



The Function of Nutrition in a Basketball Player's Recovery: A Systematic Review

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Abstract

Introduction: only sparse scattered studies present a practical approach on the nutritional requirements of modern basketball players. This paper aims to gather and complete such a disseminated knowledge from a theoretical-practical perspective. **Objectives:** to analyse the fatigue produced during a basketball game, while offering a practical solution to accelerate its recovery through nutrition. **Methods:** database research over the reviews of the last 15 years and its original articles on basketball of the last 5 years is included. **Results:** the selection of nutrients and food supplements along with their proper timing and doses are key for a quicker and more effective recovery. **Conclusions:** nutrition before, during and after games or high intense practices, plays a fundamental role in the recovery of the basketball player.

Key Words: Basketball, Nutrition, Recovery, Training, Diet

INTRODUCTION

Basketball is an intermittent activity that combines periods of active and passive recovery with highly intensive movements and very precise technical manoeuvres (ott, *et al.*, 2020). an official contest(International Basketball Federation, FIBA) consists of four 10-minute live game periods, or 12 in the NBA (National Basketball Association), separated into two sections, with 2 minutes of rest in between each quarter and 15 between each half. The game stops frequently (for example, when the ball leaves the court, when the referee enforces the rules, or when the coach requests a timeout), so the actual operational time is less than half of the overall game time. However, the advancement of rules in comparison to the Basketball has gotten faster and more spectacular during the past ten years. Game, shortening rest periods and extending the overall distance Raised, increasing the physiological and energy needs(Stojanovic E., *et al.*,2018) Which are followed by increased fatigue in the player(Štrumbelj, E., *et al.*,2013). additionally, the competition calendar directly impacts Tiredness (Sargent, C., *et al.*,2014). A top-tier basketball player can participate in up to three games per week (taking part in various events including the Euro league, National League, National Cup, etc.) over around a34 weeks with roughly 70 games overall Svilar, L.,*et al.*, (2018). It follows that Basketball players frequently receive recovery times of less than 48 hours. between games, they must also deal with numerous other things. Teramoto, M., *et al.*, (2017) travel hours. However, the

restoration process takes at least 48 hours (Chatzinikolaou, A., *et al.*, 2014) the player's maximum muscular glycogen, homeostasis, and performance. A speedy recuperation period could cause an accumulation. pressure and exhaustion, which may lower the player's performance Reilly, T., & Ekblom, B. (2005) or heighten the danger of harm, particularly in the eleventh minute of the game. In essence, exercise and game Basketball players' ability to heal and perform is affected by congestion. Consequently, the athletic performance team is really worried. Regarding recovery techniques to expedite this process, and sufficient nutrition is important before, during, and after a workout or game. Regarded as a crucial component in the player's recuperation. Any training and competition programme must include sports nutrition (Grozenski, A., & Kiel, J. 2020 – Fullagar, H. H., McCunn, R., & Murray, A. 2017). The International Olympic Committee (IOC), the American College of Sports Medicine (ACSM), or the American Dietetic Association (ADA), among other organisations Thomas DT., *et al.*, (2018) , Maughan, R. J., *et al.*, (2018), all concur that an athlete would perform better physically and recover more quickly after a training or game with the support of optimal nutrition. In many In some instances, the physiological needs of a game or practise are indirectly assessed with the use of factors like heart rate or blood lactate concentration. Moreover, the examination of the foot age The movement of the athlete aids in calculating the requirements that Dietary balance is required. In many In some instances, the physiological needs of a game or practise are in directly assessed with the use of factors like heart rate or blood lactate concentration. Moreover, the examination of the foot age The movement of the athlete aids in calculating the requirements that Dietary balance is required. This refers to the level of work intensity at which Average blood lactate levels are 3.7 mmol/L, which are stable. Since all explosive reactions take place over the MLSS, anaerobic pathways must resynthesize ATP, endangering glycogen stores. The amount of weekly matches and training sessions, as well as intrinsic and extrinsic aspects such game position, player level and experience, gender, and age, make more exact, specific, and tailored diet necessary Holway, F. E., & Spriet, L. L. (2011). However, only a small number of works—the majority of which were conducted before the year 2000—offer a workable approach for comprehending the nutritional needs of modern basketball. As a result, this paper presents a theoretical-practical suggestion for basketball based on an analysis of the literature over the last ten years.

FATIGUE TAXONOMY

We must understand the mechanisms that cause a player to become fatigued before we can address the most important components of nutrition in basketball. According to Cepeda, N. T., Rodriguez., *et al.*, (2004) classification, the major causes of weariness would be the depletion of energy substrates (glycogen) or the build up of various waste products (lactate). Professor Meeusen, on the other hand, categorises weariness in accordance with the level at which it manifests Meeusen, R., & Roelands, B. (2010), either at the musculoskeletal or nervous system levels. Any of those circumstances will result in the player's performance declining as they are unable to maintain high intensity motions, cover less ground, and make more mistakes and inaccuracies when shooting or passing. Lyons., *et al.* (2006) examined how fatigue affected pass accuracy using a discernible drop in pass accuracy, especially for novice players. (920-1150 mg/l) Palacios Gil-Antuñano, N., (2008), based on the theory that muscle glycogen replenishment will be quicker the earlier the player starts drinking that isotonic drink (during the game and immediately after), will allow to start the glycogen recovery for the next game. Therefore, if the player is disciplined and adheres to the prescribed food guidelines, the muscle glycogen stores would have been restored in about 48–72 hours Krstrup, P., *et al.*, (2011). At the same time, energy pathways produce wastes (lactate, ammonium, extracellular potassium, hydrogen ions), as well as other physical effects (heat), which when accumulated, can affect various biological systems of the muscle fibre, inhibiting processes like the Krebs cycle or anaerobic glycolysis, lowering membrane potential, or acidifying the cellular environment. This causes fatigue because there is a lower and slower power output to match motion demands.

THE SITE OF THE FATIGUE

Both decision-making and performance structures (peripheral and central) are susceptible to fatigue. Neuromuscular fatigue is a peripheral fatigue. The musculoskeletal structures are unable to support high levels of physical activity Gómez-Campos, R., *et al.*, (2010). Jumping ability, a crucial component of the game's performance, is one sign of neuromuscular exhaustion condition Rodríguez-Rosell D., *et al.*, (2017), Scanlan, A. T., *et al.*, (2017). Concerning central fatigue, altered hormonal patterns, particularly in the cortisol-testosterone relationship Ott, I. E., & Santos, J. I. (2020), Schelling, X., *et al.*, (2015), can be accompanied by a decline in physical performance that causes behavioural and cognitive changes, such as poor synchronisation in the execution of technical gestures or tactical situations Coutinho, D., *et al.*, (2020). However, there are ways to "cheat" the brain. For instance, rinsing a carbohydrate mouthwash for five seconds without swallowing it deceives the brain into thinking it will immediately consume carbohydrates and activates motivational centres, which then tell the muscle to "go one step further" in physical effort and trick fatigue (Jeukendrup A, Chamers E (2010), Chambers ES, Bridge MV, *et al.*, (2009).

FOOD PLANNING TO SPEED UP REHABILITATION

The following are the main goals of a basketball nutrition recovery strategy: In order to a meet the player's energy requirement, b) top off glycogen reserves, and c) heal injured muscle tissue. These tactics must begin as soon as the game is done (even in the middle of it) and must last for up to 24 hours (until the healing process is complete) Krstrup P., *at el.*, (2011).

NEEDS FOR ENERGY

Basketball games need an energy expenditure of at least 8 METs (metabolic equivalent of task), according to a study of matches employing video analysis and global positioning technology with accelerometers and gyroscopes Scribbans, T. D., *et al.*, (2015). As a result, a 98 kg male player will likely consume 13.7 kcal/min of energy during an ACB (Asociación Clubes de Baloncesto) or European League match, compared to 10.5 kcal/min for a 75 kg female player Salgado-Sanchez I, *et al.*, (2009). However, factors like the number of accelerations, speed, or distance travelled Torres-Ronda, L., *et al.*, (2016) are crucial to provide a more thorough picture of energy expenditure. Given that persistent energy deficiency can cause a variety of physiological impairments that jeopardise the athlete's performance and health, understanding an athlete's energetic expenditure—which includes both normal daily expenditures and those resulting from physical activity while participating in the sport—is crucial Mountjoy, M., *et al.*, (2018). Basketball is a high-intensity, intermittent sport where the player frequently exceeds the MLSS from a bioenergetics perspective. Although aerobic pathways play a major role throughout the game, anaerobic metabolism is essential to achieving high intensity actions at maximum velocity. Because muscles cannot get enough oxygen during these actions, anaerobic pathways are essential for resynthesizing ATP and meeting the high physiological demands. As a result, following a basketball game or practise, glycogen storages need to be ready. Blood lactate, which measures participation and subsequent glycogen emptiness in an indirect but reliable manner and ranges from 0.7 to 1.3 mmol/l in restful conditions to over 7 mmol/l depending on, among other things, game position or skill Stojanovic E., *et al.*, (2018).

CARBOHYDRATE AMOUNT, TIMING, AND RHYTHM IN GLYCOGEN RESTORATION

A basketball player should consume more than 7 grammes of carbohydrates per kilogramme per day (Table I), and if recovery time between games is limited (40–72 hours), they should consume up to 10 grammes per kilogramme per day Burke, L. M., *et al.*, (2011). These amounts should be distributed among 3 or 4 average meals and should include foods that are sources of this macronutrient (potatoes, pasta, rice, and vegetables). When consuming large amounts of carbs, it is also advised to combine these sources with food supplements (gels, bars, or shakes) to prevent stomach discomfort brought on by the excessive intake of dietary fibre and fats. Injuries, desirable training adaptations, and other individual characteristics (age, gender, anthropometric, game level, game position), in addition to the demands imposed by practises and

games, must also be taken into account. As a result, nutrition needs to be modified according to the player and each weekly micro cycle Ranchordas MK, *et.,al.*, (2017), Anderson, L.,*et.,al.*,(2016), Jeukendrup AE. (2017). Thus, timing is a key element in achieving a rapid glycogen storage recovery Ranchordas MK, *et.,al.*, (2017).for the first two hours, recovery There is a "window of opportunity" to optimise glycogen resynthesis (over 45%) during the first 30 minutes following a game if 100 g of carbohydrates (1,2 g/kg) are consumed, ideally in liquid form Ott, I. E., & Santos, J. I. (2020). Recovery begins 2-4 hours after the conclusion of a game or practise. Table I. Typical foods that basketball players consume to aid in recovery sources of carbs in food ptions that give 10 g include:- A half (15 g) cereal bar- One small (100 ml) drinkable yoghurt- A 120 g little apple- 1 tiny tangerine (diameter: 5.5 cm)- Nuts: 60 g of walnuts and 30 g of cashews15 grammes of raisins- 30 g of white bread- Two (16 g) rice pancakes Optional sources of 50 g:- A fruit smoothie or milk (250–350 ml)- 2 cereal bars, each 30 grammes- Two medium-sized bananas (18–20 cm)- 75 ml sports gel- 150 g of cooked pasta- Two jam-topped slices of bread- Three big potatoes, cooked sources of proteins in food Options that give 10 g include:- 2 chicken eggs, medium- One 40 g tiny tuna can- 0 g cooked meat (beef, chicken, pork)- 50 g of fish (tuna, salmon)- 200 g of Greek yoghurt- One (30 g) high-protein bar- 1 large glass (300 ml) of milk Optional sources of less than 3 g leucine:- 170 g of cooked fish (hake, tuna), or 140 g of prepared meat (chicken, beef).- 3 tiny chicken egg whites Options offering 3 g of caseine:- 1 cup (250 ml) of skim milk from cows- Two 125 ml natural low-fat yoghurts. Therefore, maximising this recovery phase with a focus on replenishing muscle and liver glycogen is a crucial nutritional point for a basketball player's recovery, so players should be encouraged to eat and drink ready-to-eat foods in accordance with their unique and cultural preferences as soon as possible and using suitable moments (leaving the court, the locker room, the press zone) Ranchordas MK, *et.,al.*, (2017). Giving the player submaximal amounts of carbohydrates (1.2 g/kg) along with 20 grammes of high biological value protein (0.2–0.5 g/kg) is a more successful recovery strategy than giving them alone when the player exhibits signs of lack of appetite or digestive discomfort related to high carbohydrate intake Calleja-Gonzalez J,*et.al.*,(2015) Ranchordas MK, *et.,al.*, (2017), Kerksick CM, *et.,al.*,(2017) .about 2-4 hours for recovery The best results in glycogen resynthesis have been achieved by giving athletes 150g of carbohydrates (1-1.5 g/kg) within 2-4 hours of exercise. Although sometimes this distribution may not be possible, particularly when the game or practise ends late and the player goes to bed, solid and liquid foods, taken every 30 minutes, have shown the best results. However, players frequently have trouble falling asleep as a result of postgame stress, which is brought on by exposure to a variety of stressors such the significant physical and mental exhaustion, the pavilion lights, or the challenge of maintaining a sleep regimen due to the erratic nature of the tournament schedule Nedelec M, *et.,al.*, (2015). In order to introduce food and beverages that can aid in relaxation and sleep as well as rehydrating and rebuilding glycogen storage, it is suggested that a player take this opportunity to relax once again. After four hours of rest Finally, if the next event is scheduled for 5-7 days from now, the timing of CHO (carbohydrate) replenishment from the next 4 hours onward (up to the end of 48 hours) would range from 500g (5 g/kg/d) to 1000g (10 g/kg/d) if scheduled for the next 40-72 hours. These big amounts should be spread out over three to four main meals, along with supplements containing carbs to make it easier to consume them without increasing the fibre and fat content.

SKELETAL MUSCLE TISSUE REPAIR: PROTEIN REPLENISHMENT TIME, AND SCHEDULE

Similar to how it is with carbs, establishing a recovery procedure that minimises protein catabolism on the one hand and maximises protein synthesis on the other depends on the quantity and timing of protein replacement. encourages the creation and repair of muscle tissue on the other, and eventually aids in the recovery of muscle glycogen Areta, J. L. *et.,al.*, (2013), Close GL,*et.,al.*,(2016). And even if this notion is still debatable, it appears that supplying 20–25 grammes of protein with a high biological value as soon as feasible is essential to achieving this equilibrium Ranchordas MK, *et.,al.*, (2017) . This amount can be obtained by combining various commonly eaten foods (Table I) or by using protein isolate-containing formulations, which are particularly suitable when athletes are not hungry after exercise Ranchordas MK,

et.,al., 2017, given that their high concentration of essential amino acids and quick absorption into the bloodstream have been shown to be effective in the recovery and repair of muscle damage Close, G. L. *et.,al.*, (2016). In the future, the protein in the diet should continue to promote adaptability and biological restoration to ensuring a daily minimum of 1,4–1,7 g/kg, with a maximum of 2,2 g/kg Schoenfeld, B. J., & Aragon, A. A. (2018). This minimum amount can be attained by including 20–30 grammes of high biological value protein in each of the player's three–four main meals and one–two snacks. These foods include meat, fish, eggs, dairy products, and their derivatives, as well as some plant sources including nuts, legumes, and seeds. On the other hand, a little amount of carbs with a source of casein, such as a bowl of milk with cereal, is currently thought to be an efficient method for maintaining and stimulating muscle anabolism throughout sleep, especially before bed Snijders, T., *et.,al.*,(2015). Last but not least, leucine is regarded as the most important essential amino acid when trying to find muscle hypertrophy because it appears to be the most effective. When given in appropriate amounts, leucine plays a crucial part in signalling, which permits the creation of proteins (mTOR, or mammalian target of rapamycin) Kerksick CM, *et.,al.*, (2018).

ERGONUTRITIONAL AIDS TO SPEED UP BASKETBALL REHABILITATION

Despite the fact that nutritional supplements are generally very well-liked by athletes, only a small number have been shown to actually boost physical performance Maughan RJ, *et.,al.*, (2018). Furthermore, using nutritional supplements carelessly could harm an athlete's health and career because many of the supplements on the market today contain ingredients that are prohibited by the World Anti-Doping Agency (WADA) Outram S, Stewart B. (2015), typically through the use of anabolic steroids. Therefore, before using these items, the athlete must request the quality and purity certificate. The International Olympic Committee has published a consensus report Maughan RJ, *et.,al.*,(2018) that examines ergo nutritional aids that have been scientifically shown to improve sports performance and safety. We will choose things from this list that can actually aid in basketball practise after determining whether our athlete actually need them Owens, D. J., *et.,al.*,(2018) and the potential synergy between them Spanidis Y,*et.,al.*, (2016).

THE OMEGA 3 AND OMEGA 6

Basketball players' eccentric movements disrupt the cellular cytoskeleton in their muscles, which results in an inflammatory response that can linger for up to 48 hours after the game. an activity Chatzinikolaou A, *et.,al.*,(2014). According to a study conducted by Spanidis *et.,al.*,(2016) increasing oxidative stress, which is a risk factor for muscular damage, is something that players face more of throughout the course of the season. Although regulating training loads and allowing enough recuperation time between matches are the best preventive measures, several ergo nutritional supplements may be useful when this is not possible. For instance, the anti-inflammatory properties of various fatty acids, particularly those with polyunsaturated chains like omega 3 and 6, are well established, particularly in the clinical field Aguilera, C. M., et.al. (2001). For the majority of athletes, it is advised to offer them in a ratio of 2: 1 (omega 3: omega 6), as it is the ratio in which they are supplied that promotes an inflammatory or anti-inflammatory status in the body Simopoulos, A. P. (2002), Ott, I. E., & Santos, J. I. (2020). It is very challenging to identify sources of omega 3 and omega 6 that are exclusively found in food, therefore make sure this ratio is complex. Organisations like the Australian Heart Societies and the American Heart Societies are advising eating more foods high in omega 3 as a result. Reduce the intake of processed foods (cookies, cakes, pre-cooked food) that may include higher omega 6 content, such as fish (choosing those with less sodium), nuts, sunflower or olive oils, and fish (eating it twice a week). On the other hand, it would appear that ingesting them as supplements could potentially be a successful method for achieving their potential anti-inflammatory impact Maughan, *et.,al.*,(2018).

MONOHYDRATE OF CREATINE

or its benefit in enhancing physical performance when performing repetitive sprints, increasing lean muscle mass, strength, and power, which makes it possible to withstand a higher training load, and improving physical performance in competition, creatine monohydrate supplementation is a very popular strategy Kreider, R. B., *et. al.*, (2017). Skeletal muscle contains about 90% of the entire amount of creatine and phosphocreatine, but these reserves are not infinite because 1.7% of the total amount is lost through spontaneous urine excretion each day, necessitating ongoing replacement. The recommended daily intake of creatine is 2 g. Therefore, arginine, glycine, and methionine are used to make creatine in the liver, pancreas, and kidneys (endogenous synthesis: 1-1.7 g/day). Additionally, fish and meat have an exogenous input of 3-5 g of creatine per kilogramme of raw weight. The Mediterranean diet offers 0.25 to 1 g per day. A secure additional method is presented in Table II. An investigation by Mujika *et al.* 2000 It was noted that the addition of Short (5 m) and repeated sprints performed with 25 g (0.3 g/kg) of creatine monohydrate over 6 days resulted in increased physical performance. Additionally, a study by Roberts *et al.* Roberts, P. A., *et. al.*, 2016 raises the possibility that using creatine supplements can hasten the process of muscle glycogen replenishment after exercise. A maintenance phase with 2–5 g of creatine monohydrate per day (or 0.03 g/kg per day) may be adequate when muscle deposits are saturated because continuing to administer large doses may be deleterious (Kreider, R. B., *et. al.*, (2017), Santesteban Moriones V, (2017). Every 6-8 weeks of supplementing should also include a wash period of 2–4 weeks. It is important to remember that roughly 20–30% of people will not benefit from taking supplements of creatine monohydrate Jäger, R., *et. al.*, (2011), and that muscle soreness is the most frequent side effect. thus it is advised to consume more water to stay away from them Santesteban Moriones V, (2017).

FORMULA D

The human body gets 80% of its vitamin D from the sun's UV rays, which is a fat-soluble vitamin. The remaining calories must be obtained from meals like dairy products, eggs, or fish (salmon, tuna, and mackerel). The scientific community's interest in vitamin D has been sparked by the gradual rise in the number of athletes who have started taking vitamin D supplements in recent years Spanidis Y, *et. al.* (2016). An new school of thought contends that it may regulate immune system function and repair of muscle injury, reducing the risk of infection Schoenfeld, B. J., & Aragon, A. A. (2018). Basketball players are among the athletes that primarily train indoors and are therefore more likely to have inadequate or insufficient plasma levels of vitamin D, despite the fact that there is a large inter individual range in blood vitamin D levels. If they are black, this is especially accurate. This is crucial because athletes train and compete a lot in the winter, when their vitamin D levels are at their lowest. According to Owens and colleagues' recent review, athletes who expose 35% of their body, such as their arms and legs, to the sun for at least 20 minutes each day and/or who live in areas with sufficient sunlight will likely not need to take vitamin D supplements. In the absence of this, vitamin supplementation is advised, and the authors advise a daily dosage of 2000–4000 IU (50–1000 g) Spanidis Y, *et. al.*, (2016). A priority before beginning a supplementation approach should be the examination of serum vitamin D levels because too much vitamin D can be toxic and damaging to health.

BETA-HYDROXY BETA-METHYLBUTYRATE (HMB)

Leucine, an amino acid found in foods including meat, fish, dairy, and eggs, is converted into **HMB** in the body, but only 5% of the entire quantity taken will undergo this process Ott, I. E., & Santos, J. I. (2020). The role of nutrition in the recovery of a basketball player. *Nutricion Hospitalaria*, (2020). 3 g/day dosages are a safe, side-effect-free dosage regimen. The anabolic pathways are activated when supplementation with this ergo nutritional aid is combined with a strength training programme, leading to an increase in strength and muscle mass. On the other hand, it was discovered to be successful in reducing muscle damage and protein catabolism, which enhances the athlete's perception of their level of recovery Santesteban Moriones V, (2017).

EFFECTIVE APPLICATION

A player weighing 90 kg (Fig. 1) who has played for at least 20 minutes in an official tournament match is used as an example. The player receives an urgent recovery kit in the locker room following the conclusion of the game, which is mostly composed of drinks (carbohydrates and proteins) to be ingested during the post-game discussion or press conference. When playing the role of a guest, the player is given a bag that serves as a "picnic" for the return trip. This bag contains meals that aid in recovery and have been prepared in advance by the appropriate meal department. The final three to four main meals and one or two snacks would round out the following 48 hours of recovery.

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