

Foundational Health for Runners: Is it the Key to Minimizing Injury?

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ABSTRACT

BACKGROUND: Injury rates in runners are as high as 80%. Here, we focus on the concept of foundational health including sleep, recovery, nutrition, stress and physical health and how it can reduce injuries.

METHODS: The literature was reviewed to find papers linking running injuries and athletic performance to the foundational health topics discussed.

RESULTS: There are many factors that can improve athletic performance and reduce injuries in runners other than the often-discussed topics: training philosophies, footwear, and running form. This paper shows how a multidisciplinary approach including education on sleep, rest, stress, nutrition, strength, and mobility all can improve performance and reduce injuries.

CONCLUSIONS: The care and management of an injured runner is multifactorial and the treatment should be as well. By optimizing foundational health, the sports medicine professional will not only reduce injury risk, but also improve performance and overall health.

KEYWORDS: foundational health, running, injuries, recovery, strength

INTRODUCTION

Injuries are the bane of runners' existence and with injury rates as high as 79%, it is of no surprise the struggle runners have with pain and recovery.¹ Why are the injury rates so high? Why are these injuries so difficult to prevent and treat? What can runners do about them? Let's explore.

The high mileage of distance runners, especially marathon distances, requires huge time commitments and demands on the body. Running is a repetitive activity that takes place in one plane, going in one direction, with high ground reaction forces, one foot striking in front of the next for approximately 1,200 steps per mile. The inherent nature of the activity is a true example of a cumulative trauma injury, so it's no wonder the injury rates are so high. Let's take this example to shed more light:

Jane is a 140 lb. runner who takes 1,200 steps per mile and runs 25 miles per week. Jane also endures ground reaction

forces of 2x's her body weight with each step (hypothetical and realistic assumption).

- 140 lbs. x 2 (twice her body-weight per step) = 280 lbs. of force per step
- 1,200 steps per mile x 25 miles per week = 30,000 steps per week
- 30,000 steps per week x 280 lbs. per step = 8,400,000 lbs. of force entering her body weekly

Resiliency can be defined as the ability to recover from and adapt to stimuli. From the example above you can see the stimuli is massive with runners. If a runner lacks resiliency and proper biomechanics, then injuries will occur. Injury risk can be lessened with good foundational health (physical, emotional, and mental), a symmetrical and efficient gait pattern, and adequate motion and strength. Here we will focus on foundational health factors rather than the popular, but rarely agreed upon, topics such as running form, training philosophies, or footwear.

Minimizing injury and improving performance can be aided by all foundational health topics discussed in this article: improved sleep, better recovery, better nutrition/hydration, less stress, better strength. Most runners reach a point where the body can not manage the demands of running and can not recover adequately, which is when injury usually occurs. A more holistic approach to these athletes may be the key.

RESULTS

Sleep

We are a nation of sleep-deprived people from teens to adults. The National Sleep Foundation recommends that teens get 8–10 hours of sleep and adults 7–9 hours nightly. Our teens are sleeping an average of 5–6 hours per night and adults are not doing much better. For optimal recovery from exercise and for optimal health, adequate sleep is crucial. What happens to us when we deprive ourselves of the needed sleep?

Increased injury risk:

- Athletes who sleep on average <8 hours per night have a 1.7 times greater risk of being injured than athletes who obtain ≥8 hours of sleep per night.² If we're not giving our bodies enough time to recover and heal post workout, it is no wonder we are susceptible to injury.^{3,4}

Decrease in athletic performance:

- Without enough sleep our speed, endurance, reaction time, focus, and motor skills all suffer.⁵ Sleep has been shown to improve motor skills by 15–20% which can be essential to establish efficient running form and cadence.^{6,7}

Decreased recovery, muscle growth and repair:

- During sleep and leading up to sleep, there are a number of hormonal responses that take place to allow for optimal recovery after exercise.⁴
- Decrease in neurocognitive functions like memory and attention.^{4,5}

Increased risk of illness:

- Exercise is a physiological stressor that activates hormones regulating the immune system and metabolic functions.^{4,5,8} Lack of sleep lowers immune protection, making one more susceptible to sickness or injury.
- Increased risk of depression and anxiety disorders has been linked to lack of sleep as well.

Difficulty maintaining a healthy body weight:

- Less sleep has been associated with a higher BMI.⁵ Altered sleep patterns can affect metabolic hormones that relate to appetite and food consumption. This can lead to changes in food intake and processing, making weight maintenance difficult.⁸

It is safe to say that every major body system does better with sleep and nothing improves with less sleep. So, how do we get more sleep? Well, it comes down to why we are not getting a good night's sleep. If you struggle to “shut down” and fall asleep, here are a few tricks to try.

Brain dump: Before bed, write down what is on your mind (i.e. worries, concerns, to-dos). By writing these down, you can decrease the mental burden and promote relaxation.

Screen time: Stop screen-use approximately one hour before bedtime. The light from the screens stimulates our brains and does not promote restfulness. What you do on your screen (work, social media, paying bills, etc.) may also add to your mental burden, shifting you further from relaxation.

House lighting: Our natural circadian rhythm directs us toward sleep at sunset. The invention of light bulbs has caused a disruption in that natural cycle. By limiting the bright light in our home close to bedtime we may be able to encourage a rest state and decrease stimulation.

Hot baths: Our circadian rhythm leads to a drop in body temperature as we approach time for sleep. After a hot bath, you will encourage a cooling effect. This drop in body temperature could help mimic the natural rhythm and encourage somnolence.

Bedroom is a resting place: Keep the bedroom for sleeping and do not bring work, electronics, or clutter into your

room. Dark, quiet, and cool (65–68 °F) will enhance the resting state.

Rest Days

Rest days are crucial and can vary depending on the athlete. An *absolute* rest day means the runner is not partaking in any physical activity at all and will have a more sedentary day. While this can allow an athlete to recover and remain below the injury threshold, absolute rest, if done too often or for too long, can eventually reduce resiliency. It is the authors' recommendation to have one absolute rest day per week.

Active recovery/cross-training days are another form of rest day. Performing an activity at a low/moderate intensity without the same physical demands and stressors of running can aid in recovery. Some examples of good active recovery/cross-training include swimming, yoga, rowing and hiking. Remember, the purpose of rest days is to aid recovery from the running and to rebuild what was depleted and broken down; therefore, a minimal to moderate intensity is ideal. It is the authors' recommendation to have at least one active recovery/cross-training day per week. Some runners, such as fast-growing teens and aging runners, may require more absolute and active rest days.

Nutrition And Hydration

Nutrition and hydration requirements can vary depending on the runner and the level of exercise. Recommendations for loading before exercise, fueling during exercise, and recovery post-exercise may be slightly different per individual. Yet, there is an overall theme that awareness of what an athlete is putting into his or her body can help or hinder exercise goals and health. A proper balance of nutrient intake and water consumption is essential. Think about incorporating as many natural whole foods in their diet as possible and limiting processed foods. Whole foods are foods that rot and rotting is a natural process. If a food item has a shelf life of two years, it is most likely highly processed and could lead to increased rates of inflammation in the body.⁹ Ingesting enough nutritious calories ensures that one has the energy available to fuel the high demands of distance running. Although nothing will replace the personal advice of a nutritionist or registered dietitian, here are some evidence-based guidelines:

Carbohydrates: Runners cannot afford to “cut carbs” as they are a primary fuel source. In addition to being vital for endurance performance, carbohydrates can slow the release of stress hormones in the body.¹⁰ Look to take in approximately 6–10 grams of carbohydrates per kilogram of body weight daily.

Proteins: Protein intake allows for accelerated muscle growth and accelerates recovery by rebuilding the muscle fibers stressed during a run. The amino acids found in proteins help build the body's cells, including stimulating

white blood cells of the immune system, which can protect the body from illness.^{10,11} Look to take in approximately 1.2–1.7 grams of protein per kilogram of bodyweight daily.

Fats: Fats should not be avoided or excluded from the diet.¹⁰ Restricting fats and overall caloric intake can actually be detrimental to athletic performance and recovery. It has been linked to increased injuries in female athletes and directly related to disorders like Relative Energy Deficiency Syndrome in Sport.^{10,12} Twenty to thirty-five percent of daily caloric intake should be comprised of healthy fats such as olive oil, fish, avocados, seeds, and nuts.

Hydration: A personalized hydration plan can be useful due to individual differences in sweat content. In general, runners should aim to drink consistently throughout the day to maintain a baseline hydrated state.^{10,13} Examining the color of one's urine is a simple way to assess fluid intake. Adequately hydrated urine should be clearer. Additionally, one must be careful with supplements or over-hydrating before running. Try to attain the standard eight 8-ounce glasses per day.

Vitamin and mineral supplements: If a diet is lacking in essential components then supplementation may be beneficial. One should consult with a registered dietician or nutritionist for guidance. It is not uncommon for female runners to be deficient in calcium, vitamin D, and iron. Supplementation may assist these runners in remaining healthy and warding off injuries.

- Calcium plays an important role in bone building. Vitamin D is also important as it aids in calcium absorption. Daily recommendations of calcium and vitamin D for adults are 1000–1500 mg/day and 600–2000 IU/day respectively. These levels can maximize bone health and muscle function.^{14,15}
- Iron is an essential mineral that helps with oxygen transport in the blood, energy metabolism, and thermoregulation. Optimal intake is 8–18 mg/day. Women should aim for the higher end: 15–18 mg/day.¹⁶ Consuming leafy green vegetables, lean red meat, or beans ensures adequate iron intake.

The calories burned will depend on the size, gender, and the intensity of the workout. It is necessary to replace these calories with nutrient-rich foods to help recover and prepare for the next run. Any diet that restricts a food group or limits caloric intake to an arbitrary number should be avoided.

Mental & Emotional Health

Mental and emotional health are important aspects of our overall well-being that can be overlooked in clinical and athletic settings as we focus on physical health of the runner. Stress is prevalent across our population, especially high schoolers and young adults. We are seeing alarmingly high rates of anxiety, depression, and suicide. While there are

numerous theories on this trend, many point to the increase in social media and smartphone use.¹⁷ If stress levels are elevated for too long, it can negatively impact physical performance and resistance to injury. In a high-stressed state, the body breaks down. By then introducing the demanding physical nature of distance running, it can be too much for a runner to tolerate, leading to injury.¹⁸

The topic of mental health is gaining traction in the media. In this way, it is becoming more socially acceptable and integrated into our daily dialogue. Hopefully, this will further reduce the stigma and lead more people to seek professional help. Coaches and healthcare providers should be aware of the signs of anxiety, depression, or other emotional stressors; and then encourage professional help.

There is a correlation between poor running performance, lack of sleep, increased screen time, and increased stress. By encouraging proper rest and lessening screen-time use we may be able to keep stress down and enhance the overall health of runners thus improving resiliency. Mindfulness-based interventions have been shown to help manage negative emotions and improve overall athlete well-being. Some literature supports mindfulness-based interventions for reducing injury, but further research is warranted.¹⁹ Other simple techniques to help manage stress might include meditation, breathing exercises, yoga, tai chi, or other restorative activities to complement a rigorous training schedule.

Pre-Run Warm-Up And Post-Run Cool-Down

Pre-run and post-run activities help reduce injury rates. Performing techniques like myofascial release and massage, either with a professional or with a device like a foam roller, help when executed pre and post-run.^{20,21} When performed prior to running, these techniques can improve range of motion and muscle activation. After running, they can reduce soreness and augment recovery.^{20,21}

In addition to tissue preparation, a dynamic warm-up performed immediately before running can prepare the body, which reduces injury and enhances recovery.²² Dynamic warm-ups should include activities emphasizing the muscles needed for running such as the calves, gluteals, quadriceps, and hamstrings. These activities should have slightly less impact and slightly more range of motion than actual running. Activities like jumping jacks, squats, lying leg raises, and standing leg swings are some that would suffice.

Passive stretching, foam rolling/massage after a cool down activity (i.e. walking) are examples of effective post run activities.

Strength

Lack of adequate strength is a modifiable intrinsic risk factor that can increase the likelihood of a running injury. It is widely known that strength-training can improve performance in athletes and can help reduce injury.²³ Therefore, it is extremely important to ensure that runners are participating

in a running-specific strengthening routine that emphasizes the physical demands of running. A detailed assessment by a professional is often helpful in addressing the needs of the individual.

Some general key points for strengthening are:

- Most runners would benefit from exercises activating the gluteal muscle group. Exercises that involve hip extension, abduction, and external rotation are crucial. Some examples of common exercises are bridges, clamshells and squats.
- Most runners would benefit from an intrinsic foot-strengthening program. Barefoot exercises help make a runner aware of toe placement and arch height. At its simplest, barefoot walking in a grassy field or barefoot balance exercises are a good foundation.
- Most runners would benefit from a strengthening program incorporating core and pelvic stabilizing muscles. Some examples of common exercises are planks, bird-dogs and weighted farmer's carries.
- Running-specific strengthening should include single-leg standing exercises. These should only be performed once the athlete is strong and stable enough for these balance-based positions. Bilateral simultaneous two-legged strengthening is not as effective, as the single leg positions that mimic running. To prepare for single-leg activity, a runner can transition from squats to partial range single leg squats or shift from deadlifts to partial range single leg deadlifts.
- A combination of body weight exercises, plyometric exercises (jumping), and weight lifting should be incorporated into most running programs.

Range of Motion

Flexibility/stretching (which falls under many names such as passive stretching, active stretching, dynamic stretching...) is another modifiable intrinsic risk factor for injuries. Studies published over the past decade have changed the general perception of stretching. As with most research, we find conflicting results, with some concluding that stretching can prevent injuries and the majority concluding it doesn't change the incidence. Although most of the evidence is not there to support stretching as an injury-preventative modality, when asked, "not stretching" was the number one reason runners thought their injuries occurred.²⁴ There is obviously a gap in the overall consensus of research and the knowledge base of recreational runners.

Adequate flexibility, which can be assessed by a health-care or exercise professional, may reduce the likelihood of certain muscle and tendon injuries. Becoming hypermobile or stretching beyond what is considered a normal range does not provide further benefit. Many muscles can become restricted by running. Some common areas where flexibility

is needed are the calves, iliopsoas (hip flexors), hamstrings and Iliotibial band. It is important to note that the runner with a chronically tight muscle that does not respond to stretching may not have a tightness issue. There may be an underlying problem associated with weakness or dysfunction of the muscle leading to a strain. In this case, a strengthening/muscle activation intervention can reduce the tightness and associated pain whereas stretching would not help. This emphasizes the need for a detailed assessment of a runner's function – strength, mobility, motor control, posture – to get to the source of an injury.

CONCLUSION

The strongest predictor of running injury is prior injury.¹ A possible cause of this would be runners returning to the sport before fully recovering or before the causes related to the injury are fully addressed. Is this a failure of the patient or of the sports medicine professional? For this reason, healthcare professionals – especially those involved in rehabilitation – need to ensure that the sources of a runner's injury are identified and addressed properly rather than merely attending to pain relief.

Running injuries are multifactorial and the care and management of injured runner should be as well. There is no perfect exercise, no perfect running form, and no perfect running shoe that we can recommend for all runners. What we can universally recommend is the concept of optimal foundational health, which should supersede any specific running strategy. As sports medicine professionals, we should never let the metrics of athletic performance outweigh the health and wellbeing of the runner. Promoting good foundational health will not only reduce injury risk, but also improve performance and overall health which are essential metrics of sports medicine.

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