptations than can be achieved using more traditional approaches (Overturf & Kravitz 2002). Recently, a unique program has been suggested for establishing a nutrition framework to support exercise periodization (Coyle 2004). This dietary approach, referred to as **nutrient periodization** or **carbohydrate periodization,** focuses on adjusting macronutrients to best support exercise periodization techniques.

What Is Nutrient Periodization?

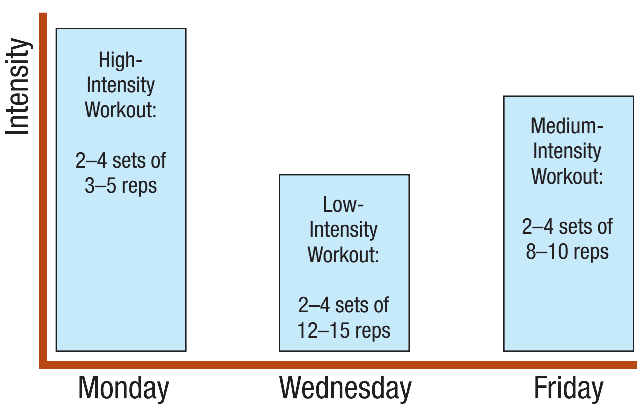
Nutrient periodization is a robust system of fluctuating the intake of macronutrients (carbohydrate, fat and protein) to optimize muscle strength and hypertrophy, based on the most current exercise and nutrition research. Supported and driven by the *Dietary Guidelines for Americans 2005* (U.S. Department of Health & Human Services & U.S. Department of Agriculture 2005), this is a balanced dietary program that personal fitness trainers and their clients can embrace.

Is the Program Grounded in Solid Nutrition Guidelines?

In 2002, the Food and Nutrition Board of the Institute of Medicine established new dietary guidelines for macronutrient consumption, called the **Acceptable Macronutrient Distribution Ranges (AMDRs)** (National Academy of Sciences, Institute of Medicine 2002). The AMDRs define the appropriate average ranges for dietary intakes of carbohydrate, fat and protein. These guidelines were designed to avoid nutrient deficiencies that seem to occur when macronutrient consumption consistently falls above or below the recommended levels. The AMDR recommendations, which have been incorporated into the *Dietary Guidelines for Americans 2005,* advocate the following balance of macronutrients: 45%–65% of total kilocalories (kcal) from carbohydrates, 20%–35% from fat and 10%–35% from protein. These recommendations allow for the dietary individualization necessary for meeting specific exercise goals, such as building muscle and increasing muscular strength.

A SAMPLE UNDULATING PERIODIZATION PROGRAM

(3 workouts a week)



What Are the Benefits for Muscle Hypertrophy?

Athletes and serious exercise enthusiasts often engage in extreme intakes of one macronutrient while de-emphasizing others. Although there may be a need for an acute increase of a particular macronutrient, chronic dietary imbalance may result in decreased performance, loss of muscle and overall fatigue. For example, elevating protein intake (a common practice for building muscle) may decrease fat and carbohydrate consumption to levels that can hinder performance and ultimately inhibit optimal muscle growth. Conversely, a high-carbohydrate diet (essential for recovery from intense training bouts) may not include enough fat and protein, which can lead to altered cholesterol profiles (American College of Sports Medicine [ACSM], American Dietetic Association [ADA] & Dietitians of Canada [DC] 2000), depressed testosterone levels (Lambert, Frank & Evans 2004), overtraining (Venkatraman & Pendergast 2002) and, ultimately, the inability to gain muscle mass.

Nutrient periodization is a sensible practice for serious exercisers because it can modulate macronutrient intakes while reducing the chance of nutrient deficiencies over an extended period of time. This approach works by promoting a day-to-day fluctuation of macronutrient intake to match the exercise periodization needs for building muscle and gaining strength. Since the AMDR recommendations give guidelines for average intakes, individual days can be below or above those recommendations. As long as the diet falls within the guidelines over the course of several days or a week, nutrient deficiency and disease risk will be low.

Is Kcal Intake Important?

Physiologically, the key to gaining muscle mass is to consume more energy than you expend while focusing on high-intensity resistance training (Lambert, Frank & Evans et al. 2004). Nutritionists and other health professionals have long understood the importance of tipping the energy scales in favor of excess kcal consumption for muscle gain. Although this view may be criticized for being overly simplistic (and the method may sometimes be ineffective), energy intake is usually considered a critical strategy for muscle gain.

The exact number of excess kcal required to gain muscle is not clearly known. The effects of metabolism, exercise and nutrient status make pinpointing specific requirements difficult. Experts recommend between 1,000 and 3,500 excess kcal over the course of a week to gain 2.2 kilograms (kg), or 1 pound (lb), of muscle. This number is based on several overfeeding studies and estimates of muscle gain (Manore & Thompson 2000).

In real-world situations, however, hypertrophy may require higher levels of kcal intake, with research suggesting approximately 44–50 kcal per kg of body weight per day (kcal/kg/day) (Manore, Thompson & Russo 1993). Based on this research, an individual who weighs 100 kg (220 lb) and is attempting to build muscle might require 4,400–5,000 kcal/day or more. Some persons completing serious training may have even higher energy requirements.

So what is the bottom line on kcal consumption? A review of the literature suggests that at least **47 kcal/kg/day** may be recommended for building muscle, with the understanding that factors such as individual metabolism may make that number higher or lower.

What Role Does Protein Intake Play?

An individual participating in resistance training, particularly heavy resistance training, experiences an increase in the rate of both protein synthesis and protein breakdown in the muscle for at least 24 hours after a workout. Additional protein may be needed to (1) help repair exercise-induced damage to muscle fibers, (2) promote training-induced adaptations in muscle fibers and (3) assist with the replenishment of depleted energy stores (Gibala 2004).

Optimal protein and amino acid ingestion is regarded as crucial for strength and hypertrophy. Individuals who consistently engage in moderate to high levels of exercise should consider a protein intake that exceeds the U.S. Dietary Reference Intake (DRI) of 0.8 grams (g)/kg/day (Lambert, Frank & Evans 2004). However, in a recent review, Tipton and Wolfe (2004) state that there is confusion in the research about what optimal protein intake is, because the level of optimal intake in athletes is very different for varying activities and individual goals. For example, a strength athlete requires sufficient protein to maintain *and gain* muscle mass, while an endurance athlete is more concerned with simply maintaining muscle mass while improving performance. Consequently, protein recommendations need adjusting to specific levels, but what these levels are has not yet been adequately researched.

According to a recent Position Stand on nutrition and athletic performance, experienced male bodybuilders and strength athletes may consume 1.6–1.7 g/kg/day of protein to allow for the accumulation and maintenance of lean tissue (ACSM, ADA & DC 2000). Data on female strength athletes is not available, but there is no evidence to suggest that this level will not sufficiently meet the dietary requirements of female athletes as well. (Since the recommendation is relative to body weight, the level will adjust to the smaller body size and weight typical of most women.)

The impact of carbohydrate and fat on protein metabolism is a topic of current interest, with investigations suggesting there are anabolic concomitant effects of carbohydrate and fat on protein balance (Miller et al. 2003).

Research on protein intake for building muscle indicates that higher levels of protein may drive muscle metabolism toward hypertrophy, so the suggestion for muscle building is to maintain a high protein intake within the current guidelines (Lambert, Frank & Evans 2004). A **protein intake of 1.7 g/kg/day** should optimally meet an exerciser's muscle fitness goals.

How Does Carbohydrate Periodization Help?

The current theory on the effectiveness of periodization programs is that very intense workouts will stress different muscle fibers than less intense workouts. This means that during an intense workout, certain muscle fibers are activated while other fibers rest. Purportedly, alternating cycles of high-volume, low-intensity work with low-volume, high-intensity work will provide a satisfactory stimulus/recovery for the different types of muscle fibers in the human body and minimize the risk of overtraining (Overturf & Kravitz 2002).

Stored carbohydrate (glycogen) is the predominant fuel source for moderate- to high-intensity activities. High-intensity exercise takes a particular toll on glycogen stores because the availability of fat for fuel becomes limited at this level. When muscle glycogen stores are diminished, fatigue is imminent.

Replenishment of depleted muscle glycogen stores is of utmost importance to athletes and other very active people. If the stores are not recovered, the ability to exercise at a given intensity is greatly diminished, possibly leading to muscle detraining (Burke, Kiens & Ivy 2004). When building muscle, especially through a periodization program, this is an important consideration because inadequate glycogen stores will decrease the ability to maintain appropriate exercise intensities. Resistance exercise may be particularly affected by decreased glycogen stores. Some research suggests that total muscle glycogen may drop by as much as 25%–40% during multiple-set resistance exercise to fatigue (Rankin 2000).

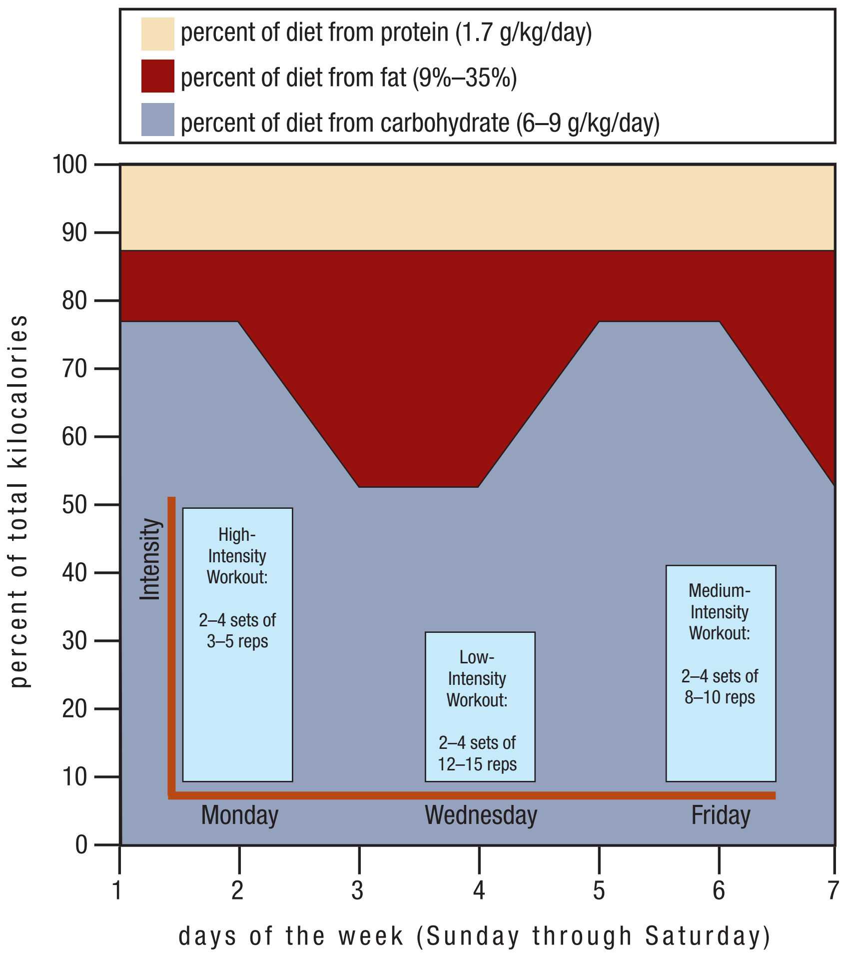
INDIVIDUAL DAYS CAN BE BELOW OR ABOVE THE RECOMMENDATIONS OF THE ACCEPTABLE MACRONUTRIENT DISTRIBUTION RANGES AS LONG AS THE DIET FALLS WITHIN THOSE GUIDELINES OVER THE COURSE OF SEVERAL DAYS OR A WEEK.

Most active people report a diet of about 45%–50% carbohydrate (about 5g/kg/day), which can easily support moderate bouts of exercise of about 1 hour a day (Hawley et al. 1995). Current literature recommends that athletes and recreational exercise enthusiasts seeking to maintain higher-carbohydrate diets achieve a carbohydrate intake of 7–12 g/kg/day when attempting to restore glycogen stores after an intense workout (Coyle 2004). This recommendation targets endurance exercise but translates to prolonged high-intensity resistance workouts as well. The problem with this practice is that a long-term high-carbohydrate diet may elevate serum triglyceride levels and interfere with muscle building by decreasing fat and protein intake.

Coyle (2004) proposes that a carbohydrate periodization approach best resolves the long-term consequences of a diet too high in carbohydrates, while meeting the demands of the serious exerciser. The idea is that not every day of training requires a high carbohydrate intake, since not every day's workout is intense or prolonged. Coyle writes, "Unfortunately, there has been little investigation of how best to vary carbohydrate intake on a day-to-day basis to match the typical alteration of hard, easy and moderate days of training performed during a week by well-coached competitive athletes." It is assumed that the most important objective of periodization of daily carbohydrate intake is to ensure high muscle glycogen levels at the start of hard training sessions. Serious exercise enthusiasts, who often perform two to four hard training sessions per week, should eat a total of 7–12 g/kg of carbohydrate during recovery from one intense training session to replenish carbohydrate stores prior to another intense training session (Coyle 2004). The recovery period should not be less than 24 hours (Burke, Kiens & Ivy 2004). However, during the 24 hours prior to a moderate or easy day of training, it may be satisfactory for serious exercisers to eat 5–7 g/kg of carbohy-

A SAMPLE NUTRIENT PERIODIZATION APPROACH TO UNDULATING EXERCISE PERIODIZATION

This graph depicts a sample nutrient periodization program for a 100-kilogram (kg), or 220-pound, individual seeking to optimize muscle mass while following an undulating periodization program. Relative macronutrient percentages fluctuate with exercise intensity to adequately facilitate recovery. Total intake for the exerciser is 4,700 kilocalories per day (kcal/day). Protein intake is maintained at 1.7 grams per kg of body weight per day (g/kg/day), since the research does not yet support periodization of this nutrient; carbohydrate intake changes from 6–9 g/kg/day, depending on the intensity of the associated workout; and fat intake adjusts to the carbohydrate and protein intake. Although on a day-to-day basis macronutrient percentages fall outside the AMDR recommendations, over the course of the week the macronutrients are moderated. Averages are about 20% fat, 14% protein and 65%–66% carbohydrate. In effect, the recommendations for carbohydrate replenishment from intense workouts are met, as are the nutritional values from the *Dietary Guidelines for Americans 2005.* This program presents a sensible, balanced approach for nutrition periodization for building muscle.



drate (Coyle 2004). This nutrient periodization technique optimally accommodates macronutrient needs to the intensity fluctuations of periodized exercise programs. Please note that these suggestions should not be confused with the widely published "nutrient timing" recommendations for carbohydrate and protein intake *immediately pre- and postworkout,* although these can be incorporated into a nutrient periodization schedule.

Consider the following application from the research. After an intense workout, carbohydrate stores should be restored with a carbohydrate intake of 7–12 g/kg/day (Coyle 2004). Since most individuals trying to build muscle are not necessarily engaging in *prolonged* intense activity, meeting the upper end of the carbohydrate intake recommendation (12 g) may be unnecessary; a more favorable macronutrient balance may be achieved with a moderate approach. Therefore, an intake of **9 g/kg/day of carbohydrate for 24 hours following an intense workout** may be ideal for individuals attempting to maximize muscular fitness gains. Furthermore, after the carbohydrate stores have been replenished, high carbohydrate intake is no longer necessary and the exercisers can focus on the other macronutrients. The fitness enthusiast attempting to build muscle may consider an intake of **6 g/kg/day of carbohydrate during the 24-hour period prior to a moderate- or light-intensity activity.**

How Should Fat Intake Be Adjusted?

Fat is an essential nutrient in the human diet. In addition to providing energy, it is responsible for the transport of vitamins A, D and E. Fat is also contained in every cell in the human body as a component of the cell membrane. If fat intake is too low, blood lipid profiles are affected, and various negative health and performance consequences may occur (Dreon et al. 1999). Experts do not recommend fat intakes below 15% of the total energy requirement (ACSM, ADA & DC 2000), since health concerns would exist with this low intake and no sports performance benefits are associated with it.

Fat is an energy-dense substance, providing approximately 9 kcal/g of energy, which makes this macronutrient a prime choice for recreational athletes who want to build muscle. Healthful fat is an essential macronutrient for individuals attempting to maintain the high-kcal dietary needs of vigorous exercise.

Some of the most exciting research on fat intake has examined its suspected contribution to minimizing the effects of overtraining, a major concern in exercise, as overtraining severely diminishes the success of a fitness program. The use of omega-3 polyunsaturated fatty acids has been advocated as a possible means of reducing overtraining symptoms (Venkatraman & Pendergast 2002).

The current dietary recommendations for the general public are to maintain fat intakes of 20%–35% of total energy intake. This should be divided fairly evenly among saturated, polyunsaturated and monounsaturated fatty acids. Chronic low-fat diets (less than 15%) should be avoided because they may make it difficult for an exerciser to achieve a high-kcal diet, may result in overtraining, may negatively affect the lipid profile and/or may decrease exercise performance (Venkatraman & Pendergast 2002). Chronic high-fat diets (greater than 35%) should also be avoided because they may reduce carbohydrate and protein consumption, decrease long-term performance, reduce carbohydrate-associated vitamin and mineral intake and potentially increase the risk for cardiovascular complications (ACSM, ADA & DC 2000). With the nutrient periodization approach to training, the suggestion is to **allow fat intake to fill in the kcal after protein and carbohydrate levels have been established.** Carbohydrate levels after intense workouts will be high, so fat intake will be correspondingly low. When carbohydrate intake is low (prior to moderate- or low-intensity workouts), fat intake will be much higher, compensating for the low-fat-intake days. In effect, this technique will moderate fat intake while allowing optimal fluctuations of carbohydrate.

Putting It Together

Exercise periodization is a widely used technique for optimizing muscle fitness benefits. Using an integrated approach of periodization-supportive nutrition is an evidence-based way to maximize these benefits.

For individuals seeking muscle growth and strength gains, a carbohydrate cycle of 6–9 g/kg/day should be developed around a particular periodization program; protein intake should be maintained toward the upper end of the recommendations (1.6–1.7 g/kg/day); and the intake of healthful fats should be periodized in relation to carbohydrate and protein intake. (See "A Sample Nutrient Periodization Approach to Undulating Exercise Periodization" on the previous page.)

The literature indicates that appropriate nutrition aids mus-

NOT EVERY DAY OF TRAINING REQUIRES A HIGH CARBOHYDRATE INTAKE, SINCE NOT EVERY DAY'S WORKOUT IS INTENSE OR PROLONGED.

cle growth, recovery and development. Nutrient periodization is a very creative and innovative approach to training that is backed by research and makes intuitive sense.

Phil Block, MS, is a doctoral student in the exercise science program at the University of New Mexico, Albuquerque (UNMA). He earned his master's degree in nutrition and dietetics in 2001 and has research interests in the field of applied sports nutrition. He currently works as a personal trainer and health educator at Sandia National Laboratories and as a university lecturer in nutrition.

Len Kravitz, PhD, is the coordinator of exercise science and a researcher at UNMA, where he won the 2004 Outstanding Teacher of the Year Award.

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