

Factors Affecting Performance in Taekwon-Do Athletes

Senior Dan Grading Thesis

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I. Introduction

I have been training and competing in Taekwon-Do for 13 years. Throughout these 13 years, I have been selected to represent New Zealand at three World Championships: Ireland 2017, Germany 2019, and Finland 2023. Additionally, I competed at the 2018 World Cup in Sydney and multiple other Oceania and National tournaments. During this time I have also trained in other fighting disciplines including boxing, kickboxing, and Muay Thai, all to develop myself as a martial arts practitioner. As a result, I have experienced the sport side of ITF Taekwon-Do at the highest level available. I have dedicated years of my life to developing myself as an athlete by researching all of the necessary components to become a successful Taekwon-Do athlete with the tenets shaping my values. Taekwon-Do truly is my life. I understand that a high percentage of Taekwon-Do practitioners do not have the same goals that I have and that I continue to strive for. However, it is my goal throughout this thesis to give some guidance and inspiration to those who want to compete at the highest level of competition that Taekwon-Do has to offer.

A note as to the content of this thesis. It is not my intention for this thesis to be followed as a step-by-step guide to becoming a World Champion. During my years of training, I have tried and experimented with different training techniques and methods which I have structured into my training based on what works for me. This thesis shall present multiple approaches to developing yourself as a high-performance athlete which should then be experimented with by the reader to develop a personalised training regime. This is not a universal blueprint, but rather a resource that will help the reader develop a plan specific to them.

Firstly, for the readers who are unsure about competing, my honest advice is to give it a go. At the age of 22, I have visited 17 different countries, purely as a result of travelling for Taekwon-Do. During my travels and training, I have formed friendships that will last for life, as well as created some of my best memories whilst competing. Taekwon-Do has allowed me to develop myself as an athlete and as a person. There is always another tournament in the future that allows constant goals to be set and achieved, providing both motivation and inspiration

within your life. So, for those who are on the fence about competing, I advise you to give it a go, as some of the best moments of your life may be around the corner.

Secondly, throughout this thesis, I talk a lot about nutrition and hydration as well as weight cutting. I do not claim to be a doctor, nor a nutritionist, but I present my personal experiences as an athlete as well as varying scientific literature within this area. The topics I cover should be taken as a starting point, and if needed, a medical professional should be consulted as to any types of diets or weight cutting methods that may be very restrictive upon your body.

II. Drug Testing

An important part of training and nutrition is the rules around doping and supplements. This is not something I learnt about until my first selection for the New Zealand Team. Doping in athletes is defined as the unlawful use of drugs to enhance or inhibit the performance of an athlete.¹ In New Zealand, doping is governed by an organisation called ‘Drug Free Sport New Zealand (NZ)’. Doping can be done intentionally through purposely taking prohibited substances such as steroids, or using illicit training methods such as blood doping.² However, it can also be done accidentally through cross contamination of vitamins and supplements, or through taking common medications.³

As an athlete, it is your responsibility to control what goes into your body. Drug Free Sport NZ teaches that to be 100% sure that you are not consuming an illicit substance, a zero supplement diet should be used. This means getting all essential vitamins and minerals through eating real foods, rather than supplementing them.

Through doing this, you reduce the chance of consuming supplements that may have been subject to cross contamination of illicit substances. Further, it eliminates the risk of consuming substances that are disguised as something else on the product label. You can never be sure what

¹ Drug Free Sport New Zealand: <https://drugfreesport.org.nz/substances/prohibited-substances/>.

² Drug Free Sport New Zealand: <https://drugfreesport.org.nz/rules-and-rights/sports-anti-doping-rules/>.

³ Ibid.

is in some supplements, or what else has come into contact with the supplement that you wish to take.

As aforementioned, even some common medications such as asthma inhalers are prohibited within competition. However, with the example of an asthma inhaler, if the athlete requires this medication, a therapeutic use exemption (or a TUE) can be applied which allows the competitor to use the prohibited item.⁴ To qualify for a TUE, the athlete must seek medical advice and gain a medical certificate.⁵

It is important to remember that although you can compete in Taekwon-Do, it is a martial art, therefore it would go against the tenet of integrity to engage in doping practices. There are serious consequences such as being disqualified from your event, being banned from practising Taekwon-Do, and being subject to public scrutiny.⁶ However, through proper doping education, a healthy nutrition and training programme can be developed which can help an athlete achieve their goals.

III. Visualisation

As an athlete, it is common to focus on the physical side of training. This may be doing your fitness regime or attending different types of training. But, it is important to remember that mental training is just as important as physical training. Success at the highest level is often determined by the smallest of margins, with athletes doing everything they can within the rules to gain an edge. One of these 'edges' is gained through mental training using techniques such as visualisation.

Mental visualisation is defined as training that makes use of human imagination in such a way as to program a person's mind to perform a movement task in the best possible manner.⁷

⁴ Drug Free Sport New Zealand: <https://drugfreesport.org.nz/substances/therapeutic-use-exceptions/>.

⁵ Ibid.

⁶ Drug Free Sport New Zealand: <https://drugfreesport.org.nz/substances/the-consequences-of-doping/>.

⁷ Piepiora, P., Witkowski, K., & Migasiewicz, J. (2017). Evaluation of the effects of mental visualisation training in sport with regard to Karate Shotokan fighters specializing in kata. *Journal of Combat Sports and Martial Arts*, 8(1), at 49.

Visualisation, especially in athletes, has been intensely studied to see what the possible results of such mental training could yield. Further, it is stated that proper mental training allows the athlete to solve problems that may occur, build their confidence, and reduce stress or at least learn to cope with the anxiety that may present itself to the athlete.⁸

From personal experience, competing at a tournament does not get any easier, especially after a national team selection when everyone's eyes are on you to do well. The expectation of success is a heavy weight to bear, and the athlete must not let the moment get the better of them.

Studies were done on Olympians which illustrated that the best athletes in the world associate their success with elements of their mental training and preparation.⁹ They state that their result was dependent on their everyday use of mental training. Through mental training, they found that their ability to focus on an exercise as well as their ability to control their emotions increased.¹⁰

A study of visualisation was done on Shotokan Karate fighters who were required to practise a specific mental training regime three times a day for three months. The results illustrated that all participants after undergoing this mental training felt like their mental preparation for their event was almost, if not perfect.¹¹ The participants reported increases in positive thinking, mental resilience, focus, and confidence.¹²

In a Taekwon-Do context, having to travel overseas for a World Championships for example, comes with lots of foreign challenges that you may not have faced before. Not only are there challenges of actually getting to the country you are competing in, but even to the extent of having little to no room for warming up before your event. Further, being able to see your potential competition can be unnerving if not anxiety inducing. In my own experience, through proper mental training, I was able to calm my nerves and relax my mind and body to perform at my best.

⁸ Piepiora, P., Witkowski, K., & Migasiewicz, J. (2017). Evaluation of the effects of mental visualisation training in sport with regard to Karate Shotokan fighters specializing in kata. *Journal of Combat Sports and Martial Arts*, 8(1), at 50

⁹ Ibid, at 50.

¹⁰ Ibid, at 50.

¹¹ Ibid, at 52.

¹² Ibid, at 52.

Another study found that visualisation techniques can improve physical attributes such as motor skills and muscle strength.¹³ It is stated that top athletes have long understood that the human body has its physical limits, however, the mind has unlimited potential.¹⁴ This study involved a 22 year old basketball player who, through visualisation, was able to increase the number of points he scored in a game.¹⁵ His mental preparation routine began outside of the basketball court and flowed into the warmup area as well as in between quarters. The athlete was taught to relax and visualise successful sequences of play in problematic situations. This mental training increased the amount of points he was able to score during a game.¹⁶

Further, a study was conducted on the sport of table tennis with children aged seven to ten years old.¹⁷ Results found that there was an improved quality of technical and tactical performance as well as an increase in the speed and ease of learning.¹⁸ Additionally, focus was increased in athletes as well as them being able to organise their thoughts in a positive, disciplined, and planned manner.¹⁹

There are several ways that mental training can be practised. It is stated that it is important to not limit mental training to visual aspects but to instead include other senses such as hearing and or feeling.²⁰ By doing this, it will maximise the efficiency of visualisation.

One of the best examples of visualisation in athletes is by the most successful Olympian of all time, Michael Phelps. Throughout his Olympic career, he boasts an incredible twenty-eight Olympic medals, twenty-three of those being gold. His coach Bob Bowman explained the mental training and visualisation that Michael would do in preparation for his races. He explained that it

¹³ Visualisation techniques in sport - the mental road map for Success. (2020). *Discobolul – Physical Education, Sport and Kinetotherapy Journal*, at 251.

¹⁴ *Ibid*, at 246.

¹⁵ *Ibid*, at 246.

¹⁶ Visualisation techniques in sport - the mental road map for Success. (2020). *Discobolul – Physical Education, Sport and Kinetotherapy Journal*, at 246.

¹⁷ *Ibid*, at 247.

¹⁸ *Ibid*, at 247.

¹⁹ *Ibid*, at 247.

²⁰ *Ibid*, at 245.

was very important for him to not visualise errors or failures within his performance.²¹ Conversely, Michael was focused on visualising the perfect race. He would also visualise problems that may occur, such as his goggles breaking or swimsuit ripping before the race.²² Through doing this, a response was already programmed into his nervous system for any adversity that could arise.²³ This made him calmer and able to adapt to stressful situations.

As previously mentioned, mental training is just as important as physical training. You could have the best physical attributes in the world, but without self-confidence, success will be hard to come by. It is something that can be self-taught and is a free way to gain an edge over your opponents. For some, it may be easy to learn, but for others, it may take the use of our perseverance to gain this skill. From personal experience, being able to get into the mindset that I like to call “delusional confidence” right before I walk into the ring is imperative for my success. In that moment I believe I am unbeatable and that allows me to get the best performance I can deliver out of myself. Through techniques such as mental imagery, coupled with auditory elements of listening to specific music I associated with certain feelings and emotions, I can walk into the ring mentally prepared and ready to leave my best in the ring.

IV. Recovery

Being a Taekwon-Do athlete requires immense dedication to training. I train multiple sessions per day from strength and conditioning, to fitness and drill training. This volume of training will inevitably produce injuries and muscle soreness. Therefore, an important part of an athlete’s training programme must be based on recovery. It can be detrimental to go to training still being sore from the previous one, which could result in sub-par training and an increased risk of injury. Recovery allows us to reduce fatigue and increase the rate and quality of recovery. This is important as each small gain or advantage that can be used will pile up and result in a big advantage against your opponents.

²¹ Visualisation techniques in sport - the mental road map for Success. (2020). *Discobolul – Physical Education, Sport and Kinetotherapy Journal*, at 249.

²² *Ibid*, at 249.

²³ *Ibid*, at 249.

During the last 20 years, there has been a significant increase in research in the area of recovery. With many conflicting and contradicting pieces of literature, the reader will need to experiment with different types of recovery methods to find what works best for your body. Something that works for me might not necessarily suit you as the reader. But through experimenting with different methods available, you can reduce fatigue and increase your performance which will lead to better training. Some common recovery techniques that I often use are active recovery, stretching, and massage (in particular sports specific massages).

Active recovery involves the use of a low intensity training session following a high intensity training session.²⁴ This could include activities such as slower paced running or swimming, or even going for a walk. Studies have found that an active recovery session can help restore muscles after exercise by increasing blood flow to muscles.²⁵ This increase in blood flow to your muscles allows the body to remove metabolic waste products, such as lactate, from your body that build up during exercise.²⁶ Conversely, some literature hasn't found a positive correlation between active recovery and an increase in performance. This illustrates that this area of research is still relatively new and that different techniques need to be tried by each athlete to find which one suits your body best. However, some literature has indeed found a positive correlation between active recovery and a reduction in lactate concentrations, therefore increasing performance in subsequent training sessions. From my experience, I enjoy running so I will often use active recovery as a recovery method by going for a low intensity jog. This has helped me reduce muscle fatigue and get back to training at peak performance sooner.

Another recovery technique is the use of stretching. This is anecdotally one of the most used recovery methods among athletes.²⁷ One study found significant improvements in power output in a cycle sprint when an active recovery session was performed before the following training session.²⁸ Some studies have found that it may not be very effective in muscle recovery, though no detrimental effects have been recorded. However, especially for martial artists, stretching has a part to play in increasing flexibility and therefore performance. So while some studies have

²⁴ Hanson, S. (2014). Recovery Techniques for Athletes. *Gatorade Sports Science Institute*, at 3.

²⁵ Ibid, at 3.

²⁶ Ibid, at 3.

²⁷ Ibid, at 4.

²⁸ Ibid, at 4.

found that stretching may not be effective in muscle recovery, some studies have found a positive correlation between the two. With the added benefits of increasing range of motion and flexibility, stretching should be an imperative part of a Taekwon-Do athlete's training regime.

A third recovery technique that has been helpful to me is the use of sports massages. This again is a technique that is widely used by athletes to increase blood flow to the muscles and allow the body to clear metabolic waste products.²⁹ There have been some studies that have demonstrated the positive effects of massage on increasing athlete performance. Comparatively, some studies have found that the perceived increases in performance may be purely psychological.³⁰ Further, some studies have found that sports massage might inhibit blood flow to muscles.³¹ The combination of these mixed findings indicates that different methods of recovery work for different athletes. Therefore illustrating that it is important that each athlete finds the methods that work best for their body. In terms of massages, there are other reasons to use this method, such as for injury prevention and management.

I find that my body reacts well to massage and allows me to get my muscles and body back to peak performance quicker. However, it is not viable with my schedule to have a massage every day. I have found that a massage gun that I can operate myself is a great alternative that I can use immediately after my daily training. This has helped me to recover quicker and make sure I can train with high intensity the following day.

Whatever recovery methods work best for you, you must incorporate them into your training regime. Reducing fatigue and increasing the rate and quality of your recovery will allow you to gain more out of your training, and therefore will impact your success as an athlete.

V. Sleep

After my first selection for the New Zealand team in 2017, I began to struggle with fatigue and sleep deprivation as a result in the increase of my training volume, coupled with the need to

²⁹ Hanson, S. (2014). Recovery Techniques for Athletes. *Gatorade Sports Science Institute*, at 4.

³⁰ *Ibid*, at 4.

³¹ *Ibid*, at 4.

maintain my grades at school. With having to travel multiple times per week for training, as well as early starts and late finishes for both training and school related activities, I noticed a dip in my performance at training. This caused me great stress, as I was aware of what was expected of me at training and school and I began looking for answers.

After immense amounts of research around sleep, I managed to develop healthy sleeping habits which in turn increased my performance both in training and in school. When it came around to my second selection for the New Zealand team in 2019, I had just begun my university studies. But this time around with the healthy sleeping habits I had developed, I was able to avoid the drop in performance that I experienced during my first selection. As an athlete, I had neglected the importance of my sleep, either through ignorance of the benefits or through sacrificing my sleep to gain some relaxation time after my strenuous day. However, after educating myself about the benefits of sleeping, I now more than ever value sleep as the most important recovery method.

Sleep is a basic human need but is closely related to physical and mental health. Recently, there has been an increase in the body of research on sleep and its role in enhancing performance and recovery. Proper sleep has a multitude of benefits including the growth and repair of muscles, an increase in emotional and physical well-being, and also an increase in neuromuscular performance.³² As an athlete, it is important to understand sleep and how to improve the quality of your sleep. Further, it is important to develop sleeping habits that can help you to optimise your sleep to maximise the benefits to your physical and mental health.

Sleep plays a key role in the rest activity cycle. Studies state that there are specific functions that occur during quality sleep that allow for muscle recovery.³³ A full sleep cycle tends to last between ninety to one hundred minutes.³⁴ The average adult needs between five and 6 of these sleep cycles, equalling seven and a half to eight hours of sleep, to gain adequate sleep for the

³² Venter, R. (2023). *South African Journal for Research in Sport, Physical Education and Recreation*, 45(1), at 172.

³³ *Ibid*, at 168.

³⁴ *Ibid*, at 168.

night.³⁵ However, a study conducted by Bomba and Haff illustrated that athletes may need up to nine or ten hours of sleep, including naps during the day.

I must sleep for between seven and a half to nine hours of sleep every night. This allows my body time to recover as well as setting me up for success in my training and studies the next day. I allow myself a fifteen to twenty minute nap after my lunch to reset my brain and energise me for my afternoon studies and evening training.

It is important as an athlete to understand the factors that affect your sleep quality and patterns. One of the biggest influences of poor sleep quality is arousal in a sleep setting.³⁶ This arousal can be hard to reduce if it is related to the stress of exams or a deadline. However, things such as playing computer games or exposing yourself to blue light right before bed are things that can affect your sleep quality, but that can be avoided. In terms of feelings of stress, I tend to try and meditate or practise mindfulness before bed to clear my mind and remove the feelings of stress.

Another factor that can affect your sleep quality is the environment in which you sleep. Studies have found that sleep environments that are too noisy, too hot, or too bright can cause difficulties in getting to sleep as well as decrease the quality of your sleep.³⁷ Further, studies have found that putting red light on before you sleep can help increase the production of melatonin, your sleep hormone, as well as increase muscle recovery.³⁸

It is important to build healthy sleeping habits around these factors that affect your sleep patterns and quality. Things like avoiding caffeine after a certain time, avoiding blue light right before bed, and having a strict routine of going to bed and waking up at the same time can allow for an increased quality of sleep.³⁹ This consequently results in greater muscle recovery which will in turn improve your training.

³⁵ Venter, R. (2023). *South African Journal for Research in Sport, Physical Education and Recreation*, 45(1), at 168.

³⁶ Ibid, at 175.

³⁷ Ibid, at 175.

³⁸ Ibid, at 175.

³⁹ Vitale, K. C., Owens, R., Hopkins, S. R., & Malhotra, A. (2019). Sleep hygiene for optimizing recovery in athletes: Review and recommendations. *International Journal of Sports Medicine*, 40(08), at 7.

The things I learnt in 2017 as a result of my research into sleep are still with me today. I believe I have a high quality of sleep which has allowed me to be successful in both training and competition. I truly cannot stress enough the importance of sleep and the effects that it can have on the performance of an athlete.

VI. Nutrition

Flashing back again to 2017, along with the research I conducted around recovery and sleep, I also began looking into how I could optimise my nutrition. With the increased volume of training I was experiencing, I was struggling with both my recovery and a drop in my performance. During school, I had been given the basic run down on nutrition to be a healthy individual, but this was not comparable to the workload I was undertaking. I have always been very interested in the nutrition side of athletic performance, and through researching this area, I have learnt so much about my body and how to get the maximum performance out of it.

Athletes often lack proper knowledge or education on nutrition specifically for athletic performance. This results in a higher use of supplementation that as previously mentioned, can be problematic for the anti-doping side of performance. However, there is a large list of benefits to proper nutrition for athletes which justifies the need to understand what foods you put into your body. From being able to train at an elite level, to enhanced recovery, lowering the risk of injury, and even gaining psychological confidence through knowing you are fuelling your body optimally.⁴⁰

Firstly, the basics of nutrition involve understanding the different types of food that we put into our bodies. Macronutrients are the nutrients that we need in larger quantities including carbohydrates, fats, and proteins.⁴¹ There are varying studies on the proper distribution of macronutrients in your diet, but these will vary depending on your body and training. The Institute of Medicine however calculated an acceptable distribution range of 45%-65% of your

⁴⁰ Maughan, R., & Burke, L. (2012). Nutrition for Athletes.

⁴¹ Clifford, J., & Maloney, K. (2015). Nutrition for athletes.

diet being made up of carbohydrates, 10%-35% of your diet being made up of proteins, and 20%-35% of your diet being made up of fats (whilst limiting saturated fats and trans fats).⁴²

Diving into a bit more detail around the different macronutrients, carbohydrates can be seen as an important fuel source.⁴³ There are multiple forms of carbohydrates such as complex and simple carbohydrates. Complex carbohydrates are found in potatoes, cereals, grains, and vegetables and take the body longer to break down, meaning they can be used as energy when your body needs it.⁴⁴ Conversely, simple carbohydrates, found in fruit, milk, honey, and sugar, are easier to break down.⁴⁵ The body breaks down carbohydrates by either turning them into glucose, allowing the energy to be used straight away, or by converting them into glycogen which is then stored in the muscle and used for energy later on.⁴⁶

The second of the macronutrients are fats which are also a significant contributor to energy.⁴⁷ Using fats as fuel is dependent on the duration and intensity of performance, as well as the condition of the athlete.⁴⁸ It is commonly said that reducing fat in your diet is essential to have a healthy diet. However, maintaining adequate fat intake is crucial to meeting the nutritional needs of an athlete.⁴⁹

The last of the macronutrients are proteins. Protein is found in foods such as meats, nuts, and milk.⁵⁰ Comparatively, with carbohydrates and fats, proteins contribute minimally to the energy needs of the body.⁵¹ However, they play the most important role in muscle recovery after exercise has occurred. After training, a process called muscle protein synthesis occurs which allows the muscle cells to repair themselves and also to grow stronger to make the next session

⁴² Maughan, R., & Burke, L. (2005). Exercise and the Institute of Medicine recommendations for nutrition, at 195.

⁴³ Clifford, J., & Maloney, K. (2015). Nutrition for athletes.

⁴⁴ Ibid.

⁴⁵ Ibid.

⁴⁶ Ibid.

⁴⁷ Clifford, J., & Maloney, K. (2015). Nutrition for athletes.

⁴⁸ Ibid.

⁴⁹ Ibid.

⁵⁰ Ibid.

⁵¹ Ibid.

of exercise easier for the body.⁵² Proper amounts of protein in a diet allows for muscle protein synthesis to occur at a higher level, maximising recovery and growth of new muscle.⁵³

Aside from the three macronutrients, there are also micronutrients such as vitamins and minerals that must be included in your diet to allow for optimal athletic performance.⁵⁴ Essential vitamins needed for a healthy diet can usually be consumed through a balanced and healthy diet. Depending on the individual it may take the incorporation of an extra food to gain any potential deficiencies. Minerals can also be consumed through a balanced diet.⁵⁵ Sodium intake is something that should be monitored however as sodium is lost through sweat and with a high volume and intensity of training, it is important to make sure sodium levels are kept up after exercise.⁵⁶

The required macro and micronutrients for a balanced diet can be achieved through eating whole foods. However, athletes may turn to supplementation to gain these nutrients in other ways. As previously mentioned, supplements should be used at the athlete's own risk, but Drug Free Sport New Zealand advises that a zero supplement diet be used. There are instances where medical professionals may recommend supplementation for certain nutrients that are hard to get in foods. In these cases, a therapeutic use exemption should be sought if the nutrient is inhibited by the doping rules. However, through consuming a balanced diet, nutrient deficiencies should be rare, meaning that supplementation will not be needed.

The timing of your meals is just as important as what you eat. It has been found that eating before training can increase athletic performance when compared with training in a fasted state.⁵⁷ The timing of meals depends on the athlete as well as the size of the meal. Eating a bigger meal should be consumed around three to four hours before training.⁵⁸ This allows for optimal digestion and energy supply to the muscles.⁵⁹ These meals should contain complex carbohydrates

⁵² Clifford, J., & Maloney, K. (2015). Nutrition for athletes.

⁵³ Ibid.

⁵⁴ Ibid.

⁵⁵ Ibid.

⁵⁶ Ibid.

⁵⁷ Ibid.

⁵⁸ Clifford, J., & Maloney, K. (2015). Nutrition for athletes.

⁵⁹ Ibid.

as these are digested at a rate that provides a consistent energy supply to the body. Subsequently, smaller meals should be consumed if less time is between eating and training.⁶⁰

Post-training meals are as important, if not more important than pre-training meals.⁶¹ Studies have shown that a small meal should be eaten within thirty minutes of training, but this is sometimes not practicable.⁶² If you cannot get a meal within thirty minutes of training, making sure you eat one as soon as possible after training is imperative. This is because muscle protein synthesis is greatest after training.⁶³ This meal should contain all three macronutrients.

Nutrition is dependent on the athlete and their body. Your body may not react well to certain foods and you might have specific dietary requirements as a result of allergies or even being a vegetarian. Through educating myself about nutrition, I was able to increase both my recovery and performance. I learnt so much about my body and what foods I can and cannot tolerate, as well as when I need to eat before and after training to maximise performance and recovery. It is an individualised area of athletic performance, but a very important one.

VII. Hydration

An important aspect of athletic performance that is tied to nutrition is hydration. Once again, athletes often lack education about hydration including when to drink, how much to drink, and possible modifications to do with their training environment. What is clear is that dehydration is detrimental to physiological function and therefore results in lower athletic performance in training.⁶⁴ Adults are told that drinking between two and three litres of water per day is healthy for the average adult. However, as an athlete coping with the high demands of training, this amount might not be enough. Hydration amounts are tailored to the athlete and will depend on how much they sweat as well as the intensity of their training.⁶⁵

⁶⁰ Clifford, J., & Maloney, K. (2015). Nutrition for athletes.

⁶¹ Ibid.

⁶² Ibid.

⁶³ Maughan, R., & Burke, L. (2012). Nutrition for Athletes.

⁶⁴ Murray, B. (2007). "Hydration and physical performance." *Journal of the American College of Nutrition*, at 542.

⁶⁵ Maughan, R., & Burke, L. (2012). Nutrition for Athletes.

It is important to understand when to drink to maximise athletic performance. It is imperative to begin a training session hydrated as being dehydrated can impact the level of performance.⁶⁶ Drinking during training is dependent on the duration and intensity of your training sessions. Studies show that for athletes training for shorter than forty minutes, hydration might not be needed, but this is dependent on the individual.⁶⁷ For training that is longer than forty minutes, it is essential to limit the amount of water lost through sweat through replenishment throughout training.⁶⁸ Sweating is an exothermic reaction that occurs as the body's response to try and cool down its internal temperature.⁶⁹ This is done through secreting sweat through the body's sweat glands and can result in dehydration if the water is not replaced.⁷⁰ Studies show that at a minimum, an athlete drinks at a rate that replenishes enough sweat loss to limit the body's overall fluid loss to no more than two percent of your overall body mass.⁷¹ This means that you should not be losing too much weight during training.

On the other hand, you should not be gaining much weight whilst you are training. This is a result of overhydration which can cause problems as well. A problem known as hyponatremia exists whereby drinking too much water results in the dilution of blood sodium concentration levels which can cause a decrease in performance and recovery, and can also lead to more serious effects outside of training.⁷²

Sodium is a mineral that is lost alongside water when the body sweats. It is important to keep our sodium levels up when hydrating to avoid our blood sodium levels dropping. The replenishment of sodium can be achieved through sports drinks such as Powerade or Gatorade. However, athletes should be wary of what these drinks contain as they may have substances on the banned list of the doping agencies governing the sport. Sodium levels can be increased by simply eating a snack after training, removing the need to run the risk of consuming these sports drinks.

⁶⁶ Maughan, R., & Burke, L. (2012). Nutrition for Athletes.

⁶⁷ Ibid.

⁶⁸ Ibid.

⁶⁹ Maughan, R., & Burke, L. (2012). Nutrition for Athletes.

⁷⁰ Murray, B. (2007). "Hydration and physical performance." *Journal of the American College of Nutrition*, at 542.

⁷¹ Maughan, R., & Burke, L. (2012). Nutrition for Athletes.

⁷² Ibid.

Rehydration after exercise is especially important as this plays an essential part in recovery.⁷³ Again, the amount of rehydration an athlete needs is dependent on how much they sweat and the training they have undergone. It is estimated that around one to one and a half litres of fluid should be consumed for each kilogram of weight lost during exercise.⁷⁴ It is important to replenish the body with water and sodium. This number can change depending on the environment that you train in. If you are training in a hot environment, this can further increase the body's internal temperature, resulting in more sweat. Therefore, more water will need to be consumed to match that body's water loss during training.

I have never had issues with hydration. I have routinely consumed four to six litres of water per day for the last seven-plus years of my life. I have a thorough understanding of how much I sweat during a training session, and what I need to drink throughout the day to recover and prepare for subsequent training sessions. Athletes need to find the same out about their bodies so that they can achieve optimal performance and recovery within their training.

VIII. Weight Cutting

A big part of competing in Taekwon-Do, in terms of sparring, is the associated weight cut that fighters do to get into their respective weight divisions. Weight divisions play a big role in your training and nutrition as an athlete and can make or break the performance that you can give on competition day. Throughout all combat sports with weight divisions, it has been common practice for athletes to gain or lose weight to gain any advantage they can to help them with their success. However, there are serious implications of weight cutting that can be detrimental to your performance and also your health in general. Common weight loss methods include restrictive diets, acute dehydration, and water loading.

There have been many studies that highlight the alarming weight cutting behaviours and the concerning consequences of those behaviours. Several studies have found there to be an

⁷³ Maughan, R., & Burke, L. (2012). Nutrition for Athletes.

⁷⁴ Murray, B. (2007). "Hydration and physical performance." *Journal of the American College of Nutrition*, at 544.

increased risk of brain trauma as a result of weight cutting behaviours.⁷⁵ A study found a subtle increase in the volume of the ventricular system of the brain following acute dehydration of the body.⁷⁶ This finding illustrates that the increase in volume could allow the brain to move further in the head following an impact to the head. Further, this would increase the deceleration forces of the brain when it impacts the cranium which could result in contusion injuries.⁷⁷ This is alarming for Taekwon-Do athletes as we can be subject to head contact. This risk is more extensive for practitioners of mixed martial arts as there are chances of further hits to the head after one has been knocked out due to the referee not having stopped the fight yet.⁷⁸ The risk of this brain trauma is dependent on the amount of weight lost and the severity of the weight loss procedure used.⁷⁹

Rapid weight loss regimes such as acute dehydration have been studied extensively. Some results show that following acute dehydration there was a reduction in anaerobic capacity, strength, power, and in high intensity performance.⁸⁰ Further, weight cutting in general may compromise athlete performance, well-being, may cause cardiovascular problems, as well as increase the risk of brain injury through a potential alteration of brain morphology.⁸¹ Not to mention the effects of weight cutting on your mental wellbeing.

I have been weight cutting for almost all of my Taekwon-Do career, as well as for multiple kickboxing bouts, and have experimented with several diets and weight cutting methods. For the last few years, I have stuck to calorie restrictive diets over a longer period of time to avoid rapid weight loss in the last weeks before competition. However, even these restrictive diets have consequences that could result in decreased performance and detriments to your health. It is not

⁷⁵ Kempton, M, et. al., 2007. Effects of acute dehydration on brain morphology in healthy humans. *Human Brain Mapping*, 30(1), at 292.

⁷⁶ Ibid, at 292.

⁷⁷ Ibid, at 297.

⁷⁸ Crighton, B., Close, G. L., & Morton, J. P. (2015). Alarming weight cutting behaviours in mixed martial arts: A cause for concern and a call for action. *British Journal of Sports Medicine*, 50(8), at 1.

⁷⁹ Ibid, at 1.

⁸⁰ Brechney, G. C., Cannon, J., & Goodman, S. P. (2022). Effects of weight cutting on exercise performance in combat athletes: A meta-analysis. *International Journal of Sports Physiology and Performance*, 17(7), at 993.

⁸¹ Barley, O., Chapman, D., & Abbiss, C. (2019). The current state of weight-cutting in combat sports. *Sports*, 7(5), at 4.

uncommon when I am cutting to feel tired and depleted before a training session, which is not ideal to gain peak performance.

Further, in 2019, I decided to try and get into the microweight division in preparation for the next World Cup which was to be held in 2020. I used an extremely restrictive diet for seven months and managed to get into the microweight division, going from 68 kilograms down to 56.5 kilograms. However, throughout that time I was constantly exhausted and struggling with my recovery. Further, even things like trying to focus on my university studies became difficult. Within three weeks of reaching my desired weight, I began to have health complications, including my whole body turning yellow, and later I became very unwell. It was unclear to the doctors what was wrong with me but as a result of the COVID-19 lockdowns, I ended up stopping my cut due to there being no competition. I then decided to put on some weight and as a result of that my health complications stopped. It was clear to me that the microweight division was not a viable option and that I should not go that low in weight. So even though restrictive diets over a longer period of time may be a healthier way of cutting, there are always consequences with significant weight loss for competition purposes.

There are both positives and negatives of weight cutting specifically to get into a weight division for competition. If you decide to weight cut after weighing up either side of cutting, it is important to know how to weight cut safely, as well as replenish your body after the weigh in.

Weight loss is dependent on your body. A simple calculation to achieve weight loss is to burn more calories than you eat, known as a calorie deficit. This can be achieved in many ways such as different diets or increased training intensities. There is a lot of stigma and misinformation on the internet around weight loss trends and fads. The type of diet you undertake is completely up to you as they all function around the same premise, that is consuming fewer calories than you burn to lose weight.

I have tried many different diets such as the keto diet, which reduces your carbohydrate intake and increases your fat intake to use fat rather than carbohydrates as a source of energy. However, many of the diets I have tried have resulted in deficiencies and a reduction in my performance.

Instead, I opt for a balanced diet and have a thorough understanding of food in terms of macronutrients and calories through having tracked my food intake for several years. Through eating healthy foods, and being restrictive of my calories, I have been able to successfully weigh in as well as maintain my performance.

An important part of competition is the recovery period you get after your weigh in.⁸² For our national tournaments, we usually weigh in the night before competition. Whereas for competitions such as the World Championships, you may have more than a day in between weighing in and competing. For my kickboxing fights, I would be required to weigh in later in the evening the day before I fight. The way you replenish your body is dependent on the length of your recovery period, the severity of your cut, and the type of weight cutting method you have undertaken.⁸³ Generally, replenishment during recovery periods involves restoring your glycogen stores and hydration levels through consuming both carbohydrates and electrolytes.⁸⁴ The recovery period is heavily dependent on your body and can either directly benefit or detriment the level of performance you can bring to the ring.⁸⁵ Therefore it is imperative to be prepared with the right foods and hydration plan after you weigh in.

IX. Injury and Illness Management

A note of injury and illness management. This is a massive part of competing and training at a high level and being a martial artist there is always a risk of injury. Whether it be from contact during sparring or even overstretching a muscle whilst performing basic movements, the risk of injury is there. Further, whether it be the environment that you work in, or even just the season of the year, illnesses and sicknesses can also start to affect your training. It is important to understand when to push your body and when there is a need for rest. If there is any doubt about your health in terms of injury or illness, it is best to seek the advice of a medical professional as you do not want something small to be exacerbated to a level where you have to take serious amounts of time off of training to get better.

⁸² Barley, O., Chapman, D., & Abbiss, C. (2019). The current state of weight-cutting in combat sports. *Sports*, 7(5), at 4.

⁸³ *Ibid*, at 6.

⁸⁴ *Ibid*, at 7.

⁸⁵ *Ibid*, at 7.

There is added pressure when you are selected for the New Zealand Team. The coaches will always want to see you training and will expect you to give everything you have to that training session. It is therefore imperative to understand when to push through adversity, and when to realise that the injury or illness that you have is serious and requires you to stop. However from there, it is your responsibility, as well as the coach's expectation of you, to seek medical advice as soon as possible, and follow any rehabilitation guide, in order to get back to training as soon as possible.

X. Conclusion

Overall, it is clear that many factors affect athletic performance. It is important to consider these when developing your training programme and regime. As stated at the beginning, this thesis is not supposed to provide the reader with a blueprint that is to be followed word for word. Instead, I hope this has provoked some thought into the areas that need to be developed to be a high performing athlete. Your training can always be adapted and even I still constantly commit time to research into areas that I can improve on, whether that be during a training cycle or after a big competition. I hope that reading this thesis has provided you with enough thought to begin developing your training regime, or at the very least, inspired you to strive for that next level of competition within Taekwon-Do.

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