The science behind winter exercise

From tight airways to frostbite, experts break down how Pittsburghers can stay safe while staying active in sub-freezing temperatures

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With 2026 on the horizon, 'tis the season of New Year's resolutions.

For some, this may look like adding more walks — or even winter runs — to their weekly routine to meet physical activity guidelines. The American College of Sports Medicine recommends that individuals engage in 150 minutes of moderate-to-vigorous intensity exercise per week, with two to three days of activities that strengthen muscles and bones.

But with sub-freezing temperatures hitting Pittsburgh, the cold stresses the body in ways most people don't realize.

Experts say the hidden responses of exercising in the cold — from

redirected blood flow to tightened airways — explain why usual cold-weather tips matter, and why understanding what's happening inside the body is important for maintaining safety.

Exposure to cold temperatures

A runner makes her way along Pearce Mill Road in North Park shortly after the snowfall on Dec. 2.
(Steve Mellon/Post-Gazette)

When the body is exposed to cold temperatures, it immediately starts protecting its core temperature by increasing heat production and decreasing the rate of heat loss.

"One of the very first things that our body will do is, we begin to shift blood away from our extremities, and we try to shift that blood more centrally into what we call our core, which is really deep down inside our visceral organs, trying to preserve that temperature the most," said Brian Leary, an assistant professor and director of tactical performance physiology at West Virginia University.

If exposure to the cold continues, the body increases heat production. Shivering — a type of involuntary muscular contraction — generates heat as a byproduct. The muscular contractions that occur during exercise act similarly.

"We either try to get that blood away from the skin, try to provide some type of insulation to preserve the heat, or we try to produce heat through shivering," said Leary.

While exercise generates heat and helps protect against some of the more severe effects of the cold, it also comes with trade-offs and risks. The American College of Sports Medicine warns that under the wrong conditions, even experienced exercisers can run into trouble.

How cold is too cold?

So, can it be "too cold" for exercise?

The short answer: Yes.

However, it's not always that simple, said Sarah Ostop, a sports physical therapist, athletic trainer and adjunct faculty at the University of Pittsburgh School of Health & Rehabilitation Sciences.

The cutoff temperature is different for everyone.

"Your body has to get used to being out in the cold," she said. "If you're new to exercising outside, you might not be able to exercise if it's as cold as 5 degrees, or 25 degrees might be your cutoff."

Vincent Penco of McCandless gets in his daily 5-mile walk at North Park.
(Steve Mellon/Post-Gazette)

There's also an important difference between feeling cold — a mild drop in skin temperature — versus a decline in core body temperature, which crosses into a health risk, according to the textbook "Physiology of Sports and Exercise."

Even if your core stays warm, cold weather can cause other issues, including cardiac strain, changes in breathing and other physiological stress, especially in those with preexisting health conditions.

The cold affects function in the small muscles of the periphery — such as the fingers and toes — and limits the ability to perform fine motor skills needed for tasks like tying and gripping.

When it comes to actual exercise performance, Leary said the biggest limitations typically show up in muscular strength and force production.

When a muscle cools, it contracts with less force. Most performance decline is seen in explosive or anaerobic efforts — anything lasting up to about 90 seconds — according to a 2024 article from the ACSM.

"[The cold] does affect the connection between your nervous system and

your body's ability to turn on muscles, called neuromuscular control. It just doesn't work as fast," said Ostop. "So, especially if you're trying to do some quick explosive motion, you might notice you can't move quite as fast."

Even a small drop in muscle temperature matters. A decrease of just over half a degree Fahrenheit can reduce muscle power and VO2 max — the maximum amount of oxygen your body can take in and use during exercise — by 4-6%. A 14-degree drop can decrease power output by about 30%.

While the effect of cold weather on endurance performance is still debated, both Leary and Ostop said it's usually less impaired. Clothing insulation and exercise metabolism are often sufficient to maintain body temperature, and deep muscles rarely experience low temperatures because the steady blood flow prevents heat loss.

Airway dysfunction

Breathing dysfunctions like exercise-induced asthma and bronchoconstriction are the most common issues seen when exercising in the cold, Leary said.

A study published in 2018 in Nature found that about 20% of adults reported symptoms like shortness of breath or wheezing when it was cold outside.

The main culprit? Cold, dry air.

"When we're exercising, we lose a little bit of moisture every time we breathe," said Leary. "When we're exercising and we're getting a lot of air moving in and out of that respiratory tract, that means we're going to lose a lot more fluid from that area."

When combined with a cold day — which is already an irritant to the respiratory tract — Leary said this triggers breathing issues, especially in those with preexisting asthma.

The moisture loss can lead to hypohydration, making proper fluid consumption vital.

"If you're out doing a run, skiing or more of these endurance exercises, drinking a little bit of fluid along the way as you exercise is really important, because that's going to keep those airways hydrated, and that's

going to prevent them from constricting quite as much," said Ostop.

To layer or not to layer

Layering clothing is the best line of defense when exercising in cold weather, according to the American College of Sports Medicine. The extra layers help insulate the body to slow heat loss.

However, experts warn that it is possible to overdress.

"The worst thing that can happen is when you sweat — because you're going to sweat even though it's cold outside. The moisture sticks to your skin, so then you're at more risk for cold illnesses or cold injuries, because now your skin is cold and wet," said Ostop.

As the temperature difference between the skin and environment increases, the body loses heat faster. Overdressing can trap too much warmth, prompting sweating; once that sweat saturates clothing, evaporation pulls heat away and lowers body temperature. Moisture also accumulates inside of clothing, leaving the skin wet and vulnerable to frostnip and frostbite.

To avoid overdressing, Leary suggested layering strategically and avoiding certain fabrics that retain moisture, like cotton.

"One of the first layers against the skin should be something that can help remove some of that moisture off the skin so it's not lingering there, and that's usually merino wool," he said. "The second or third layer can be our typical insulatory layer — a down jacket or a lined piece — to create some type of air barrier."

Leary said the outermost layer should be something windproof and waterproof to keep any water or snow from soaking through.

Ultimately, keeping the core warm — along with areas that don't get as much blood flow in the cold, such as the hands and feet — is critical.

"If you're wearing a sweatshirt that's cold and wet, it can make it harder for your core body temperature to stay warm," said Ostop. "So now we're talking about risk for things like mild or moderate hypothermia."

Preventing cold injuries

Leary said some of the most common musculoskeletal injuries from exercising in the cold occur from “slips, trips and falls.” Cold-specific injuries such as frostnip, frostbite and hypothermia are also risks, especially for youth and older adults.

Properly warming up and cooling down can help reduce injury risk.

“There’s really two types of stretching,” said Leary. “The classic form is static stretching — holding a position, like touching your toes, for 20-30 seconds to stretch an individual muscle. The other is dynamic stretching, which involves moving through a motion, like walking leg kicks, high knees or lunges.”

Dynamic stretching before exercise is most effective for performance because it prepares muscles for strength and power work, while static stretching before exercise can inhibit performance. After exercising, static stretches are more beneficial because the muscles are warmed up and flexible, improving long-term flexibility.

Another challenge after exercise is how the body transitions from activity to rest in cold conditions.

During exercise, blood flows to the working muscles, producing heat. Upon stopping, blood flow remains high, but the body is no longer producing as much heat.

Sweat on the skin increases heat loss because water conducts heat away quickly.

This combination can make the body feel colder and increase the risk of cold-related injuries if there is no proper warm-up or cool down.

“Your body is working hard to stay warm while exercising,” Ostop said. “That’s why it’s so important to gradually transition back to a normal physiologic state.

“Whether you’re walking back to your car or finding a warm spot inside, you need to give your body time to readjust. Cold constricts blood vessels and airways, and warming up too quickly, especially if you’re dehydrated, can make you feel lightheaded or dizzy.”

Leary said that hypothermia is rare for most people because it requires a significant drop in core temperature, which usually only occurs in extreme situations, like getting lost while hiking or backpacking.

The bigger risks are frostnip and frostbite.

Frostnip is the initial freezing of superficial skin tissue and, although painful, is reversible with rewarming. Frostbite occurs when cells continue to cool and freeze, which can damage tissue and leave areas with a waxy appearance.

Early signs of frostnip and frostbite include discomfort on exposed skin, such as numb fingers, cold toes or reddening cheeks. These injuries usually don't cause permanent damage if precautions — like proper layering and limiting exposure — are taken.

Ostop said that, of all the tips for exercising in the cold, proper clothing might be the most important.

"You can always layer up or take off a layer if you get warm, but it's really hard to add a layer if you get cold, especially if you're already out doing your exercise," she said. "Just make sure you pick good fabrics that, again, wick away the moisture and dry quickly, so you're not just exercising and moving outside with cold, wet fabric touching your skin."

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