

THE FASCINATING WORLD OF MOUNTAIN AND LONG-DISTANCE RACING

– Written by *Chloë Lanthier, France*

Mountain endurance sports have experienced considerable growth in the last decade. Notably with mountain-trail running and ultra distances (over 170 km). Now, there are races around the globe, of all distances from half-marathons to six hundred plus kilometers.

When I started competing in mountain running, twenty-five years ago, we were a small, elite group of women and men. The total number of participants was around 350 for the most popular events, today the same races have up to two thousand participants, and they refuse three times as many registrations. The long distance attracts not just the mountain athletes and elites but the masses, the everyday adventurer, recreational road runner, and has inspired sedentary quadragenarians to a new healthy lifestyle. The same is true for cross-country endurance mountain biking, off-road triathlons and a new rapidly growing sport; ocean rowing – crossing the Atlantic and Pacific Oceans, solo or in a team – seeking the thrill of a lifetime. Individuals want to explore their limits with an ultimate challenge, to do something they have never done before. While battling sleep deprivation,

discomfort, blisters and pain, they experience the summits' breathtaking views, they discover camaraderie, self-discovery, a lifetime experience – which can provide a profound feeling of accomplishment.

But are all of them ready to embark on the ultimate test of body and mind in some of the most hostile and challenging environments? There are many more variables and unpredictability than in a road marathon on a flat course with the constant cheering of the crowd and paramedics on every corner. The unknown can be romantic to many, and a lack of experience can mask the reality of what it takes to run the Tor des Géants® in the Italian Alps – 330 km with a total elevation gain of 25,000 meters. It can take years to gain the physical fitness, skill set and mindset to accomplish these types of events. We can't accelerate fitness, and progression is not linear, likewise patience, coherence, dedication, resilience, perseverance and experience are often overlooked. Most registrations for events are done by draw or by accumulating "stones" from racing often, and not necessarily through experience, which proves you can complete not only the distance but also in

that specific environment.

When we add all these parameters the result is an increasing number of overuse injuries and DNFs (did not finish), at times up to fifty percent of the participants. The reasons are controllable factors. Often a lack of preparation (undertraining) and resilience, poor training and racing strategies; hydration, fueling, pacing, decision making, adaptability etc. It is not necessarily because the events are too difficult, it is simply due to a lack of understanding of the physical and mental demands and the skills required to cross the finish line to the best of the athlete's ability.

Crossing the Atlantic Ocean is a serious undertaking, 3,000 miles and more than thirty days of rowing. You can't suddenly decide to quit, the boat must keep moving even if you get seasick, or your hands are covered in blisters, or you're sleep deprived for weeks, or facing 30-foot waves in gale force winds.

There is a natural commitment to prepare logistics, safety, gear, navigation skills, weather knowledge, nutrition and the training involved when your life depends on it.



HOW DO YOU TRAIN FOR SUCH AN EVENT?
For mountain and long-distance events you need much more than pure endurance, contrary to what one might suppose. The distance and terrain become the intensity and for these reasons you need a high level of resistance to fatigue, which is achieved not only by training at high volume and low intensity, but by developing speed, strength and power to be able to endure the distance, the course's technicality, the total altitude gain, and all this most often than not in a challenging environment. Also, movement

economy is important, good mechanics conserve energy, reduce the risk of injury, resulting in faster recovery, and we move faster between point A and B.

BASE SPEED | A FUNCTION OF POWER

The more fatigue you accumulate, the more your speed decreases with the distance traveled. It can be the difference between running and walking. The more power a mountain athlete has, the more he or she can maintain a constant pace over a long period of time before slowing

down. Power training optimizes the neuromuscular pathways and the muscle fibers' energy supply by increasing the number of contractile proteins, actin and myosin, which are necessary to improve the quality of muscle contraction. Power is about putting strength at the service of speed on all mountain terrain. Additionally, doing speed and power drills on a regular basis, such as quick power knee-ups, jumps or strides, an athlete automatically moves with better mechanics, greater elasticity and economy, it also allows the mountain runner to optimize propulsion with a more dynamic triple extension at toe-off, with a quicker leg turnover, and the development of eccentric force required in descent¹. The approach to training for a long-distance mountain event is very different than for a traditional road race. Every sport is different, but mountain running is truly unique, due to all its components: terrain, elevation, weather conditions, altitude and distance.

THE GOAL IS TO IMPROVE OVERALL MOUNTAIN FITNESS

The fact that heart rate is established as the main indicator of performance is due to the availability of measurement techniques. But it is obvious that muscular work determines the intensity of training and the measured heart rate is only one of many indicators that reflect this intensity. Squatting heavy weights is not the best way to build power for mountain running, but by doing hill repeats and pushing the effort on climbs or on technical 1,500-meter descents, building power in both the anterior (for the descent) and posterior (for the uphill) kinetic chain is a must.

ENDURANCE VS. LONG-DISTANCE TRAINING

The difference lies in the time spent training. Generally, endurance training sessions do not last more than 90 minutes to 2 hours. As for long distance, they exceed 2, 3, 5+ hours.

THE SECRET TO LONG-DISTANCE TRAINING LIES IN PHYSIOLOGICAL CHANGES

During long-distance training, the body does what it cannot accomplish during simple endurance sessions, namely two adaptations in response to training. First, the body learns to increase its efficiency by releasing and burning free fatty acids. It does this in the form of enzymatic and hormonal changes in muscle cells, making it easier

to use fat as fuel. Second, the circulatory characteristics in the peripheral muscles will improve and subsequently better evacuate toxins to bring blood, oxygen and fuel to the legs to run longer. With weeks of consistent training, you can go longer without slowing down as much.

One mistake is to train focusing on the distance, in actual fact, the race profile is more important.

Obviously, training sessions are done at low intensity but once again the terrain will make the training effort intense. Including one to two endurance and long-distance sessions per week is enough for gains and to avoid overtraining. One session should be shorter and the other longer, and one on more technical terrain to optimize coordination, agility and confidence. A crucial and often overlooked strategy, training sessions should be similar to the race profile. That said, for example, if the start of the race is a 1,000 m climb followed by a 10 km high-altitude traverse over hilly terrain, this type of profile needs to be part of your training plan. Mountain running

events involve very long descents followed by flat sections, which are very strenuous on the quadriceps, and often a limiting factor, again this specific profile must be included in the training program. It's best to begin the training program with less elevation and distance to progressively build from that. Mountain running (and mountaineering) requires a very high level of muscular, physiological and mental adaptation. By focusing only on distance, this type of training generates an accumulation of fatigue, not energy or specificity. 1-hour to 90-minute sessions are also very important, on flat and rolling terrain. This type of training represents a combination of reaction time and speed of movement while improving mechanics and economy. It will provide that speed, leg strength and endurance for the distance.

Not everyone lives in the mountains, so creativity is essential for good training. But it is important to plan regular mountain training "weekends" and commit to travel. You can't do all the training in Paris and be ready to race the UTMB®, 171km with

10,040 meters of elevation gain. Training intelligently with good time management is important, but prioritizing the quality of each session can be decisive for daily energy, motivation and results.

The incline of a hill and the force of gravity are the best tools a mountain athlete has to develop resilience, power, strength, resistance to fatigue and pain.

UPHILL TRAINING: IT'S THE INTENSITY THAT COUNTS

The work done on a climb is a performance activator and shapes the mindset in the face of adversity. Therefore, it has a strong impact on the muscles as well as the aerobic and anaerobic thresholds. Above all it is a way of training the perception of effort, both physical and mental. It is also about training beyond the comfort zone and rewiring the brain with the aim of a new potential. Uphill sessions build great mental capacity, resilience and confidence, while preparing for the discomfort of competition. It allows the athlete to learn to endure the intense





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mental effort that accompanies very hard physical efforts to be able to persevere when things get tough. It is an asset for competition and to learn how to better push efforts and unlock potential. This uphill work preserves glycogen and delays muscle fatigue over longer distances. It's an effective training strategy for maintaining a sustainable pace before the athlete feels the debilitating effects of fatigue – both physical and mental – that will slow him or her down.

VERTICAL TRAINING SESSIONS

Uphill and downhill intervals are a priority and extremely effective, the results are particularly high given the brevity of the session – between thirty minutes to one hour depending on fitness level and experience. Its uniqueness lies in the fact that in a single session the body works on a wide range of skills essential for mountain running and all mountain sports. Whether a recreational or competitive athlete, base speed will improve on all terrain and gain better running economy for the distance and total elevation gain. Because the body has to fight an extra battle against the force of gravity, these workouts also increase aerobic and anaerobic capacity, you generate an adaptation to greater oxygenation of the legs, and you run faster and longer without the debilitating effect of lactate production, as well as building a competitive and sustainable mindset.

In the mountains, the terrain is constantly changing therefore the body has to adapt

and recover quickly and effectively to be able to cover the distance. Training both uphill and downhill engages the posterior and anterior kinetic chains. Many mountain athletes can't even run uphill, they walk and for one simple reason, they don't train to run uphill. They have minimal muscle energy available. But it's not by repeating 10-second uphill sprints and resting for a minute between each repetition that we develop strength, power and oxidation to climb a thousand meters non-stop. As is known, sport specific training is very important for progression and performance. Combining uphill and downhill intervals in one session is essential. The athlete develops the strength to be able to run moderate climbs, alternate between running and fast walking for longer climbs, and has the power to tackle the steep incline. This could mean completing a 100 km race in 25 hours versus 35 hours – or a DNF.

GUIDELINES FOR VERTICAL TRAINING

The load must be added progressively. The ideal is to have two slopes to train on, a steep, short slope and a longer, moderate one. For those who live in the city, a hill of about 40-60 meters will do. The treadmill is not recommended for these workouts because you won't get the eccentric muscle development needed for the downhill. Make sure to include a 10-minute warm-up and cool down, and to be done only once a week. Intervals of 30 seconds to 5 minutes, and between 3 to 8 repetitions for each set. It is also important to vary the speed, the

intensity of the intervals to target different energy systems. The goal is to develop different "gears" like a car, not to have just one speed – walking – we want the athlete's "engine" to have three gears.

EXAMPLES

From increasing the speed every 20 seconds over a minute, to maintaining a moderate and constant pace over 3 minutes, or to alternating easier and faster speeds within the same repetition. By alternating with downhill intervals, at a faster and more consistent pace, and slow uphill running or walking as a recovery between repetitions. The goal with the downhill intervals is to develop eccentric muscle strength and to control the vertical impact force with good mechanics starting with the foot and lower leg, and all the way up the kinetic chain.

The brain adapts to a new level of work intensity and the athlete's perception of effort changes, they walk less, run slightly faster and longer even if the effort seems the same². I recommend not doing the vertical sessions based on a specific heart rate zone, because it's high-intensity effort and this could be a limiting factor. Also, the goal of vertical training is to simulate the intense effort experienced in the mountains. So, because they are high-quality short sessions, recovery is quick and involves little risk.

POSTERIOR CHAIN: A SECRET WEAPON

I founded the vertical training technique twenty years ago for my own training and to coach others. It has been a major

performance factor to my athletic career, allowing me to remain mostly injury free and with longevity. It is the best way to combine power, strength, speed and endurance without risking overtraining. Athletes love the sensations and the results.

I even include it in the Ocean Rowing programs for the athletes I work with to develop a stronger and more durable posterior kinetic chain: back extensor, glutes, hamstrings, calves, Achilles tendon, plantar fascia, foot motor function etc. The posterior chain is a secret weapon, whatever the distance or the sport, it is an accelerator, it propels us forward.

FOUR MAJOR PHYSIOLOGICAL OBSTACLES

Success, crossing the finish line in long-distance racing relies on important strategies, whether in the mountains, at sea, in the desert, in the Amazon, in the middle of a heatwave or in the freezing cold of the Arctic – even before physical fitness – I see mountain athletes incapable of thinking for themselves, dependent on their support crew, either for practical reasons (poor hydration, fueling, gear, clothing etc.) or for mindset (ego, lack of experience, underestimation of the importance of details, mental fatigue etc.). These strategies studied and implemented by the greatest explorers more than a century ago are not always considered by some of today's long-distance athletes and coaches.

EXAMPLE FOR A MOUNTAIN RUNNER

Caloric expenditure - fueling

It's metabolic, it all depends on how each athlete uses their resources. The athlete must ask the question, "Do I have the capacity to sustain the effort required with the hydration and nutrition strategy that I plan to adopt?". Some strategies, for example, try a wide range of gels, energy bars and food in different duration and intensity sessions, as well as various weather conditions, during night runs, when fatigued, to see how the body will react and which food will work best in different scenarios.

Thermoregulation

Management of body temperature and perspiration. It depends on the intensity of movement, the environment, temperature, humidity level, and the female athlete's hormonal cycle³. Some strategies, for example, would be to consume more mineral salts (electrolytes) on hot days

and when humidity levels are highest; clothing breathability; add a layer when temperatures drop; reduce effort intensity in extreme heat etc.

Fatigue

Effort and pain management, how exercise intensity impacts the athlete⁴. Some strategies for example, don't start too fast; alternate between walking and running when extreme fatigue kicks in; include vertical training, speed sessions, strength training that will reduce the perception of effort and optimize overall fitness; integrate long-distance training runs on technical terrain trying not slowing down.

Economy

Optimization of running mechanics for all terrains, oxidation of the kinetic chain,

overload and mechanical wear (blisters, irritation, wounds etc.), foot motor skills (reduce the risk of ankle sprains) etc. Some strategies for example, working with a trail running coach to improve mountain running mechanics; reduce stride length on steep climbs; as soon as you feel any skin irritation: stop, clean the area and apply a bandage.

These four strategic plans are essential to minimize the risks of muscle cramps and soreness, dehydration, gastrointestinal problems, wound infection, knee pain, ankle sprain, early onset fatigue, hyperthermia etc. These are also the reasons why doctors and medics will assist the many participants. Many parameters can be mastered with proper preparation and experience, by learning from mistakes and incorporating new strategies into training and racing.





BIOMECHANICS | INJURY PREVENTION

Good mechanics are important, the distance and the terrain represent an additional mechanical load on the body, therefore the risk of injury is high. Running is not bad for the body, poor mechanics is. And running versus cycling is a gravity sport, the goal is to reduce the force of gravity with better mechanics.

KNEE PATHOLOGY

Almost all knee pathology in mountain running occurs during the descents due to a mechanical overload in force absorption. Common patterns are vertical oscillation and overstriding increasing hip and knee flexion at ground contact, with valgus knee loading and overpronation of the foot. This results in increased mechanical stress with compressive and torsional force on the knee joints and tensile loads mostly on the quadriceps, popliteus, soleus and gastrocnemius and the tibialis anterior muscles.

Posterior chain overload when running uphill comes from bending the upper body forward with hands on thighs. Leading to plantar fasciitis, Achilles tendinopathy, calf muscle tears, tight hamstrings and lower back pain.

Ankle sprains are common and are often caused by poor foot motor control and lower leg strength, in particular, weakness in the

flexor hallucis longus, tibialis posterior and peroneus muscles.

These overuse injuries are common but easily preventable by improving running mechanics. Good injury prevention starts with a biomechanical analysis of the runner, followed by running drills and exercises to optimize mechanics for all terrain. Individual musculoskeletal imbalances should also be assessed followed by strength and mobility programs. Unfortunately, a very high percentage of mountain endurance athletes spend time away from training and competition due to injury, and as discussed in this article a lack of a multidimensional preparation.

MEDICAL ISSUES

Among the elites and some recreational mountain runners, both female and male, there is an increasing incidence of immune dysfunction due to overtraining, excessive mileage, and lack of appropriate and planned maintenance, recovery and fueling. The combination of addiction to training, even through injury, and eating disorders, the consequences can be long term. We see more and more cases of REDs (relative energy deficiency in sport), and LEA (low energy availability) and stress fracture of the femoral head and pelvis, especially in very underweight athletes. This is a minority of the total number of participants, but the

numbers are increasing, and the masses often admire these athletes. Unfortunately, once an athlete can no longer train at their level, they are at risk of suffering depression and serious mental health issues. We need to talk more about these issues and offer better assistance and education through online webinars, training centers and sports orthopedic clinics.

MINDSET OVER MUSCLES: LEARNING TO PERSEVERE THROUGH DISCOMFORT

To maximize the chances of success, the key is to "experience discomfort" during training to develop the mental and physical resilience needed to optimize the athlete's potential. This includes, for example, performing training sessions in difficult circumstances that they are likely to encounter during the event, and to list their weak points or fears, e.g. being in the wild alone at night, and work on them. Pain or extreme fatigue are sensations, that is, impressions perceived subjectively⁵. Being fit alone does not increase tolerance or resilience. But the way we train directly influences it. Tolerance is both a point that can be improved through training and a major limiting factor in endurance. Perceived effort is above all in our heads: the brain controls our muscles, therefore our sensations.

In general, when a mountain, long-distance athlete uses the word "pain", most

often the reference is to the symptoms of fatigue and discomfort that accompany pushing their body.

During the months preceding my departure for Alaska to participate in the Iditasport Trail Invitational, – an unsupported winter cycling event in Alaska, 1,000 miles from Anchorage to the Arctic Circle – I trained several times a week at night. I fell asleep around 9 pm and set my alarm for midnight. I rode on snowy forest roads with my bike equipped to simulate the energy demand I would have to face. It was an emotional challenge with little sleep, perfect for practicing my efforts in British Columbia's cold winter. A new mental elasticity formed over the following months, an opportunity to push my physical and mental efforts to a level that would give me a better chance of performing over the distance and in this environment. I did not train for sleep deprivation, it is impossible, but I trained so that my brain and body would get used to riding long hours with minimal sleep. It also helped me have confidence in my skills for the journey. I would not have had the same results riding twice as many hours on my turbo trainer at home.

ADAPTABILITY: THE KEY FACTOR TO PERFORMANCE

Part of the challenge is that a long-distance endeavor is a conceptual Swiss Army Knife. Sometimes you have to use different tools to adapt to the unexpected. It's what you need to progress and perform beyond your potential with multiple strategies to gain resilience, courage, focus, motivation, survival skills and adaptability. The only way to acquire a Swiss Army Knife is to practice, practice, practice, and learn from experience during training and racing. This is how we gain confidence – by doing it and training diligently. Your brain is continually rewired with new perceptions and by gaining new skills. I believe that the challenge of endurance is done by pushing efforts beyond signs of fatigue while being able to identify the moments when we are about to put ourselves in danger before crossing the red line.

Your mindset is as elastic as a bungee cord, you can go from very high to very low in an instant. But when you manage your head, you manage your body.

We cannot dissociate the mental from the physical, so the mindset is integral. Two athletes with the same physical condition can have very different reactions and perceptions when faced with the same stress during an event: a change in temperature, the effort intensity, the pressure of failure, the fear of drowning. Beyond physical and emotional attributes, genetics can also determine how an individual will face obstacles, pressure, pain, defeat, success etc. Some people can seem indifferent to pain and can push it to the margins of consciousness when others seem more sensitive.

Obviously, long-distance performance is not possible without discomfort. It is the absolute accomplishment of endurance and each of your experiences is different. We can't plan how we will feel on THE day, but we can prepare for all possible scenarios and train our brain to take quick decisions and adapt on the spot instead of reacting and losing precious energy from negative emotions. Just like we train astronauts before a space mission, ensure nothing is forgotten and be ready to face any obstacles. Like the Apollo 13 mission – find a solution when the plan doesn't go as expected – instead of just giving-up!

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Chloë Lanthier is a consultant in performance physiology, biomechanics, and sport injury. Published author, educator and keynote speaker. Accomplished athlete with over forty podiums in mountain running, a former 24-hour mountain bike World champion and expeditions in Alaska and the Arctic. Bachelor of Science in exercise physiology, Masters in Biomechanics and human performance.

References

1. Thomas J. Roberts, Stan L. Lindstedt, Hans. Hoppeler, Contribution of elastic tissues to the mechanics and energetic of muscle function during movement. *J Exp Biol.* 2016 Jan; 219(2): 266-275.
2. de Morree HM, Klein C, Marcora SM. Perception of effort reflects central motor command during movement execution. *Psychophysiology.* 2012;49:1242–53. doi:10.1111/j.1469-8986.2012.01399.x.
3. Maughan R.J. Distance running in hot environments: A thermal challenge to the elite runner. *Scand. J. Med. Sci. Sport.* 2010;20:95–102. doi: 10.1111/j.1600-0838.2010.01214.x.
4. Renfree A, Martin I, Micklewright D, et al. Application of decision-making theory to the regulation of muscular work rate during self-paced competitive endurance activity. *Sports Med.* 2014;44(2):147–58. doi:10.1007/s40279-013-0107-0.
5. Marcora SM, Staiano W, Manning V. Mental fatigue impairs physical performance in humans. *J Appl Physiol.* 2009;106(3):857–64. doi:10.1152/jappphysiol.91324.2008

Chloë Lanthier
 Founder & Director
 Chamonix Mountain Endurance Academy
 National Professional Running Coach
 NCCP

Chamonix, France

Contact: chloe@chamonixacademy.com