IJHSR
ijhighschoolresearch.org
REVIEW ARTICLE

Injury Prevention in Intermediate Runners

Tanay V. Doppalapudi

Bellarmine College Preparatory, 960 West Hedding St, San Jose, CA, 95126, USA; tanay.doppalapudi24@gmail.com
Mentor: Daphne Schmid

ABSTRACT: Recreational runners are prone to injury, leading to decreased levels of physical activity and well-being. Fortunately, injury prevention methods reduce risk and can benefit athletic performance. By synthesizing current literature, this paper details how nutrition, sleep, stretching, and thermotherapy can improve muscular recovery to avoid injury. Fat, protein, carbohydrate, caffeine, water, and electrolyte consumption should be moderated by general guidelines and personalized based on energy expenditure. While disturbed sleep patterns have minimized effects on running performance, runners should avoid sleep deprivation due to its detrimental impact on muscular recovery and mental health. Consistent and well-validated recovery techniques should be used, such as applying cold therapies immediately post-exercise and heat therapies later in the recovery process. For warmups, prioritizing dynamic stretching over static, ballistic, or PNF stretching is also recommended to protect the runner from muscular strain by maintaining a healthy range of motion across joints. By incorporating strategies from each category into a comprehensive recovery routine, intermediate and novice runners can protect and prolong their ability to be physically fit.

KEYWORDS: Health Sciences, Sports Medicine, Running, Recovery, Preventing injury.

Introduction

Almost half of all intermediate runners get injured every year.[1,2] This unfortunate reality can make running highly disheartening to many athletes. To add on, running supersedes the rate of self-injury in every other sport except basketball.[3] Why, then, is running still the most popular sport in the world? Because it's easy? Definitely not. Logically, the reason could be because it's the most accessible - you can run anywhere. But also, to cite Christopher McDougall from his novel, *Born to Run*, "Running was the superpower that made us human."[4] Running is naturally developed, whereas sports like football, basketball, and cricket are all human creations.

As everyday life has become more sedentary - even more so with the COVID-19 quarantine- some individuals have become physically incapable of carrying out people's daily tasks from just 200 years ago. In the last 20 years alone, obesity prevalence increased by 10% among Americans.[5] This may be because of the rise in consumption of fatty foods, which running can help counter.[6] Running also improves cardiovascular health, reducing death risks and prolonging life.[7] Research on the benefits of running states, "Runners have found a new and interesting medium for renewed interest in their bodies as vehicles for reaching some standards of physical and self-accomplishment which they were unaware of."[8] When intermediate runners are injured, they are often discouraged and may lose interest in running, causing them to lose valuable benefits. In a way, running is almost necessary for all human beings - a perpetually prescribed medicine.

Many runners experience immense frustration due to injuries. Since some injuries can be quite debilitating, it is imperative to keep the body healthy. The purpose of this paper is to discuss ways in which intermediate runners can avoid injury. While most of this information applies to athletes of all levels, the general overview provided is more suitable for newer runners (at the high school and recreational levels). Hence, the paper focuses on 'intermediate' runners.

Nutrition:

A runner's nutrition can impact their perception of a race or training session and be the difference between an excruciating five miles and a blissful five miles. To avoid injury and sustain high performance, it is imperative to ingest the right kind of nutrients and meet the energy intake requirements.[8,9] Unfortunately, no one diet plan fits all athletes as individual differences in metabolic rates, allergies, and other factors influence food selection and consumption. One important theme is that moderation and balance must be used in the diet to allow for optimal recovery and performance. The following information will provide general nutritional recommendations and information specific to runners.

Fats, proteins, and carbohydrates are the three categories of substances that fuel the engine that is our body.[10] The energy created from these nutritional compounds travels in the form of a molecule known as adenosine triphosphate (ATP).[11] All three substances are essential and must be kept in a healthy ratio to allow the numerous body systems to function at top condition during workouts, runs, or races.

The information above contrasts with the common misconception that fats must be avoided. It is recommended that endurance athletes (who participate in >2hr endurance exercises daily) ingest 2 grams of fat per every kg of body weight daily because it is a significant energy provider.[12] Too much fat could adversely impact performance by consuming fewer carbohydrates and proteins. A lack of fat (primarily found when runners attempt to lose weight) can deplete runners' energy

DOI: 10.36838/v5i5.22

and hinder performance.[12] Moreover, injury rates increase when an endurance athlete consumes less fat or when a smaller percentage of energy intake is from fats.[13] This reinforces the importance of a healthy amount of fat in every diet. One study found that, regardless of other total energy intake, a lower fat diet often resulted in increased stress fractures, demonstrating that a fat deficit could weaken bones.[14] All in all, it is essential to maintain a diet with a relatively balanced amount of fat intake.

Proteins, another energy source, are arguably the most important in an athlete's diet. Proteins comprise thousands of amino acids and provide essential structural and regulatory benefits to muscles.[15] As all amino acids contain nitrogen, scientists can calculate the daily recommended protein intake by attempting to balance out the nitrogen intake and output (urine, sweat, etc.). Since that output increases with physical activity, endurance athletes require more protein intake.[16] The average daily requirement for a regular person (non-athlete) is estimated to be 0.8 gram/kg body weight/day, whereas an endurance athlete requires of recovery 1.2g-1.4g/kg body weight/day.[16] To increase the efficiency and the amount of muscle replaced, protein is the most important nutritional component because proteins provide the amino acids to repair, resize, and build the new muscle tissue.[17] To perform at our best level and prevent injury, it is imperative that the muscle tissue is allowed to heal, and proteins allow for that, fortifying the necessity of protein in our diets.[18] Protein can be found in plant-based foods (nuts, soy, beans, lentils, peas) and animal-based food (eggs, meat, and fish).[19] To conclude, protein is essential for runners because of its increased use with endurance exercises and immense benefits on recovery.

During endurance exercise, out of the three energy sources, carbohydrates are the most essential.[20] At the most basic level, our body converts carbohydrates into glucose to create energy for our muscles to operate and stores the remnants as glycogen or fat to use later.[21] Therefore, glucose is essential to the diet because it facilitates movement. Popular foods with a high concentration of carbohydrates include potatoes, bread, and various grains (rice, cereal).[22] For endurance athletes, it is recommended to consume about 500g of carbohydrates daily,[23] though the average American adult intake is said to be 287g.[24] Ingesting carbohydrates post-exercise benefits the glycogen levels in your muscles and allows for more energy to ensure recovery.[25,26] While carbohydrates are essential, specific sub-types may be detrimental in excess. For instance, as sugar consumption has significantly increased over the past few decades, consumption recommendations have become a highly debated topic.[27] Generally, ingesting carbohydrates does not negatively impact runners, mainly because they can be effectively used as monosaccharides or glucose/glycogen.[28] However, when a specific subsection of carbohydrates, disaccharides, is ingested in excess, it can lead to increased inflammation.[29] Therefore, athletes should be cautious of the types of carbohydrates they ingest.

As caffeine intake becomes increasingly prominent, primarily through the large variety of American drinks, top research institutions suggest that individuals should consume less than 400 milligrams of caffeine daily.[30,31] However, these recommendations may not apply to athletes as caffeine suppresses natural signals from neurotransmitters for rest, recovery, and sleep.[32,33] If caffeine is ingested when the body is tired and asking for rest, the body is forced to push through fatigue. Caffeine can also increase urination excretion, leading to dehydration and a loss of various nutrients that could adversely impact recovery.[34] Each of these nutrients (e.i., Calcium, Vitamin D, and Iron) have its own pertinent purposes, and any inadequacy could adversely impact the body, especially when being taxed by running.[35,36] Hints that caffeine negatively impacts cardiovascular health, most specifically through increasing the risk of coronary heart disease, suggest that decreased quantities may protect against chronic health issues.[37,38] However, when consumed in moderation, caffeine's stimulating properties may improve performance and preserve muscle glycogen.[39] To conclude, caffeine may enhance race performance but is generally detrimental during training.

Regularly drinking water, or hydrating, is crucial to a runner's nutrition. Dehydration consistently reduces aerobic capacity in runners,[40] predominantly due to the increase in body temperature, which induces a more incredible feeling of fatigue.[41] Furthermore, evidence also indicated dehydration and hyperthermia (raised body temps) could cause extra cardio-vascular strain during exercise.[42] In most endurance races, the cardio-vascular system demands a lot, as it usually has to be pumping blood at a fast pace for hours, demonstrating how important it is to avoid any strain.[42] Dehydration also restricts exercise heat acclimation, or how the body can get used to running in the heat, which limits the body's capabilities.[43] Additionally, the body needs extra hydration to stay cool in the heat. To compete at a runner's optimal level, the athlete must hydrate to avoid excess fatigue, cardio-vascular strain, and heat acclimation loss. When going on long runs, water lost in sweat loss may exceed the amount of water intake. If attempts at rehydration are not used at this point, similar symptoms of dehydration can ensue.[44,45] Moreover, dehydration does not only occur with exercise. When people wake up in the morning, they have most likely been fasting (not eating or drinking) for the past 10 hours. It is essential to combat this complete dehydration by drinking a surplus of water to allow for various benefits.[46]

To combat increased body heat during exercise, the body releases sweat, which results in not only a loss of water but also electrolytes.[47] Electrolytes, such as sodium, potassium, and chloride, are all crucial parts of basic body functionality and are ingested through various foods and drinks.[48] Major sodium deficits are correlated with performance decreases and health hazards.[49] This emphasizes the importance of maintaining a healthy electrolyte level pre-exercise and throughout everyday life. In addition, electrolytes should also be consumed to allow for the desired recovery, especially leading up to powerful performances.[50] Unfortunately, no set number of electrolytes is required for every runner - it varies from person to person. To reduce electrolyte loss and increase sweat efficiency, runners can use the body's acclimation ability by getting used to the heat and climate.[51] Keeping the body's electrolyte levels healt-

DOI: 10.36838/v5i5.22

hy is almost as crucial to health, performance, and recovery as hydrating.

Sleep:

Historically, humans have had to sleep 6+ hours daily to survive.[52] Today, people often disregard that fact and use the night to complete the immoderate amount of work thrown at them. For instance, according to the CDC, 71% of high schoolers sleep less than the recommended 8 hours.[53] While some people can survive without much sleep, an athlete, who pushes their body in ways others do not, requires a substantial amount of bedtime.[54, 55] Athletes need enough sleep to relieve the body from physically demanding training. When committed to a rigorous training plan, runners often have lower sleep efficiency and longer sleep latency.[55] In other words, due to the significant impact running has on your body, it takes longer to get to bed, and you get less out of time in bed. This suggests that runners need more time in bed to get the same amount of sleep as non-runners. Sleep loss can hinder the assembly of muscle protein, which impedes the recovery process.[56] When the muscles cannot heal themselves, damage accumulates and often leads to injury. So, patterns of sleep loss must be addressed to avoid negative impacts on training.

Many 5k racers find that the night before their race yields barely 6 hours of sleep, but they can still perform at their top level the next day.[57] Most studies categorize 24 hours or one full day without sleep as deprivation. Anything less than deprivation seems to have little to no effect on a runner's race-day performance. In contrast, sleep deprivation has a significant effect.[58] To clarify, a minor loss of sleep (2-4 hours under regular sleep time) will not impact your endurance performance in a one-time occurrence, disregarding psychological reasons.

Five scientists and professors from the UK found that the cardio-respiratory and thermoregulatory functions during endurance training displayed minimal fluctuations between sleep deprivation and regular sleep.[59] However, the sleep-deprived athletes covered less distance.[59] This indicates the fascinating possibility that sleep deprivation affects a runner's perceived effort. In other words, the runners felt like they were doing the same work but ended up running a shorter distance. This mental effect is detrimental to any runner's performance. In addition, Skein and colleagues found that 30 hours of sleep deprivation resulted in muscle glycogen loss.[60] Muscle glycogen is a glucose polymer that surrounds muscles and provides muscles with a way to produce ATP. When there is a reduction in the glucose polymer, there is also a reduction in the rate of production of ATP.[61] So, sleep deprivation actually reduces the body's capacity to do work, which is disastrous to any runner, especially on race day.

Therefore, while sleep is crucial for a runner's success, it is the hardest for us to attain, and sleep deprivation, a total of 24 hours without sleep, can be lethal for performance through mental or physical issues.

Stretching:

Runners often rely on stretching, a "movement applied by an external and internal force to increase muscle flexibility and joint range of motion",[62] to relieve muscle stiffness and tension following training. By elongating muscles, stretching increases flexibility and mobility while alleviating tension.[62,63] Unfortunately, stretching for a singular time, like most recovery techniques, is a temporary relief and does not provide long-term benefits.[64] This means runners must stretch consistently to get full mobility and flexibility benefits.

There are four categories of stretches, all of which have their purposes.[65] The first category of stretches, and the most common ones, are known as static stretching. Static stretching involves extending a limb to its full range of motion and holding that dormant state for 15-60s.[66] While static stretching increases flexibility, it does not consistently improve running economy or distance performance making it an effective technique only in the short term.[67] As one would imagine, there are countless static stretches, and it is essential to make a solid routine of stretches to complete throughout the day. One study found static stretching, specifically a supine leg lift, to increase the elasticity of the hamstring, which in turn, increased the flexibility. In muscular studies evaluating runner performance, hamstrings are found to take the brunt of the force when shifting weight from leg to leg between strides, which demonstrates that it is imperative to keep the hamstrings in top shape.[68]

Dynamic stretching, the lengthening of a muscle in motion, contributes to flexibility and dynamic balance improvements.[69] Just as flexibility is critical in preventing injury, dynamic balance helps avoid musculoskeletal injuries like ankle sprains.[70] Dynamic stretching also tends to be orientated towards a specific sport because different types of balance are needed for different sports. In running, you need to control your motion perfectly with each stride, which comes with dynamic exercises for your legs. For instance, leg lifts, commonly referred to as Frankenstein kicks, involve balancing on one leg while extending the other in its full range of motion.

The third category of stretches is ballistic stretching, a swifter type of stretch that involves a body part stretching to its limits with momentum or gravity.[71,72] Completed very quickly, ballistic stretching makes it challenging to control the intensity of the movement and may pose an injury risk.[73] In comparison, ballistic stretching is more like a pulse of a stretch, while dynamics are slower and more orientated toward the range of motion practiced in the exercise.

The last stretching category includes proprioceptive neuromuscular facilitation (PNF) stretches. PNF stretches improve muscle elasticity by using a pattern of contracting and relaxing agonist and antagonist muscles, improving flexibility and range of motion.[74,75] Agonist and antagonist muscles are inverse or opposite muscles (i.e., hamstrings/quads, biceps/triceps). So, PNF stretching involves activating a muscle to influence a passive stretch of the opposite muscle.[76] These stretches are less common because they typically require an outside trainer or extra exercise tools.

Scientists have conducted many studies exploring effective ways to incorporate these four types of stretches into muscular warmups. Warming up before exercise prepares the body for movement by raising the internal muscle temperature by 1 or 2 degrees Celsius and stimulating all body parts required

for running.[77,78] Researchers recommend active warmups, which refer to stretching and movement, rather than passive warmups, which usually involve hot showers or saunas. However, exerting too much effort during warmups can hinder short-term performance.[79] For many years, scientists have recommended that active warmups include static stretching, but new evidence indicates that static stretching in warmups exhibits almost no difference when compared to no warmup.[80] Further studies report that static stretching may lead to adverse effects. A study conducted with experienced collegiate male runners demonstrated how static stretching lowered the distance covered in a 30-min run because it increased the energy required to run.[81] Since this shift in general consensus occurred in the last decade, it is important to note that suddenly eliminating static stretching from a seasoned runner's routine could lead to a negative psychological response.[82] In contrast, warming up with dynamic stretching benefits performance. Seasoned coaches worldwide almost always incorporate dynamic stretching into their athlete's pre-exercise routines. Often, dynamics involve approximately 20 yards of each stretch, with about three steps in between each rep.

While static stretching's impact on neural activation is limited, dynamic stretching more effectively primes the body for movement by integrating patterns of motor neuron activation that occur during running into the warmup process.[83] For instance, dynamic stretches improve the height of a two-leg jump in women, whereas static stretching decreases that performance. Since leg muscles are as crucial in running as in jumping, dynamic stretching appears effective for a warmup. Ballistic stretching is not as favorable as a warmup stretch because of its potential to injure and has been proven ineffective in many studies. One study determined that ballistic stretching had a similar effect to not stretching in a warmup.[84,85] Lastly, PNF stretching is found to decrease muscular performance as a part of warmup before exercise.[86] In conclusion, modern consensus suggests that dynamic stretching is the most fruitful method of warming up and can benefit runners in ways other forms of stretching cannot. As for the other stretches, they are generally better for post-exercise routines.

Thermotherapy:

After rigorous workouts, from weights to speed training, runners are usually sore or stiff, a natural reaction from exercise known as DOMS (Delayed Onset Muscle soreness). DOMS is a result of micro-tears within the exercised muscle fibers.[87] Though micro-tears in your muscles sound bad, they are normal and essential for muscle gain. The micro-injuries heal through acute inflammation - your body's natural reaction to injury. In contrast to chronic inflammation, which can result in life-altering illnesses, acute inflammation is primarily harmless and the reason you feel soreness (a symptom of DOMS).[88] There are many stages in the healing process of the micro-tears. First, the impacted muscle cells must die to be replaced with newer and stronger cells. When the cells die, they become debris in the muscular system, which must be cleaned up to avoid infection. The first responses happen seconds after the micro-tears form with a massive influx of neutrophils and complement proteins.[89] Neutrophils, white blood cells, are tasked with clearing the debris from the dead cells. The complement system comprises of nine major proteins that act as the first defense line of immunity. These complement proteins then break up and infinitely reproduce as they defend from infection. To mediate this reproduction, acute inflammation is introduced. The inflammatory chemicals maintain natural balance and immunity. The next stage involves macrophages, another type of white blood cell, recruited by neutrophils as a replacement.[89] As the neutrophils around micro-tears decrease 24 hours after the impact, macrophages increase and facilitate the continuation of the muscle regeneration process. The macrophages are broken into two main types - pro-inflammatory and anti-inflammatory. The pro-inflammatory macrophages introduce cytokines, which are micro-proteins that are not fully understood yet but are generally inflammatory.[90] The last stage involves a transfer from the pro-inflammatory macrophages to the anti-inflammatory.[91] This is when muscle soreness starts to fade away. During the following workout, the micro-tears formation rate becomes less prominent because the muscles strengthen after healing, and that's usually when you move on to the next rigor.

To relieve soreness, many athletes turn to cold therapy, most commonly through cold-water immersion (CWI).[92] To reinforce this statement, five expert sports scientists reviewed the general professional literature and concluded that CWI effectively alleviated DOMS, with a temperature ranging from 11 degrees Celsius to 15 degrees Celsius.[93] Following exercise, CWI is generally effective at 24 and 48 hours. However, following eccentric exercise, which requires repeated lengthening of muscles under-weight, CWI was not effective after a period of 24 hours.[93] To explain the science behind the benefits of icing, it has been found that icing constricts the movement of cytokines. When their presence in the muscle is decreased, inflammation is reduced.[90] This speeds up the transfer to the anti-inflammatory macrophages and allows runners to be recovered for the next day.

When discussing ways to combat the symptoms of DOMS, heat therapy is commonly considered as well. A study focusing on relieving lower back soreness from rigorous exercise illustrated how a heat wrap significantly reduces back pain 24 hours post-exercise.[94] Further studies exploring moist heat application (hot water bath, hot packs) suggest moist heat is superior to dry. Scientists from Loma Linda University conducted an experiment evaluating heat therapy's effectiveness in young adults following soreness brought on by squatting. Results suggest that heat therapy induces greater strength preservation than no therapy, and moist heat therapy is more effective at reducing pain than dry heat within 24 hours of exercise, even when applied for a quarter of the time as dry heat.[95] Furthermore, the scientists explain how moist heat produces increased blood flow in deep tissue, allowing for better healing of the muscles.[95] Similar findings are seen in high-level football players, where moist heat application improved hamstring flexibility throughout rigorous training and reduced injury risk.[96] This is relevant to runners because we depend on our hamstrings to attain our desired speed, and we want to keep that muscle injury-free. Runners must take advantage of heat

DOI: 10.36838/v5i5.22

application, especially if they can access moist heat options like a sauna, hot bath, or hot pack.

Ice therapy constricts blood flow, and heat therapy increases it. How could both of these be beneficial at the same time? After a workout, the muscles are enlarged due to vasodilation increasing blood flow.[97] To aid muscle recovery following exercise, ice is often used to promote vasoconstriction and return the muscle to baseline - cooling down the muscle from the workout. Then, following icing, heat can aid recovery efficiency by increasing blood flow once more to provide oxygen and other nutrients.[97] Therefore, athletes can minimize DOMS and recovery time by using these techniques in a step-by-step process.

Despite using preventative techniques to decrease injury risk, runners still get injured. This means that runners often use rehabilitation programs to return to their pre-injury state. Interestingly, repeated heat application on muscles can be a great addition to the rehabilitation program or in times of decreased training. Heat can decrease the de-conditioning and minimize muscle loss that occurs with reduced activity.[98] While some runners believe heat or ice therapy immediately before exercise will decrease the symptoms of DOMS post-exercise, research suggests this is unlikely.[99] When a scientist from the US army research institution was trying to determine the optimal way of warming up before strenuous exercise, she found that heating of the muscles and tissue, through pulsing short-wave diathermy, was ineffective in reducing muscular damage up to 72 hours post-exercise.[100] Therefore, heat must be used appropriately to provide its various benefits.

Conclusion

In conclusion, injuries can be detrimental to runners from both physical and mental standpoints. Therefore, engaging in preventative techniques to circumvent injury is essential. Eliud Kipchoge, arguably one of the fastest distance runners in the world, has remained injury-free for almost a decade - a feat that most runners are unable to accomplish. Kipchoge's physiotherapist, Peter Nduhio, attributes this insane healthiness to the discipline and routine that Kipchoge perpetually practices.[101] Undoubtedly, this routine encompasses most, if not all, of the information I have provided regarding nutrition, sleep, stretching, and cold/heat therapy. Though this paper mainly pertains to the intermediate runner because of the more fundamental information included, professional/elite athletes can also benefit by adhering to these guidelines. Runners of higher levels (or just curiosity) should dig deeper into each mentioned subject area, address problems with one's running biomechanics, make a strength training routine, and participate in various types of cross-training for further injury resistance.

While nutrition specifications vary from runner to runner, it is essential to consume a balanced and healthy amount of fats, proteins, and carbohydrates daily. From the statistics provided above, a 75kg male runner should consume roughly 150g of fat, 100g of protein, and 500g+ of carbs daily. Disregarding this information could impair performance and recovery, which is of utmost importance to high-performance running. Moreover, runners must limit caffeine consumption and plan times of consumption based on training and sleep patterns. Ingesting the correct amount of electrolytes and water can improve performance and prevent various health hazards. To allow for optimal recovery and performance, moderation and balance must be used in all aspects of the diet.

Sleep should be another priority for runners, as it allows for the healing of the muscles, providing immense benefits for the body and the next run. Sleep deprivation must be avoided at all costs because of its adverse effects on the brain. To complete the taxing work that an athlete must push through, the mind must be primed with the right mentality. If sleep deprivation is allowed to accumulate, it can lead to disastrous performances and even injury.

Stretching has been an extremely controversial topic on when it is most beneficial to running. Still, in the recent past, its effectiveness in improving flexibility and reducing tension has not been debated. The four major types of stretches - static, dynamic, ballistic, and PNF- are beneficial in their own way if used at the right time. As part of a warmup prior to running, dynamic stretching is the most effective at priming the muscles for the workout while not weakening them. The other types of stretches are generally better for post-exercise and as part of routines outside of running.

Ice therapy is an effective technique to combat the acute inflammation that commonly afflicts runners and to relieve the symptoms of DOMS. While those processes are part of recovery, running the next workout with fully recovered muscles is essential. Therefore, icing may decrease recovery time, allowing for increased efficiency training. Heat therapy is another method of relieving pain and soreness, which speeds up recovery. Additionally, if given the option between dry heat (seat warmer, heat wrap) and moist heat (heat bath, heat packs), choose the latter to provide the most benefits. Using heat therapy before exercise has no effect, even if the term 'warming up' indicates that.

By using all of these techniques, paying more attention to diet and sleep, establishing a daily stretching routine before and after exercise, and making sure to indulge in heat/ice therapy daily, you should be able to avoid injury and compete at the preferred level of competition. Though outside of the scope of this paper, it is also recommended to address problems with one's running biomechanics, strength training, and participate in various types of cross-training for further injury resistance. Nevertheless, this paper's general overview provides a great foundation for intermediate runners. While most runners have a long way to go, we are all in this together. Let's get healthy!

Acknowledgments

I am very grateful to the various physical therapists who inspired me through the art of sports medicine. Next, I would like to express my appreciation for my mentor, Daphne Schmid, and my family, who helped guide me through writing this paper. Lastly, I would like to thank the IJHSR team and the awesome reviewers for allowing this valuable information to be distributed to the public.

References

1. Jungmalm, J. *Running-related injuries among recreational runners*;G

2. The Runner's World UK Podcast. How to run further and avoid injury with Damian Hall. Podcast. Amazon Music, January 03,2022. Retrieved from: (https://music.amazon.co.uk/podcasts/5a3443c1-ca5f-463a-b5f9-b5894d661829/episodes/1a5261ef-c673-4b37-a684-a9c78168374d/the-runner's-world-uk-podcast-how-to-run-further-and-avoid-injury-with-damian-hall)
3. Hreljac, A. (2004). Impact and overuse injuries in runners. *Medicine and science in sports and exercise*, 36(5), 845-849.
4. McDougall, C. *Born to run*; Vintage Books, 2009.
5. CDC:Data and Statistics: Adult Obesity Facts. https://www.cdc.gov/obesity/data/adult.html
6. Vincent,H.K.; Vincent, K.R.; Considerations for Initiating and Progressing Running Programs in Obese Individuals ; *J. Science Dire t*, PM&R, 2013. DOI: 10.1016/j.pmrj.2013.03.008
7. Lee, D.-chul; Pate, R. R.; Lavie, C. J.; Sui, X.; Church, T. S.; Blair, S. N. Leisure-Time Running Reduces All-Cause and Cardiovascular Mortality Risk. *Journal of the American College of Cardiology* 2014, 64, 472–481. DOI: 10.1016/j.jacc.2014.04.058
8. Altheide, D. L.; Pfuhl, E. H. Self-Accomplishment through Running*. *Symbolic Interaction* 1980, 3, 127–144. DOI: 10.1525/si.1980.3.2.127
9. Bucci, L. R.; *Nutrition Applied to Injury Rehabilitation and Sports Medicine*; Taylor and Francis Group, 1995. DOI: 10.1201/9781003068860
10. Großkopf, A.; Simm, A. Carbohydrates in Nutrition: Friend or Foe? *Zeitschrift für Gerontologie und Geriatrie* 2020, 53, 290–294.DOI: 10.1007/s00391-020-01726-1
11. Ross, J. Energy Transfer from Adenosine Triphosphate. *The Journal of Physical Chemistry* B 2006, 110, 6987–6990. DOI: 10.1021/jp0556862
12. Stellingwerff, T.; Maughan, R. J.; Burke, L. M. Nutrition for Power Sports: Middle-Distance Running, Track Cycling, Rowing, Canoeing/Kayaking, and Swimming. *Journal of Sports Sci nces* 2011,29. DOI: 10.1080/02640414.2011.589469
13. Gerlach, K. E.; Burton, H. W.; Dorn, J. M.; Leddy, J. J.; Horvath, P. J. Fat Intake and Injury in Female Runners. *Journal of the International Society of Sports Nutrition* 2008, 5. DOI: 10.1186/1550-2783-5-1
14. Bennell, K. L.; Malcolm, S. A.; Thomas, S. A.; Reid, S. J.; Brukner, P. D.; Ebeling, P. R.; Wark, J. D. Risk Factors for Stress Fractures in Track and Field Athletes. *The American Journal of Sports Medicine* 1996, 24, 810–818. DOI: 10.1177/036354659602400617
15.Tarnopolsky, M. Protein Requirements for Endurance Athletes. *Nutrition* 2004, 20, 662–668. DOI: 10.1016/j.nut.2004.04.008
16. Kato, H.; Suzuki, K.; Bannai, M.; Moore, D. R. Protein Requirements Are Elevated in Endurance Athletes after Exercise as Determined by the Indicator Amino Acid Oxidation Method. *PLOS ONE* 2016, 11. DOI: 10.1371/journal.pone.0157406
17. Moore, D. R. Nutrition to Support Recovery from Endurance Exercise. *Current Sports Medicine Reports* 2015, 14, 294–300. DOI:10.1249/jsr.0000000000000180
18. Pasiakos, S. M., Lieberman, H. R., & McLellan, T. M. (2014). Effects of protein supplements on muscle damage, soreness and recovery of muscle function and physical performance: a systematic review. *Sports Medicine*, 44(5), 655-670.
19. Comerford, K.; Pasin, G. Emerging Evidence for the Importance of Dietary Protein Source on Glucoregulatory Markers and Type 2 Diabetes: Different Effects of Dairy, Meat, Fish, Egg, and Plant Protein Foods. *Nutrients* 2016, 8, 446. DOI: 10.3390/nu8080446
20. Stellingwerff, T.; Maughan, R. J.; Burke, L. M. Nutrition for Power Sports: Middle-Distance Running, Track Cycling, Rowing, Canoeing/Kayaking, and Swimming. J*ournal of Sports Sci nces* 2011,29. DOI: 10.1080/02640414.2011.589469
21. Hermann, J. Carbohydrates in the Diet. *Oklahoma State University Extension* 2019, T-3117-T-3117–3112. Retrieved from (oksa_T-3117_2019-10.pdf (shareok.org)).
22. Brand-Miller J, McMillan-Price J, Steinbeck K, Caterson I. Carbohydrates--the good, the bad and the wholegrain. Asia Pacific journal of clinical nutrition. 2008 Mar 2;17.
23. Fogelholm, M.; Tikkanen, H.; Naveri, H.; Harkonen, M. High-Carbohydrate Diet for Long Distance Runners--a Practical View-Point. *British Journal of Sports Medicine* 1989, 23, 94– 96. DOI: 10.1136/bjsm.23.2.94
24. National Research Council (US) Subcommittee on the Tenth Edition of the Recommended Dietary Allowances; Recommended Dietary Allowances: 10th Edition. Washington (DC): National Academies Press (US); 1989. Chapter 4, Carbohydrates and Fiber. Retrieved from: https://www.ncbi.nlm.nih.gov/books/NBK234933/
25. Fuchs, C. J.; Gonzalez, J. T.; Beelen, M.; Cermak, N. M.; Smith, F. E.; Thelwall, P. E.; Taylor, R.; Trenell, M. I.; Stevenson, E. J.; van Loon, L. J. Sucrose Ingestion after Exhaustive Exercise Accelerates Liver, but Not Muscle Glycogen Repletion Compared with Glucose Ingestion in Trained Athletes. *Journal of Applied Physiology* 2016, 120, 1328–1334.
26. Viribay, A.; Arribalzaga, S.; Mielgo-Ayuso, J.; Castañeda-Babarro, A.; Seco-Calvo, J.; Urdampilleta, A. Effects of 120 g/h of Carbohydrates Intake during a Mountain Marathon on Exercise-Induced Muscle Damage in Elite Runners. *Nutrients* 2020, 12, 1367. DOI: 10.3390/nu12051367
27. Ngo Sock, E. T.; Lê, K.-A.; Ith, M.; Kreis, R.; Boesch, C.; Tappy, L. Effects of a Short-Term Overfeeding with Fructose or Glucose in Healthy Young Males. *British Journal of Nutrition* 2009, 103, 939–943. DOI: 10.1017/S0007114509992819
28. Großkopf, A.; Simm, A. Carbohydrates in Nutrition: Friend or Foe? *Zeitschrift für Gerontologie und Geriatrie* 2020, 53, 290– 294.DOI: 10.1007/s00391-020-01726-1
29. Iacobini, C.; Vitale, M.; Haxhi, J.; Pesce, C.; Pugliese, G.; Menini, S. Food-Related Carbonyl Stress in Cardiometabolic and Cancer Risk Linked to Unhealthy Modern Diet. *Nutrients* 2022, 14, 1061. DOI: 10.3390/nu14051061
30. Harvard School of Public Health: The Nutrition Source: Caffeine Page; https://www.hsph.harvard.edu/nutritionsource/caffeine/
31. U.S. Food and Drug Administration; *Spilling the Beans: How much Caffeine is Too Much?*; https://www.fda.gov/consumers/consumer-updates/spilling-beans-how-much-caffeine-too-much
32. Smith, A. Effect of Caffeine on Human Behavior. Pergamon: *Food and Chemical Technology* 2002, 1243–1255. Retrieved from (P II: S0278-6915(02)00096-0 (umfcv.ro)).
33. Fredholm BB, Bättig K, Holmén J, Nehlig A, Zvartau EE. Actions of caffeine in the brain with special reference to factors that contribute to its widespread use. Pharmacological reviews. 1999 Mar 1; 51(1):83-133.
34. Burke, L. M. Caffeine and Sports Performance. *Applied Physiology, Nutrition, and Metabolism* 2008, 33, 1319–1334. DOI: 10.1139/H08-130
35. Escott-Stump, S.; *Nutrition and Diagnosis-related Care*, Wolters Kluwer Health/Lippincott Williams & Wilkins; 2008. ISBN:9780781798457, 0781798450
36. Wolde, T. Effects of Caffeine on Health and Nutrition: A Review. *IISTE: Food Science and Quality Management*; 2014, 30, 59–65. ISSN 2225-0557 (Online)
37. Cornelis, M. C.; El-Sohemy, A. Coffee, Caffeine, and Coronary Heart Disease. *Current Opinion in Lipidology* 2007, 18, 13–19. DOI: 10.1097/MOL.0b013e3280127b04
38. Turnbull, D.; Rodricks, J. V.; Mariano, G. F.; Chowdhury, F. Caff

DOI: 10.36838/v5i5.22

feine and Cardiovascular Health. *Regulatory Toxicology and Pharm acology* 2017, 89, 165–185. DOI: 10.1016/j. yrtph.2017. 07.025
39. Graham, T. E. Caffeine and Exercise. *Sports Medicine* 2001, 31, 7 85–807. DOI: 10.2165/00007256-200131110-00002
40. Cheuvront, S. N.; Kenefick, R. W.; Montain, S. J.; Sawka, M. N. Mechanisms of Aerobic Performance Impairment with Heat Stre ss and Dehydration. *Journal of Applied Physiology* 2010, 109, 1989 –1995. DOI: 10.1152/japplphysiol.00367.2010
41. González - Alonso, J.; Calbet, J. A.; Nielsen, B. Metabolic and The rmodynamic Responses to Dehydration - Induced Reductions in Muscle Blood Flow in Exercising Humans. *The Journal of Physiolo gy* 1999, 520, 577–589. DOI: 10.1111/j.1469-7793.1999.00577.x
42. González-Alonso, J.; Crandall, C. G.; Johnson, J. M. The Cardio vascular Challenge of Exercising in the Heat. *The Journal of Physio logy* 2008, 586, 45–53. DOI: 10.1113/jphysiol.2007.142158
43. Maughan, R.; Shirreffs, S. Exercise in the Heat: Challenges and Opportunities. *Journal of Sports Sciences* 2004, 22, 917–927. DOI:1 0.1080/02640410400005909
44. González - Alonso, J.; Calbet, J. A.; Nielsen, B. Metabolic and The rmodynamic Responses to Dehydration - Induced Reductions in Muscle Blood Flow in Exercising Humans. *The Journal of Physiolo gy* 1999, 520, 577–589. DOI: 10.1111/j.1469-7793.1999.00577.x
45. Cheuvront, S. N.; Kenefick, R. W.; Montain, S. J.; Sawka, M. N. Mechanisms of Aerobic Performance Impairment with Heat Stres s and Dehydration. *Journal of Applied Physiology* 2010, 109, 1989- 1995. DOI: 10.1152/japplphysiol.00367.2010
46. Anonymous. Why is drinking water in the morning so important ? https://www.medicinenet.com/why_is_drinking_water_in_the_ morning_so_important/article.htm (Article Reviewed by Begum, J. MD).
47. Shirreffs, S. M.; Armstrong, L. E.; Cheuvront, S. N. Fluid and El ectrolyte Needs for Preparation and Recovery from Training and Competition. *Food, Nutrition and Sports Performance II* 2004,92-1 03. DOI: 10.4324/9780203448618-5
48. Shrimanker I, Bhattarai S; Electrolytes. *StatPearls Publishing* 202 1. PMID: 31082167.
49. Rehrer, N. J. Fluid and Electrolyte Balance in Ultra-Endurance S port. *Sports Medicine* 2001, 31, 701–715. DOI: 10.2165/00007256 -200131100-00001
50. Shirreffs, S. M.; Sawka, M. N. Fluid and Electrolyte Needs for Tr aining, Competition, and Recovery. *Journal of Sports Sciences* 2011, 29. DOI: 10.1080/02640414.2011.614269
51. Périard, J. D.; Racinais, S.; Sawka, M. N. Adaptations and Mech anisms of Human Heat Acclimation: Applications for Competiti ve Athletes and Sports. *Scandinavian Journal of Medicine & Science in Sports* 2015, 25, 20–38. DOI: 10.1111/sms.12408
52. Anonymous. Our ancestors probably didn't get eight hours of sle ep a night, either https://www.uclahealth.org/u-magazine/our-an cestors-probably-didn-t-get-eight-hours-of-sleep-a-night-either (Article published on study conducted by Dr. Siegel).
53. Riley, M. High School Sleep Habits https://www.sleepjunkie.co m/school-sleep-habits/.
54. Halson, S. L. (2019). Sleep monitoring in athletes: motivation, m ethods, miscalculations and why it matters. *Sports medicine*, 49(10), 1487-1497.
55. Halson, S. L. (2013). Sleep and the elite athlete. Sports science, 2 6(113), 1-4.
56. Fullagar, H. H. K.; Duffield, R.; Skorski, S.; Coutts, A. J.; Julian, R.; Meyer, T. Sleep and Recovery in Team Sport: Current Sleep-R elated Issues Facing Professional Team-Sport Athletes. *Internatio nal Journal of Sports Physiology and Performance* 2015, 10, 950–957. DOI: 10.1123/ijspp.2014-0565
57. Lastella, M.; Lovell, G. P.; Sargent, C. Athletes' Precompetitive S leep Behaviour and Its Relationship with Subsequent Precompeti tive Mood and Performance. *European Journal of Sport Science* 201 2, 14. DOI: 10.1080/17461391.2012.660505
58. Vitale, K. C.; Owens, R.; Hopkins, S. R.; Malhotra, A. Sleep Hyg iene for Optimizing Recovery in Athletes: Review and Recomme ndations. *International Journal of Sports Medicine* 2019, 40, 535–54 3. DOI: 10.1055/a-0905-3103
59. Oliver, S. J.; Costa, R. J.; Laing, S. J.; Bilzon, J. L.; Walsh, N. P. On e Night of Sleep Deprivation Decreases Treadmill Endurance Perf ormance. *European Journal of Applied Physiology* 2009, 107, 155-16 1. DOI: 10.1007/s00421-009-1103-9
60. Skein, M.; Duffield, R.; Edge, J.; Short, M. J.; Mundel, T. Intermi ttent-Sprint Performance and Muscle Glycogen after 30 h of Slee p Deprivation. *Medicine & Science in Sports & Exercise* 2011, 43,13 01–1311. DOI: 10.1249/mss.0b013e31820abc5a
61. Ørtenblad, N.; Westerblad, H.; Nielsen, J. Muscle Glycogen Stor es and Fatigue. *The Journal of Physiology* 2013, 591, 4405– 4413. D OI: 10.1113/jphysiol.2013.251629
62. Weerapong, P.; Hume, P. A.; Kolt, G. S. Stretching: Mechanisms and Benefits for Sport Performance and Injury Prevention. *Physica l Therapy Reviews* 2004, 9, 189–206. DOI: 10.1179/108331904225 007078
63. Zulaini; Harahap, N. S.; Siregar, N. S.; Zulfahri. Effect Stretching and Recovery on Delayed Onset Muscle Soreness (DOMS) after Exercise. *Journal of Physics: Conference Series* 2021, 1811, 012113. DOI: 10.1088/1742-6596/1811/1/012113
64. Shrier, I. Does Stretching Improve Performance? *Clinical Journal of Sport Medicine* 2004, 14, 267–273. DOI: 10.1097/00042752-20 0409000-00004
65. Weerapong, P.; Hume, P. A.; Kolt, G. S. Stretching: Mechanisms and Benefits for Sport Performance and Injury Prevention.*Physica l Therapy Reviews* 2004, 9, 189–206. DOI: 10.1179/10833190422 5007078
66. Behm, D. G., & Chaouachi, A. (2011). A review of the acute effe cts of static and dynamic stretching on performance. *European jour nal of applied physiology,* 111(11), 2633-2651.
67. Mojock, C. D.; Kim, J.-S.; Eccles, D. W.; Panton, L. B. The Effect s of Static Stretching on Running Economy and Endurance Perfo rmance in Female Distance Runners during Treadmill Runnning. *Journal of Strength and Conditioning Research* 2009, 25, 2170-2176. DOI: 10.1519/jsc.0b013e3181e859db
68. Dorn, T. W.; Schache, A. G.; Pandy, M. G. Muscular Strategy Shi ft in Human Running: Dependence of Running Speed on Hip an d Ankle Muscle Performance. *Journal of Experimental Biology* 201 2, 215, 1944–1956. DOI: 10.1242/jeb.064527
69. Mann, D. P.; Jones, M. T. Guidelines to the Implementation of a Dynamic Stretching Program. *Strength and Conditioning Journal* 1999, 21, 53. DOI: 10.1519/00126548-199912000-00014
70. Bressel E, Yonker JC, Kras J, Heath EM. Comparison of static an d dynamic balance in female collegiate soccer, basketball, and gym nastics athletes. *J Athl Train*. 2007;42(1):42-46.
71. Hedrick, A. Dynamic Flexibility Training. *Strength and Condition ing Journal* 2000, 22, 33. DOI: 10.1519/00126548-200010000-00 010
72. Mahieu, N.; McNair, P.; De Muynck, M.; Stevens, V.; Blanckaert, I.; Smits, N.; Witvrouw, E. Effect of Static and Ballistic Stretchin g on the Muscle-Tendon Tissue Properties. *Medicine & Science in Sports & Exercise* 2007, 39, 494–501. DOI: 10.1249/01.mss.000024 7004.40212.f7
73. Jaggers, J. R.; The acute effects of dynamic and ballistic stretching on vertical jump height, force, and power. University of Louisville, 2006. Electronic Theses and Dissertations. Paper 673. DOI: 10.18 297/etd/673
74. Hindle, K.; Whitcomb, T.; Briggs, W.; Hong, J. Proprioceptive Neuromuscular Facilitation (PNF): Its Mechanisms and Effects

on Range of Motion and Muscular Function. *Journal of Human Kinetics* 2012, 31, 105–113. DOI: 10.2478/v10078-012-0011-y
75. Jordan, J. B., Korgaokar, A. D., Farley, R. S., & Caputo, J. L. (2012). Acute effects of static and proprioceptive neuromuscular facilitation stretching on agility performance in elite youth soccer players. I*nternational journal of exercise science*, 5(2), 2.
76. Jordan, J. B., Korgaokar, A. D., Farley, R. S., & Caputo, J. L. (2012). Acute effects of static and proprioceptive neuromuscular facilitation stretching on agility performance in elite youth soccer players. *International journal of exercise science*, 5(2), 2.
77. Smith, C. A. The Warm-up Procedure: To Stretch or Not to Stretch. A Brief Review. *Journal of Orthopaedic & Sports Physical Therapy* 1994, 19, 12–17. DOI: 10.2519/jospt.1994.19.1.12
78. Murphy, J. R.; Di Santo, M. C.; Alkanani, T.; Behm, D. G. Aerobic Activity before and Following Short-Duration Static Stretching Improves Range of Motion and Performance vs. a Traditional Warm-Up. A*pplied Physiology, Nutrition, and Metabolism* 2010, 35, 679–690. DOI: 10.1139/h10-062
79. Bishop, D. Warm up II. Sports Medicine 2003, 33, 483–498. DOI: 10.2165/00007256-200333070-00002
80. McMillian, D. J.; Moore, J. H.; Hatler, B. S.; Taylor, D. C. Dynamic vs. Static-Stretching Warm up: The Effect on Power and Agility Performance. *The Journal of Strength and Conditioning Research* 2006, 20, 492-499. DOI: 10.1519/18205.1
81. Wilson, J. M.; Hornbuckle, L. M.; Kim, J.-S.; Ugrinowitsch, C.; Lee, S.-R.; Zourdos, M. C.; Sommer, B.; Panton, L. B. Effects of Static Stretching on Energy Cost and Running Endurance Performance. *Journal of Strength and Conditioning Research* 2010, 24, 2274–2279. DOI: 10.1519/jsc.0b013e3181b22ad6
82. Young, W. B. (2007). The use of static stretching in warm-up for training and competition. *International journal of sports physiology and performance*, 2(2), 212-216.
83. McMillian, D. J.; Moore, J. H.; Hatler, B. S.; Taylor, D. C. Dynamic vs. Static-Stretching Warm up: The Effect on Power and Agility Performance. *The Journal of Strength and Conditioning Research* 2006, 20, 492-499. DOI: 10.1519/18205.1
84. Jaggers, J. R.; The acute effects of dynamic and ballistic stretching on vertical jump height, force, and power. University of Louisville, 2006. Electronic Theses and Dissertations. Paper 673. DOI: 10.18297/etd/673
85. Unick, J., Kieffer, H. S., Cheesman, W., & Feeney, A. (2005). The acute effects of static and ballistic stretching on vertical jump performance in trained women. *The Journal of Strength and Conditioning Research*, 19(1), 206. https://doi.org/10.1519/r-14843.1
86. Hindle, K.; Whitcomb, T.; Briggs, W.; Hong, J. Proprioceptive Neuromuscular Facilitation (PNF): Its Mechanisms and Effects on Range of Motion and Muscular Function. *Journal of Human Kinetics* 2012, 31, 105–113. DOI: 10.2478/v10078-012-0011-y
87. Miles, M. P., & Clarkson, P. M. (1994). Exercise-induced muscle pain, soreness, and cramps. *The Journal of sports medicine and physical fitness*, 34(3), 203-216.
88. Harvard, A. Understanding acute and chronic inflammation https://www.health.harvard.edu/staying-healthy/understanding-acute-and-chronic-inflammation.
89. Yang, W.; Hu, P. Skeletal Muscle Regeneration Is Modulated by Inflammation. *Journal of Orthopaedic Translation* 2018, 13, 25–32. DOI: 10.1016/j.jot.2018.01.002
90. MacIntyre, D. L.; Reid, W. D.; McKenzie, D. C. Delayed Muscle Soreness. *Sports Medicine* 1995, 20, 24–40. DOI: 10.2165/00007256-199520010-00003
91. Yang, W.; Hu, P. Skeletal Muscle Regeneration Is Modulated by Inflammation. *Journal of Orthopaedic Translation* 2018, 13, 25–32. DOI: 10.1016/j.jot.2018.01.002
92. Hotfiel, T.; Mayer, I.; Huettel, M.; Hoppe, M. W.; Engelhardt, M.; Lutter, C.; Pöttgen, K.; Heiss, R.; Kastner, T.; Grim, C. Accelerating Recovery from Exercise-Induced Muscle Injuries in Triathletes: Considerations for Olympic Distance Races. *Sports* 2019, 7, 143. DOI: 10.3390/sports7060143
93. Leeder, J.; Gissane, C.; van Someren, K.; Gregson, W.; Howatson, G. Cold Water Immersion and Recovery from Strenuous Exercise: A Meta-Analysis. British Journal of Sports Medicine 2011, 46, 233–240. DOI: 10.1136/bjsports-2011-090061
94. Mayer, J. M.; Ralph, L.; Look, M.; Erasala, G. N.; Verna, J. L.; Matheson, L. N.; Mooney, V. Treating Acute Low Back Pain with Continuous Low-Level Heat Wrap Therapy and/or Exercise: A Randomized Controlled Trial. *The Spine Journal* 2005, 5, 395– 403. DOI: 10.1016/j.spinee.2005.03.009
95. Petrofsky, J.; Berk, L.; Bains, G.; Khowailed, I.; Hui, T.; Granado, M.; Laymon, M.; Lee, H. Moist Heat or Dry Heat for Delayed Onset Muscle Soreness. *Journal of Clinical Medicine Research* 2013, 416–425. DOI: 10.4021/jocmr1521w
96. Funk, D., Swank, A. M., Adams, K. J., & Treolo, D. (2001). Efficacy of moist heat pack application over static stretching on hamstring flexibility. *The Journal of Strength & Conditioning Research,* 15 (1), 123-126.
97. Wang, Y.; Li, S.; Zhang, Y.; Chen, Y.; Yan, F.; Han, L.; Ma, Y. Heat and Cold Therapy Reduce Pain in Patients with Delayed Onset MUSCLE SORENESS: A Systematic Review and Meta-Analysis of 32 Randomized Controlled Trials. *Physical Therapy in Sport* 2021, 48, 177–187. DOI: 10.1016/j.ptsp.2021.01.004
98. Ihsan, M.; Périard, J. D.; Racinais, S. Integrating Heat Training in the Rehabilitation Toolbox for the Injured Athlete. *Frontiers in Physiology* 2019, 10. DOI: 10.3389/fphys.2019.01488
99. Evans, Rachel K.; Knight, Kenneth L.; Draper, David O.; Parcell, Allen C.; Effects of Warm-up before Eccentric Exercise on Indirect Markers of Muscle Damage. *Medicine & Science in Sports & Exrcise* 2002, 34, 1892–1899. DOI: 10.1097/00005768-200212000-00006
100. Evans, Rachel K.; Knight, Kenneth L.; Draper, David O.; Parcell, Allen C.; Effects of Warm-up before Eccentric Exercise on Indirect Markers of Muscle Damage. *Medicine & Science in Sports & Exercise* 2002, 34, 1892–1899. DOI: 10.1097/00005768-200212000-00006
101. Ians. Discipline, focus help Eliud Kipchoge remain injury-free: More sports news - times of India https://timesofindia.indiatimes.com/sports/more-sports/athletics/discipline-focus-help-eliud-kipchoge-remain-injury-free/articleshow/75341369.cms

Author

Tanay Doppalapudi is a student of the class of 2024 at Bellarmine College Preparatory in San Jose, CA. As part of the school's varsity cross-country program, Tanay experienced many injuries and had to visit various outside practitioners. Through this process, Tanay's interest in injury prevention emerged.

DOI: 10.36838/v5i5.22