Nutritional Periodisation In Sports : A Systematic Review

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***Abstract* - In modern sts nutrition plays an important to elevate the performance level of an athlete in the target competition. The performance of an athlete depends upon the scientific periodisation and execution of proper training. The energy expenditure during various phases of training must be supplied by the scientific nutritional periodisation in order to meet the physiological demands. So far as sports performance is concern nutritional and training periodisation can be considered as a two side of a coin. In the present study attempts has been made to systematically review various articles and research papers in order to frame a guideline for the nutritional status of an athlete during different phases of training cycles.**

***keywords* - Nutrition, Periodisation, Training cycle and Sports.**

INTRODUCTION

Sports nutrition is a specialization within the field of nutrition that partners closely with the study of the human body and exercise science. Sports nutrition can be defined as the application of nutrition knowledge to a practical daily eating plan focused on providing the fuel for physical activity, facilitating the repair and rebuilding process following hard physical work, and optimizing athletic performance in competitive events, while also promoting overall health and wellness. The area of sports nutrition is often thought to be reserved only for "athletes," which insinuates the inclusion of only those individuals who are performing at the elite level. In this text, the term athlete refers to any individual who is regularly active, ranging from the fitness enthusiast to the competitive amateur or professional. Differences may exist in specific nutrient needs along this designated spectrum of athletes, creating the exciting challenge of individualizing sports nutrition plans (1).

When it comes to the discussion of improving performance and fitness, one can't forget about the role of a proper diet and how much our day to day nutrition affects how we feel and perform.

So what is nutritional periodization, or periodized nutrition? Simply, planning and structuring of a diet based on the goals and demands of a trainee or an athlete **.** Since training variables like intensity, volume, competition schedule and practices change from season to season and one training cycle to the next, nutritional periodization must be used and adapted according to the demands of practice, training and competition (2).

Nutrition can have a major impact on the adaptations to training (3). For example, in order to improve performance of the muscle, it is essential to exercise/train the muscle, but the effects of training influenced by nutrition. Nutrition can both improve and reduce the adaptations and is thus an important tool to optimize performance effects. It is not just the muscle that is affected (although this is the organ that has perhaps been studied the most), other tissues such as the brain, the vasculature and the intestine, can also be affected.

There is more and more discussion, both in the scientific literature and also in the popular press, about the effects of nutrition on training adaptations. Sometimes this is referred to as "periodized nutrition", sometimes "nutritional training" and others have referred to some aspects of this as "fueling for the work required" (4).

No one clearly defined, however, what methods are part of this periodized nutrition approach and people have interpreted the terms in different ways.

. The important part of the definition is that is purposeful and planned! The term "nutritional training" is sometimes used to describe the same methods and these terms can be used interchangeably.

Some people think of periodized nutrition in terms of having different energy needs and intakes in different phases of the year. In some sports, carbohydrate intake may be much higher during the season and the lower pre-season when changes in body composition may be the main goals. This is an example of periodized nutrition. Within a week there may be days with hard training and high carbohydrate intakes and days with low carbohydrate intake. Some will think of periodized nutrition as the strategic use of "training low" and "training high": training with low and high carbohydrate availability respectively. But there is more. In addition to "train-low" and "train-high", methods have been developed to "train the gut", train hypohydrated (to reduce the negative effects of dehydration), and train with various supplements that may increase the training adaptations longer term (5).

HISTORICAL BACKGROUND

The links between diet and exercise have long been recognized. In the late 1800s, the term training was used to describe a regime that included diet as well as exercise, not just exercise. Training was and is still often defined as ''the action of undertaking a course of exercise and diet in preparation for a sporting event''. At one point in history, nutrition was such an important part of athletes' preparation that the definition of training was more related to diet than the actual physical preparation itself (5).

Techniques of exercise periodization for developing muscular fitness have been made popular by a growing body of research (6). Studies consistently demonstrate that periodization programs are among the most effective muscle strengthening exercise protocols that exist (6). Although there is no single best periodization program that suits everyone due to individual differences such as gender, muscle fiber percentages, and genetics, undulating periodization programs have recently shown particular promise for optimizing muscular fitness benefits (7). It is hypothesized that distinctive training variations and modulation of the exercise stress and recovery patterns may lead to greater muscular adaptations in undulating periodization programs compared to more traditional approaches (8). Most recently a unique opportunity for establishing a nutritional framework to support periodization programming has been suggested (9). This dietary approach is referred to as nutrient periodization and focuses on adjusting the macronutrients to best support exercise periodization techniques (10).

FRAMEWORK OF PERIODISED NUTRITION

Nutrition strategies play a supportive role in enhancing acute training stimuli into optimal training adaptation. For example, optimizing protein (PRO) intake, PRO quality and timing achieves only a minor adaptive hypertrophic response without the potent stimulus of resistance exercise. However, nutrition serves an important function given that elite athletes have 1400-1800 eating occasions per year, while training 300-800 times. Accordingly, figure 1 highlights a theoretical framework that is fundamental for the prioritization and optimization of nutrition periodization that practitioners can apply to a myriad of nutrition interventions.

First, the coach and the entire support staff should have a full and comprehensive understanding of the event-specific physiological, neuromuscular, structural and psychological determinants for success.

Second, the performance gaps of the individual athlete should be quantified as best as possible against these performance determinants.

From this construct, the coach will strategically develop the various macro- (months to years), meso- (weeks to months) and micro-cycles (days to within days) aspects of training periodization and its specific sessions, using these as to bridge between the goals and the gap. Indeed, the integration of peer-reviewed evidence from training studies with the tacit knowledge of elite coaches (11) produces the "Science" and "Art" of elite training prescription and periodization (12). The periodized training schedule provides a framework for the sports nutrition professional to match nutritional strategies to support training outcomes. Table 1. Downloaded by Liverpool John Moores Univ on 01/22/19 "A Framework for Periodized Nutrition for Athletics" by Stellingwerff T, Morton JP, Burke LM International Journal of Sport Nutrition and Exercise Metabolism © 2018 Human Kinetics, Inc. 1 highlights the rationale involved in implementing macro-, meso- and micro-periodized nutrition recommendations. Conversely, figure 1 outlines the process, and highlights several periodized nutrition examples, such as the macronutrient (CHO and PRO), micronutrient (iron) and ergogenic aid (creatine) examples of macro-, meso- and micro-periodization, respectively. However, the narrative of this review will exclusively focus on energy and CHO periodization (13).

Which appropriate methods should be used depends on the specific goals of the individual and there is no method (or diet) that will address all needs of an individual in all situations. Therefore, appropriate practical application lies in the optimal combination of different nutritional training methods (13).

Some of these methods have already found their way into training practices of athletes, even though evidence for its efficacy is sometimes scared at best. Many pragmatic questions remain unanswered. One thing is clear, however, in elite sport, especially, the future of sports nutrition requires a close collaboration between trainer and sports dietitian/nutritionist. Working in silos will not work with the periodized nutrition approach and it is essential to incorporate nutrition planning in the long term (as well as short term) training planning (10).

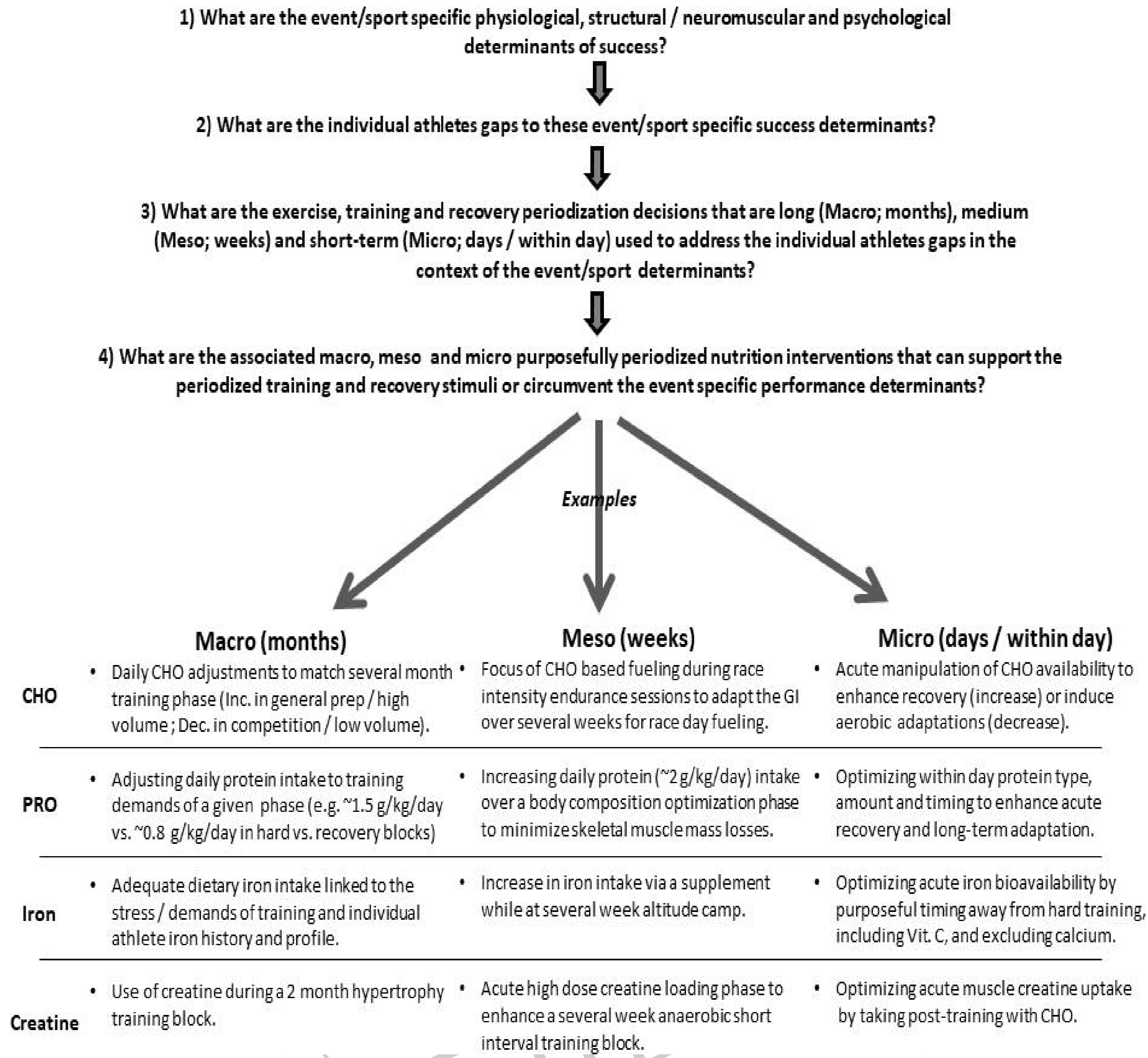

Figure 1. A methodological framework required for successful nutrition periodization, including examples of macro- (months), meso- (weeks) and micro-cycle (days / within day) nutrition periodization interventions for carbohydrate (CHO), protein (PRO), iron and creatine.

Table 1. Nutritional considerations in relation to macro-, meso- and micro-cycle training periodization (13).

Performance and/or Periodization Considerations	Nutritional Context
Macro-Periodization (months to weeks)	
What is the specific load and density of this training phase/block for this macro-cycle (stimulus)?	Estimation of required endogenous / exogenous substrates required during this block should guide nutrition advice. Assessment of any nutrition ergogenic aids that synergistically match the macro-periodization.
What are the EA requirements of this macro-phase?	Ensure adequate EI for optimal EA. If required, (14).
In relation to the training phase / block what are the current and long- term body composition goals? Are changes even necessary?	Strategic team discussions around risk & reward to optimize body composition targets, and develop an individual profile.
Are there any macro health considerations? (Injury / illness profile)	Target potential nutrition interventions to individual athlete health issues.
Meso-Periodization (weeks to days)	
What is the specific load and density of this training phase / block for this meso-cycle (stimulus)?	Estimation of required endogenous / exogenous substrates required due to the specific training stimuli during this block should guide nutrition advice. Consideration of any nutrition ergogenic aids that synergistically match the

	meso-periodization.
What are EA requirements of this meso-phase?	Ensure adequate EI for optimal EA. If required, assess RED-S status indicators as outlined by Mountjoy et al., 2018.
If a competition block (many competitions over several days to weeks), what are the chronic to acute recovery requirements?	During heavy competition phases, extensive logistical planning and practice is required for general, competition and recovery nutrition interventions.
What environmental training interventions are being implemented in this phase?	Environments (heat, cold, altitude) dictate implementation of various periodized nutrition interventions (e.g. hydration, iron etc.).
Micro-Periodization (days to within day)	
What is the specific load and density of this training phase/block for this micro-cycle (stimulus)?	Assessment of required endogenous / exogenous substrates required due to the specific training stimuli during this block should guide nutrition advice. Consideration of any nutrition ergogenic aids that synergistically match the micro-periodization.
What are the EA requirements of various different types of training days?	Ensure adequate EI for optimal EA, appreciating that there may be day to day EEE and EI variability.
What is the typical training day schedule? (within this specific training block/phase)	Understanding the individual athletes daily and weekly schedule informs micro (within hour) nutrition and supplement recommendations.
What are the acute recovery requirements from a unique / specific single training session?	Estimation of exogenous / endogenous substrates required during individual training sessions, coupled with the training goals and phase, will inform the pre, during and post-training nutrition interventions.
What are the acute recovery requirements from a single competition?	Generally, all recovery interventions are optimized during rounds of a competition, or throughout a competition block to maximize subsequent performance.
What are the training or competition specific interventions to optimize performance? (from tapering, to warm-up to sport psychology)	Competition phase tends to offer unique nutrition periodization challenges, such as body comp optimization during tapering, optimizing recovery protocols, to acute competition specific ergogenic aids (e.g. caffeine, sodium bicarbonate etc.).

CHO=carbohydrate; EA= Energy availability ,(Energy Intake (EI) - Exercise Energy Expenditure (EEE)) / Fat Free Mass;

NUTRITIONAL TRAINING

An athlete's energy requirements depend on the periodized training and competition cycle, and will vary from day to day throughout the yearly training plan relative to changes in training volume and intensity. Factors that increase energy needs above normal baseline levels include exposure to cold or heat, fear, stress, high altitude exposure, some physical injuries, specific drugs or medications (eg, caffeine, nicotine), increases in fat-free mass and, possibly, the luteal phase of the menstrual cycle (15). Aside from reductions in training, energy requirements are lowered by aging, decreases in fat free mass (FFM), and, possibly, the follicular phase of the menstrual cycle (16).

Energy balance occurs when total Energy Intake (EI) equals Total Energy Expenditure (TEE), which in turn consists of the summation of basal metabolic rate (BMR), the Thermic Effect of Food (TEF) and the Thermic Effect of Activity (TEA).

TEE = BMR + TEF + TEA
TEA = PlannedExerciseExpenditure + Spontaneous Physical Activity + Non Exercise Activity Thermogenesis.

Techniques used to measure or estimate components of TEE in sedentary and moderately active populations can also be applied to athletes, but there are some limitations to this approach, particularly in highly competitive athletes. Since the measurement of BMR requires subjects to remain exclusively at rest, it is more practical to measure resting metabolic rate (RMR) which may be 10% higher. Although population-specific regression equations are encouraged, a reasonable estimate of BMR can be obtained using either the Cunningham (17) or the Harris-Benedict (18) equations, with an appropriate activity factor being applied to estimate TEE. Whereas RMR represents 60%–80% of TEE for sedentary individuals, it may be as little as 38%–47% of TEE for elite endurance athletes who may have a TEA as high as 50% of TEE (15).

TEA includes planned exercise expenditure, spontaneous physical activity (eg, fidgeting), and non-exercise activity thermogenesis. Energy expenditure from exercise (EEE) can be estimated in several ways from activity logs (1–7 days duration) with subjective estimates of exercise intensity using activity codes and metabolic equivalents (METs),(19-20), 2015 US dietary guidelines (21) and the Dietary Reference Intakes (DRIs).

To achieve adaptations of the gastrointestinal (GI) absorptive capacity (22) for carbohydrates, an increased carbohydrate intake would be recommended. There may be a role for both of these seemingly contrasting methods in the training approach of an athlete. In the future, we are likely to see more planning of nutrition as part of the training plan of athletes. Specific workouts will be accompanied by specific nutritional goals. Nutrition can be planned as much as training can be planned and can be made more purposeful. This will also allow inter-individual differences in both physiology and goals to be taken into account. Different nutritional training methods can be used to achieve specific goals (see Table 2). It is beyond the scope of this review to discuss all methods in great detail and several methods have been discussed at length in various excellent recently published reviews (23 -27). In Table-2 an overview of some of the available nutritional training methods is provided. This list may not be exhaustive but it represents the most important variations that have received attention from researchers where there is at least some supporting evidence in the scientific literature.

KEY COMPONENT OF NUTRITIONAL PERIODISATION

One of the key concepts in current sports nutrition is periodization. Nutritional periodization involves merging it with other physical and mental training strategies. Periodization involves, providing athletes with meals that fit their needs for different moments throughout the day as well as allowing to create immune, metabolic and muscular adaptation strategies, during rest periods and also for cognitive aspects which respond to a scheduled plan or strategy. Periodization involves eating in a way which adapts to the different intensities for preseason, during competition or throughout the day, always looking for a correct adaptation and enhancement.

Table 2. Nutritional training methods: while some methods have more supporting evidence than others, these are the potential nutritional training tools that athletes and coaches can use to periodize the athlete's nutrition (5).

Train low	Training twice a day	Limited or no carbohydrate intake between the two sessions. The first training will lower muscle glycogen so that the second training is performed in a low glycogen state. This may increase the expression of relevant genes.
	Training fasted	Training is performed after an overnight fast. Muscle glycogen may be normal or even high, but liver glycogen is low
	Training with low exogenous carbohydrate availability	No or very little carbohydrate is ingested during prolonged exercise, This may exaggerate the stress response
	Low-carbohydrate availability during recovery	No or very little carbohydrate is ingested post-exercise. This may prolong the stress response
	Sleep low	Train late in the day and go to bed with carbohydrate intake restricted. Essentially the same idea as low-carbohydrate availability after training, but the period post-exercise is extended. Muscle and liver glycogen will be low for several hours during sleep
	Low-carbohydrate high-fat/ ketogenic diets	Long-term low-carbohydrate stores
Train high	Training with high muscle and liver glycogen	Carbohydrate intake is high before training when glycogen is important and there is a focus on glycogen restoration post-exercise
	Training with a highcarbohydrate diet	Carbohydrate intake is high on a daily basis independent of training, but may be especially high around training (during and after)
Training the gut	Training of stomach comfort	Increasing volume of intake with or without exercise
	Training gastric emptying	Repeated use of meals to increase/improve gastric emptying of fluids or nutrients (carbohydrate) and reduce stomach discomfort
	Training absorption	Increasing daily carbohydrate intake and/or intake during exercise to improve absorptive capacity of the gut and reduce intestinal discomfort
	Training race nutrition	Training all aspects of a nutrition strategy as on race day
Training dehydrated	Training in a dehydrated state	Training with limited/no fluid intake to allow dehydration
Improving training adaptations with supplements	Supplements	Supplements that may allow more training to be performed (see Table 3) Supplements that may initiate or increase protein synthesis and/or increase myofibrillar protein synthesis (see Table 3) Supplements with the potential to increase mitochondrial biogenesis (see Table 3)

Table 3. Categories of supplements suggested to promote training adaptations based on their mechanism of action (5)

Supplements that may allow more training to be performed	Caffeine, Bicarbonate, Creatine, Nitrates (beetroot)
Supplements that may initiate or increase protein synthesis and/or increase myofibrillar protein	Essential amino acids, Leucine, Branched-chain amino acids, β-Hydroxy β methylbutyrate

synthesis	
Supplements with the potential to increase mitochondrial biogenesis	Epigallocatechin, gallate and green tea extracts, (-)Epichatechins Resveratrol Quercetin Conjugated linoleic acid

Following this idea, different strategies are created using different ingredient proportions, according to the goal in mind. These goals can vary, such as adjusting body composition or accelerating recovery. For female athletes, it could be to adjust the carbohydrate intake to their cycle (28).

- **Preseason is key:** A good example of periodization takes place in the preseason phase, when double training session strategies, changes in lunchtime and other circumstances might cause positive outcomes.

- **Body Comoposition** :The athlete body composition has to be adjusted and it is possible to help by educating the athlete to know what meal best suits them to improve, for example, body fat. In this period an athlete's diet will contain more vegetables and food with fewer carbohydrates which are less energetic than what the athlete will consume during competition. Carbohydrates (like rice, cereal or pasta) are changed for fruits and vegetables in salads, juices or ***bowls*** in order to later increase again, and according to the needs, the amount of the first ones too. Healthy fats like olive oil, tuna, nuts or avocado also play an essential role and allow the athlete's muscle to physiologically "learn" to use this energy, and also know how to use rice, potato or pasta.Experts state that preseason is the best moment for the athlete to assimilate and learn these concepts, due to the few matches played as the league has still not started.

- **Personalization is essential :**Personalization is a second key aspect in the athletes' diet, as the strategies used for the training session and intensity that look for the player's adaptation, can vary for each member of the team. What might be beneficial for one, can be insufficient for others. To achieve the goals established by the nutrition team, it is important to take into account the which moment of the season we are in and the athlete's age or gender, as there is a metabolic adaptation.

- **The athlete's preferences :** Another aspect that shouldn't be forgotten is the range of options and preferences of meals for each athlete because, in some cases, options are very limited, and the diet lacks variety to fit the best option for adaptation. The diversity of food eaten by a person is an indicator of the quality of the diet, which also applies to athletes. On the other hand, there are cultural and religious factors that lead to not eating some ingredients like pork and other health factors such as intolerance to certain food products.

- **Be visual :**A visual example to explain pkeriodization can be through the concept of a ***bowl*** dish that changes the ingredients and quantities as required. The basic approach involves putting in a plate or ***bowls*** the ingredients: proteins, vegetables and carbohydrates and increase or decrease the number of carbohydrates such as pasta or rice according to the intensity of the effort or moment of the day (before or after exercising). From there on, it can be personalized by modifying with different options such as gluten or gluten-free, with or without lactose, vegetarian, of easy digestion…(28).

- **Exercise Intensity:**The body uses different amounts of energy substrates (carbohydrates or fats) depending on the intensity of the exercise and the heart rate of the exerciser. Protein is a third energy substrate, but it contributes minimally and is therefore discounted in the percent contribution graphs reflecting different intensities of exercise. The fuel provided by the body dictates an individual's capacity to increase the intensity level of a given activity. In other words, the intensity level of an activity determines the order of fuel recruitment. Specifically, exercise physiology dictates that low intensity, long duration exercise provides a larger percentage of fat contribution in the calories burned because the body does not need to quickly and efficiently produce energy (i.e., adenosine triphosphate) to maintain the activity. On the other hand, high intensity activity utilizes a larger percentage of carbohydrates in the calories expended because its quick production of energy makes it the preferred energy substrate for high intensity exercise. High intensity activity also yields a higher total caloric expenditure (29).

Table-3. Outlines the estimated distribution of energy consumption at different intensity levels for a healthy 20-year-old with a Max Heart Rate (MHR) of 200 (29).

Intensity (%MHR)	Heart Rate (bpm)	% Carbohydrate	% Fat
65-70	130-140	15	85
70-75	140-150	35	65
75-80	150-160	65	35
80-85	160-170	80	20
85-90	170-180	90	10

- **Muscular Hypertrophy:**

Strategy 1: Increase Lean Muscle Mass and Weight (30)

As mentioned previously, knowing your BMR and especially your TDEE value will assist you in aligning your dietary plan with your strength training goals. In this example, let's assume that your goal is to **build lean muscle mass while increasing your overall body weight**. This is a typical goal for strength trainers who are satisfied with their current body fat percentage, but wish to make gains in muscular strength, mass and density. As you make these gains, your body will naturally become heavier due to the fact that **muscle weighs more than fat** by volume, and your body will gain muscular bulk during your strength training program.

In this example, you would need to **consume more calories per day than your calculated TDEE value**. Doing so will provide you with the energy (**carbohydrates**) needed to fuel your workouts, as well as the building blocks (**protein**) needed to build larger, stronger, denser muscles after your workout.

Strategy 2: Increase Lean Muscle Mass and Lose Weight

Another typical weight training goal is to **burn fat and lose overall body weight while building muscle mass**. This scenario is a little trickier in light of the fact that the lean muscle you build will be heavier than the fat you're burning. As a result, your body's natural tendency will be to increase in overall weight, despite the fact that you'll be gaining a more lean and toned appearance.

Although this shouldn't be a concern for most individuals (after all, the best weight loss wisdom holds that you should concern yourself more with your body measurements, your appearance and how you feel, not what a scale tells you), it could be important if you're trying to **maintain a specific weight for a certain sport**, such as a fighting competition.

In order to lower your overall body weight, burn fat and still gain lean muscle mass, you'll need to **consume fewer calories each day than your calculated TDEE value**. PlayModel Each time you establish a caloric deficit of 3,500 calories, you'll lose one pound of body weight. However, you'll need to make a couple of adjustments to your diet if you want this strategy to work as intended:

i) Eat less fat and simple carbohydrates in order to reduce your total caloric intake and lose weight.
ii) Eat more protein in order to give your body the materials it needs to build bigger, stronger, denser muscles.

CALCULATION OF TOTAL ENERGY EXPENDITURE

Calculating Your Basal Metabolic Rate :

In order to calculate your Basal Metabolic Rate, you'll need to use what's known as the **Harris-Benedict formula** (31). This formula takes into account factors such as weight, height and age, and differs for men and women. The formulas are as follows:

BMR Formula (Standard English)

- **Women BMR** = 655 + (4.35 x weight in pounds) + (4.7 x height in inches) - (4.7 x age in years)
- **Men BMR** = 66 + (6.23 x weight in pounds) + (12.7 x height in inches) - (6.8 x age in year)

Calculating Your Total Daily Energy Expenditure

Although your BMR is a useful and interesting piece of information on its own, its practical use is limited because you'll never spend the entire day sleeping in bed, especially if you're an active strength trainer. Instead, it's more valuable to calculate your **total daily energy expenditure**, or TDEE. This is a measure of your BMR **plus all of the calories you burn each day through physical activity**. In short, your TDEE value is the total amount of calories you burn each day.

In order to calculate your TDEE, you'll need to use the following simple table, which requires you to **multiply your BMR by a certain figure based on your activity level** (31):

Activity Multiplier

- **Sedentary** = BMR X 1.2 (little or no exercise, desk job)
- **Lightly Active** = BMR X 1.375 (light exercise/sports 1-3 days/wk)
- **Moderately Active** = BMR X 1.55 (moderate exercise/sports 3-5 days/wk)
- **Very Active** = BMR X 1.725 (hard exercise/sports 6-7 days/wk)
- **Extremely Active** = BMR X 1.9 (hard daily exercise/sports & physical job or 2X day training, etc.)

TRAINING CYCLES

Preparatory Cycle (Pre-Season):

During the preparatory cycle, daily carbohydrate intake should range from 3 – 7 g/kg. Athletes who are not training with high volume or intensity should begin at the lower end while those training more than two hours per day should begin in the middle of the range.

Daily protein intake should range from 1.2 – 2.5 g/kg. Body weight goals will a#ect the amount of protein, hence the large range. For athletes seeking weight loss, the higher end of the range is recommended (2.0 – 2.2 g/kg) to improve satiety and better utilize the thermic e#ect of food. Adding more protein will also have a blood sugar stabilizing e#ect which will control the biological hunger response in individuals. For those interested in maintaining weight, a moderate protein intake (1.2 – 1.7 g/kg) can be recommended.

Daily fat intake should be relatively low, ranging from 0.8 – 1.3 g/kg. Fat is a necessary component in the nutrition plan and should not be neglected. However, the proper sources of fat should be a focal area. !ese include monounsaturated and polyunsaturated (specically omega-3) fats. It is important to minimize the intake of saturated and trans fats.

Tere are no definitly daily hydration guidelines that are supported by research; however, athletes should be encouraged to use the urine color chart and frequency of urination to remain in %uid balance. Urine color should be pale yellow and individuals should be urinating every 2 – 3 hours to ensure a positive hydration status (32).

Competition Cycle (In-Season) :

Energy expenditure will change as athletes progress into the competition cycle. the physical goals require a shift to higher intensity training and usually include improving strength, power and speed. This change in energy expenditure will facilitate a needed nutritional change.

Daily carbohydrate requirements will likely increase depending on the level of exercise that an athlete performs. If the exercise duration and intensity increase significantly from the previous training cycle, carbohydrate intake should also increase to support the higher physical demands. Carbohydrate intake should range from 5 – 12 g/kg.

Daily protein intake should range from 1.4 – 2.0 g/kg. Protein will still serve as a blood sugar stabilizer, thus it is important to keep a moderate amount in the nutrition plan. However, since a higher amount of carbohydrates may be consumed, protein intake may decrease slightly. The type of exercise an athlete performs will largely dictate the amount of protein. For athletes focused more on strength and power training with lean muscle mass gains as a goal, daily protein intake can remain around the 1.7 – 2.0 g/kg. For endurance athletes, focusing more on cardiovascular exercise with light strength training, daily protein requirements can be met with a range of 1.2 – 1.7 g/kg.

Daily fat intake should be moderate, ranging from 1.0 – 1.5 g/kg. As was the case in the preparatory cycle, healthy, antiin%ammatory fats should be the abundant fat consumed by individuals. It is important to understand the exercise load that an athlete follows as this will largely dictate the amount of fat consumed each day. If an athlete is training at least 2 – 3 times per day with high energy expenditure, more daily fat may be necessary to remain in energy balance.

Hydration should be a high priority during this time due to the increase in sweating from higher exercise duration and/or intensity. One thing that is often forgotten by athletes is the importance of daily hydration prior to workouts. It is imperative that athletes develop the habit of drinking enough %uids and eating enough high water content foods such as fruits and vegetables to improve their hydration status throughout the day to have proper %uid stores for their training session. Far too often, individuals become dehydrated during exercise as a result of improper daily hydration practices. If an athlete is dehydrated before exercise, there is not much they can do to prevent further dehydration during exercise and thus their training session will be compromised (32).

Transition Cycle (Off-Season) :

This is normally the time of the year where most nutritional mistakes are made due to the somewhat abrupt change in energy expenditure. The previous training cycle included longer durations and higher intensities of training which equated to higher energy expenditures. In contrast, the transition cycle typically has a significant reduction in training. Athletes may still exercise during the transition cycle, but do so less frequently and without much structure.

During the transition cycle, daily carbohydrate intake should decrease to 3 – 4 g/kg. Because of the reduction of energy expenditure, there is no need for as high of a carbohydrate intake as in the previous exercise cycle. Even if an athlete is exercising up to 6 – 7 times per week, this new carbohydrate range will still provide enough energy for the muscles and brain to fuel exercise and sustain cognitive function.

Daily protein intake should range from 1.5 – 2.3 g/kg. A slightly higher protein intake will improve the satiety response and will contribute to a higher thermogenic contribution to energy expenditure. If an athlete will be following an aggressive, hypertrophy producing strength training program during this time, the higher range of protein can be recommended to maintain protein stores from pre to post-workout. For those engaging in lighter cardiovascular and strength training activities, the lower range can be used as long as satiety is maintained. Daily fat intake may decrease slightly but, in general, should remain moderate, ranging from 1.0 – 1.2 g/kg. Increasing the omega-6 to omega-3 fat balance should be a primary emphasis by including more omega-3 rich food sources (32).

Training Dehydrated

A concept that has been considered for some time, but only recently systematically investigated is whether training in a hypohydrated state can improve performance when dehydrated. Fleming and James (33). recruited ten recreationally active individuals who performed four exercise tests in an euhydrated or hypohydrated state. Euhydration and hypohydration were induced by manipulating fluid intake in 24 h pre-exercise and a 45-min steady state run. Before and after this short training period, the subjects performed a 45-min run followed by a 5-km performance task. It was observed that dehydration reduced performance by 2.4%. The main finding, however, was that training without fluids resulted in smaller reductions in performance. On average, the runners were 5.8% slower with euhydrated training and only 1.2% slower when they trained in a dehydrated state. Additionally, the rating of perceived exertion was normalized after hypohydrated training. Thus, it appears from this study that familiarization with hypohydration may have the potential to improve performance in situations where hypohydration may occur. However, at present there is only one study to report these effects and more work is needed before we can turn these findings into clear general guidelines for athletes. In general considferation, hydration is an important aspect of sports training specially before, during and after exercise.

CONCLUSION :

Within the limitation of the present study the following conclusions can be drawn:

1. Diet for an athlete must be depended upon the requirement of energy.
2. For nutrient the energy pathway must be given priority.
3. Nutritional aspect is an individualized matter.

4. Sports nutrition is related to the nature of the activity.
5. During different phases of training cycles, nutrition should be scientifically planned.
6. Sports nutrition is highly concerned with the intensity and duration of any sporting event.
7. The ratio of macro nutrients scientifically planned .
8. Depended upon the athlete's adaptive quality there may be scope of suppliments.
9. Environmental consideration may be kept in mind for nutritional periodisation .
10. Hydrate, hydrate and hydrate.

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