Heat and altitude

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Advanced: for experienced endurance athletes.

One to two weeks of training in the heat lowers heart rate and body temperature and improves hot-weather performance.

Why it matters: Many races are hot, and altitude camps are popular with serious amateurs. Heat preparation has a solid evidence base; altitude is more expensive and less proven.

The big picture: Altitude training has weaker support: living high and training low showed gains, but study quality was weak and athletes' expectations were never ruled out.

What to do with this

- **For a hot race, acclimate:** train in heat for about 8 to 14 days beforehand, or as many sessions as you can.
- **No heat where you live?** Wear extra layers, train indoors without a fan, or use a sauna or hot bath after training, with care.
- **Start heat sessions easy and short.** Stop if you feel dizzy, confused or nauseous.
- **Skip altitude camps** unless you can afford them and race seriously; the gain is uncertain.
- **Racing at altitude?** Arrive early if you can, and expect to run slower.

Go deeper

The terms:

- **Heat acclimation:** training or resting in heat to trigger adaptations; called acclimatization when done in a naturally hot climate.
- **Plasma volume:** the liquid part of your blood. It expands with heat acclimation.
- **Hypoxia:** lower oxygen levels, as at altitude.
- **Live high, train low:** sleeping at altitude while training at lower elevation.
- **Live high, train high:** living and training at altitude.

What people believe: You can't adapt to heat in time, and altitude training guarantees faster racing at sea level.

Heat:

- A 2024 meta-analysis, updating a 2016 analysis of 96 studies with 39 more, found heat adaptation improved exercise performance and capacity in the heat by a moderate amount, though less than earlier estimates [1].
- It lowered resting core temperature and heart rate, increased sweating and plasma volume, and reduced how hot and thirsty people felt [1].
- Programs of 8 to 14 days of active heat training were most common. Passive heat, such as hot baths or saunas, was described as a practical alternative [1].

Altitude:

- A 2009 meta-analysis of 51 studies found natural live high, train low gave gains of about 4% in power output in both sub-elite and elite athletes [2].
- Other methods gave smaller or unclear gains. Brief, intermittent artificial altitude gave about 2.6% in sub-elite athletes; live high, train high was unclear. For elite athletes, only natural live high, train low showed a possible gain [2].
- The authors noted that placebo effects and the boost from a focused training camp likely contributed to some results [2].

Between the lines: Heat acclimation is a cheap, well-supported way to prepare for a hot race. For altitude camps, the evidence is too weak to recommend them for most people.

Reality check: Heat studies were mostly short and in young men. Altitude studies were often small, poorly controlled and hard to blind.

How sure are we: Strong that heat acclimation improves performance in the heat. Early on whether altitude training improves sea-level performance.

A heat acclimation plan

1. **Start 2 weeks before your race,** if possible.
2. **Do 8 to 10 sessions** of 45 to 90 minutes of easy to moderate exercise in heat, or in extra clothing indoors.

3. **Or after normal training,** take a hot bath (about 104°F) or sauna for 20 to 30 minutes, building up gradually. Skip this if you have a heart condition or are pregnant, and check with your doctor first.
4. **Drink to thirst** and replace salt with meals (see "Hydration, sodium and race day").
5. **Taper the heat sessions** in the last few days, along with your training.

The session lengths and bath temperature are common practice, not tested rules.

Sources

1. Tyler CJ, Reeve T, Sieh N, Cheung SS. Effects of heat adaptation on physiology, perception, and exercise performance in the heat: an updated meta-analysis. *Journal of Science in Sport and Exercise*. 2024;6(3):195–217. doi:10.1007/s42978-023-00263-8
2. Bonetti DL, Hopkins WG. Sea-level exercise performance following adaptation to hypoxia: a meta-analysis. *Sports Medicine*. 2009;39(2):107–127.