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Review Article

Nutrition and Recovery for MMA

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Overall Nutrition Strategy and Energy Balances

Mixed martial arts are a unique sporting endeavor for a few reasons. First, athletes compete in 3 five minute round bouts, with championship bouts going to 5 five minute rounds. Due to the fights' structure, athletes require an extreme level of condition involving every energy system. Fighters must to be ready to display aerobic endurance at a level that keeps them constantly moving, evading, striking, and grappling for 15-25 minutes. They must also possess high levels of anaerobic power to wrestle for takedowns and throw effective punches and kicks constantly. MMA Athletes must be able to display aerobic capacity and anaerobic capability in a way that allows them to be effective but not to burn out quickly.

Nutrition also poses a serious obstacle to these athletes. Mixed martial arts are a weight class-driven sport. This means many athletes will be attempting to lose large amounts of body weight before their fights to "make weight." Such extreme weight cuts mean athletes risk nutrient deprivation and hydration issues before they compete. Athletes are forced to juggle calories to allow them enough energy to train hard daily while avoiding relative energy deficiency and supporting their weight loss. Consuming enough calories and the appropriate amount of macronutrients from nutrient-dense foods is essential for success in MMA.

Athletes in mixed martial arts must be constantly aware of their caloric intake and needs. In training, athletes can default to a caloric range of 25-30kcals/kg bodyweight [1]. However, as competition gets closed, athletes must plan ahead so as to avoid unnecessary last-minute drastic weight cuts. Reverse engineering their diet by creating a daily deficit of 250 kcals can be a great way to approach their diet while minimizing side effects like fatigue and muscle loss. As the athlete continues to lose weight, they can recalculate this number to ensure a continuous loss. If that wasn't enough, athletes must also find ways to effectively recover from multiple training sessions a day while in a state that may be compromised by dehydration and caloric deficit. As one can imagine, the sport of mixed martial arts poses many challenges from a preparedness standpoint. However, athletes can minimize the negative aspects and leverage themselves towards victory with the correct approach and the right team.

Nutrient timing

Carbohydrates

Carbohydrates are the primary substrate being used in the sport of missed martial arts. This is the duration of the bouts and the constant need for explosive power output throughout each round. Athletes need to be able to punch, kick, apply and avoid takedowns round after round. These actions require endurance, but any of these techniques delivered without power are effectively useless. When coupled with the demands of weight loss pre-competition, the athlete is at massive risk for not replenishing enough muscle and liver glycogen to be effective. If not bad enough, they typically only have about 24 hours after weights to accomplish this. The training athlete has a slightly different outlook than the competing athlete as well. The training athlete does not need to diminish liker and muscle glycogen to make weight. This problem presents itself when the athlete needs to dehydrate for competition. Each gram of glycogen is accompanied by at least 3 grams of water, making reducing glycogen nearly essential for making weight [2]. One avenue for athletes to consider during training is the fact that many athletes benefit from the hermetic effects of training with low glycogen and competing with high levels [3] the added stress of training with low levels may be implicated in better performance when levels are high.

Athletes would benefit from a plentiful amount of root tubers, grains, rice, vegetables, pasta, whole-grain bread to fuel their glycogen needs [4]. Consuming carbohydrates in the hours leading up to the match should be at a rate of 8-10g/kg body weight to maximize glycogen stores. When rapid restoration of glycogen is needed, for example, in a same-day weighting scenario, athletes

should consume high glycemic index food at a rate of 1.2 g/kg/hr leading up to the event. This can be done easier with carbohydrates in beverage form and with the addition of caffeine 3–8 mg/kg caffeine 0.2-0.4 g/kg/h protein [4]. To aid in digestion, athletes should consume multiple smaller meals before and after training and compete to ensure glycogen stores are adequately filled.

Protein

Protein is another essential component of any athlete's nutritional protocol. However, due to the damage, the fighter withstands in daily practice, the need for recovery, and the importance of retaining muscle mass, protein intake is vital for the mixed martial artist. Mixed martial arts requires constant training and practice to become and remain competitive. Fighters are constantly training and grinding against other athletes in sparring, grappling, and wrestling sessions that can be difficult to recover from. Always bruised and suffering joint wear and tear can take its toll on the athlete both mentally and physically. Being sure to ingest enough protein, vital for recovery from daily training bouts. Whole protein sources like fish, eggs, lean steak, chicken, even legumes, whey, casein, pea protein, and rice protein are examples of high-quality protein sources that are easy to consume and typically reasonably priced. Protein should be consumed in a range of 1.5-2.2 g/kg B.W. However, athletes who need to cut high levels of weight for their competitions may consider increasing their protein intake to 2.3-3.1g/kg B.W. to avoid muscle loss [5] (Jäger et al., 2017; Kerksick et al., 2018). Doing so will make the weight cut and recovery before competition easier on the fighter mentally and physically. Athletes should also consider dosing protein in multiple 20-40 gram doses throughout the day to enhance digestion and muscle protein synthesis keeping in mind to consume at least one of these doses immediately post-workout [4]. There is nothing worse than competing in a weakened state because too much muscle mass was lost and poor recovery.

Fat

Fat is often the most overlooked macronutrient when it comes to athletic performance. However, fat is an essential component of nearly every cellular function in the body. Fats serve as one of the main components of cellular walls' integrity and permeability. Fat also plays a role in hormonal development and even digestion of other macronutrients like protein. Athletes who are constantly breaking down and restoring tissues through intensive training need fats to recover and heal. Intense training also takes a toll on the hormonal status of the body. Overstress can lead to decreased levels of testosterone and growth hormone, along with increased cortisol levels. Maintaining a healthy fat intake can help the athlete combat such hormonal fatigue. Lastly, fat acts as a buffer to aid in the digestion of high levels of lean protein. Although rare, high levels of lean protein without fat over weeks or months can lead to a condition known as rabbit starvation, aka protein poisoning, which can result in nausea, vomiting, diarrhea, and eventually death. Athletes consuming elevated amounts of protein during weight cuts and training camps must consider fat intake to ensure they not only get the recommended dosages but the correct types of fat. Consuming omega three rich foot sources will help keep the athlete's inflammation low while also reaping all the healing and digestive benefits. Fat account for approximately 20-35% of the athlete's daily caloric intake [4]. Mixed martial arts fighters may benefit from occasionally conditioning themselves to lower levels to ensure weight cuts' ease and success.

Recovery strategies

Everyone knows recovery is important. However, few know exactly how to program recovery intelligently for optimal output. Historically we have programed every 5-6th week of training as a deloading and nutritional recovery week. Many mixed martial arts fighters find themselves grinding and dieting week after week with no downtime from physical abuse and no recovery time from intense dieting. Educating the athlete on the benefits of deload week when the intensity and volume of exercise are reduced by 50% and overall calories are increased by 250-500Kcals/day can result in renewed vigor for training and the avoidance of burnout. Sleep is another essential component of recovery that many athletes try to simple overcome through sheer will. However, athletes who compromise their sleep cycles via early training, later training, or blatant avoidance risk acute illnesses, increased right of injuries, and even the development of chronic diseases [6,7] also concluded that athletes who neglect sleep duration and quality could suffer mental fatigue resulting in increased stress, negative mood, anxiety, and depression. Due to this, athletes must prioritize a minimum of 8-9 hrs of sleep per night. Monitoring for athletes overtraining and recovery can be relatively easily monitored, though [8] demonstrated that monitoring HRV at rest could be the single best way to estimate recovery in training athletes. Wearable HRV monitors such as Morpheus, Whoop, iWatch, and Omega Wave have demonstrated small amounts of absolute errors when testing HRV and monitoring athletes training loads and recovery [9] thereby making them reasonable options for athletes looking to maximize recovery.

Hydration strategies

Of course, with any sporting event, hydration is critical. The athletes competing in mixed martial arts are no different and must respect the amount of water lost in daily training. To combat the risk of dehydration, athletes are encouraged to consume 150% of the fluids lost during training [10]. Athletes are encouraged to do pre-and post-training weights to get this number, especially during the hottest months effectively. Athletes are then recommended to consume 24 oz of water for every pound of body weight lost.

Supplement Suggestions

Considerations for supplement use

Supplementation should be viewed as an augment to an athlete's nutritional regimen. Supplements should be critically evaluated and prescribed based on the athlete's needs and goals of training and competition. Unfortunately, the supplement industry is riddled with misinformation and false promises. Athletes looking

to supplement should consult their sports nutrition expert first to ensure the supplements they choose are legitimate and both risk and cost-effective. However, a few sports supplements have stood the rigors of modern research and constantly come out on top. Those supplements are a multivitamin, creatine, beta-alanine, and HMB, and caffeine.

Multivitamin

Multivitamin supplementation should be the first consideration for practicing mixed martial artists. The training intensity and caloric restrictions needed to be competitive can often leave the athlete behind the curve on essential micronutrients. This can become problematic for the athletes as many of the micronutrients serve essential bodily support functions in everything from cellular health to bone density and even immune system improvement. Athletes who consume multivitamins should consider those with the "Good Manufacturing Practices" Stamp or GMP. This will ensure the athlete is getting what is on the label and is following their organizational standards. It is also important to note that athletes who consume daily multivitamins should be confident that they are consuming them in safe doses [11]. concluded in their meta-analysis that those consuming multivitamins in the amounts suggested on the label will have little worry about ever reaching a toxic level even when consuming highly fortified foods.

Creatine

Creatine should be considered a mainstay in most athletes' supplement regimens. Over the years, creatine has stood up to the rigors of modern research and constantly comes out on top as both safe and effective. Creatine provides numerous advantages, including increased power output, increased overall training volume, and even central nervous system anti-inflammatory effects. Creatines works by providing essential substrate to the physiological mechanism that creates power output. In fact, the human body has an energy system dedicated to creatine usage, the creatine phosphate system. This system typically provides power output in the 10-second range before creatine stores deplete and need replenishing. Supplementing with creatine has been proven to allow the body increased time to fatigue in this energy system. What does this mean for our mixed martial arts competitors? More power for longer during their explosive training bouts. This translates to more explosive punches, kicks, and takedowns and athletes can produce. As if that wasn't enough, creatine has also shown numerous neuroprotective capabilities. For athletes in constant fatigue and at risk for brain trauma, this makes creatine essential. Typical creatine dosages for power output and performance range anywhere from 3 grams/day to 5 grams per day and can be taken safely by all age groups for extended periods [13]. Those looking for neuroprotective benefits should consider higher doses of up to 30 grams a day [13].

Beta-Alanine

Beta-alanine should be considered a staple in any high-intensity exercise regiment. When taken in proper dosages, beta-alanine is a potent precursor to the amino acid carnosine. Carnosine has demonstrated time and time again to work as an intramuscular buffer during intense exercise, especially those lasting 1-4 minutes [14]. Beta-alanine can directly benefit the aspiring MMA athlete due to the perfect matchup between effective times and round time. Due to its buffering capabilities, those consuming beta-alanine have reported increased time to fatigue as the lactic acid, and H+ ion accumulation is easily buffered by decreasing their fatiguing effects. Beta-alanine should be taken in supplemental doses ranging from 3-6 grams daily. This dosage should be divided into 1 gram doses throughout the day to avoid its main side effect while is the sensation of the skin, lip, and face tingling.

HMB

HMB (β-Hydroxy-β-Methyl butyrate) is a sports supplement that promotes lean body mass and reduces body fat. It is considered one of the more studied sports supplements behind Beta-Alanine and creatine. HMB has demonstrated capabilities in reducing muscle loss in athletes and the elderly, and those who may be suffering sarcopenia. Preventing muscle loss is essential for many reasons; however, it can be critical to any athlete who needs to perform in weight classes and undergo caloric deficits while maintaining lean body mass. HMB works due to its nature as a metabolite of the amino acid leucine. Leucine is essential for muscle protein synthesis and plays a role in ATP Production for power output. After consumption, about 5% of the leucine consumed is converted to HMB. HMB then plays a role in muscle protein synthesis and protein breakdown prevention while also stabilizing the cell membrane wall of muscles. HMB promotes muscle membrane support by working as an alternate substrate for cholesterol synthesis. It does so via activation of the mTOR pathway, thereby decreasing muscle breakdown, improving membrane integrity, and even muscle damage and necrosis [15]. After an athlete takes HMB, they can expect their levels to peak about 30 minutes post-consumption and return to baseline after about 9 hrs. Therefore, supplemental doses should be taken in multiple doses of 1 gram throughout the day [15]. The literature has also demonstrated that 3 grams a day for four weeks reduced symptoms of muscle damage in weight training individuals [16]. While 3 grams a day for four weeks also reduced signs of muscle damage in those performing 20km runs (Knitter et al., 2000).

Caffeine

Caffeine is an effective supplement for energy sustainment during times of fatigue and low energy availability. It has also been shown to improve both anaerobic and aerobic exercise output in those taking 3-9 mg/kg body weight and can be considered safe for most individuals [17]. Anaerobically caffeine has been shown to increase power output, while aerobically, it has been shown to improve time to fatigue. It has been suggested that the mechanism for increased time to exhaustion could be that caffeine has demonstrated the ability to decrease pain perception associated with this type of exercise [17]. Caffeine works by competing with adenosine at its receptor sites; its effects on exercise may be more

neural than muscular [17]. Caffeine peaks in the blood about an hour after consumption but varies depending on the delivery system. Chews and gums are the fastest drinks, the second fastest, and pills the third.

Wrapping it up

Whether training for fitness or aspirations of world championships are the goal, the mixed martial arts athlete has many things to consider from a nutritional standpoint. The first thought should be, does my current nutritional approach support my training? Am I eating enough or too much? Am I consuming the correct amount of each macronutrient to fuel my workouts and recover from the amount of stress I'm putting my mind and body through? Are the food choices I'm making giving my body the vitamins and minerals I need? Am I hydrating appropriately? And finally, if everything else is right, can I take advantage of the science behind some of the more impactful supplements on the market today? If the athlete can critically evaluate themselves and these questions, they will undoubtedly leverage themselves towards success. Additional resources for athletes can be found at https://www.sportsnutritionsociety.org/, the leader in sports nutrition information and education.

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