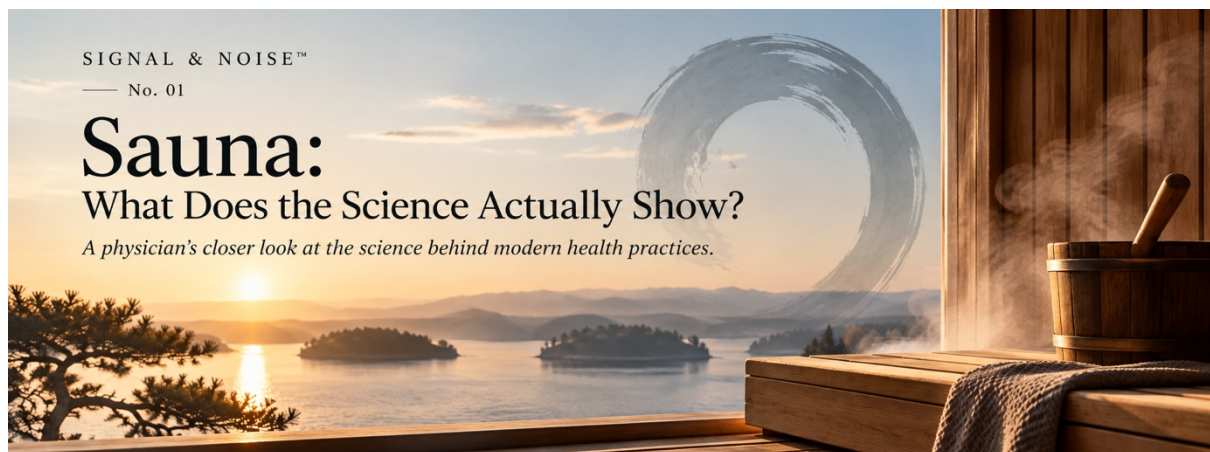




SIGNAL & NOISE™

— No. 01

# Sauna: What Does the Science Actually Show?

*A physician's closer look at the science behind modern health practices.*

Few wellness practices have acquired quite the scientific reputation of sauna. Once understood outside Scandinavia largely as a form of relaxation, sauna bathing is now discussed as something closer to a preventive health intervention. Regular use has been associated with lower rates of cardiovascular death, sudden cardiac death, stroke, hypertension and dementia. Researchers have documented changes in blood pressure and vascular function after heat exposure, while laboratory work has drawn attention to heat-shock proteins and other cellular responses to thermal stress.

Unlike many wellness trends, the enthusiasm is not built on imaginary biology. Substantial heat produces measurable physiological effects: heart rate rises, skin vessels dilate, circulation shifts and thermoregulation is challenged. The harder question is whether these acute responses translate into meaningful long-term health benefits.

The difficulty begins when these different levels of evidence are assembled into a single story. The existence of a physiological response does not necessarily mean that it improves long-term health, and an improvement in a cardiovascular marker does not automatically mean fewer heart attacks decades later. Even striking associations between sauna use and longevity cannot, by themselves, tell us whether sauna caused people to live longer.

This makes sauna an unusually good place to begin Signal & Noise™. There is clearly a signal here. The more interesting question is where that signal ends—and where our interpretation of it begins.

## The Claim

The modern case for sauna extends well beyond relaxation. Advocates propose that repeated heat exposure functions as a form of controlled physiological stress, provoking adaptations that may improve vascular function, reduce blood pressure and inflammation, protect the cardiovascular system and perhaps influence brain health and longevity. More ambitious versions of the argument invoke heat-shock proteins, “detoxification,” metabolic benefits and the idea that sauna can reproduce some of the effects of exercise.

Some of these claims are biologically plausible and supported by human evidence; others travel much further than the data. The useful question is therefore not whether sauna simply ‘works’, but which claims the evidence actually supports.

## Why It Might Work

When a person enters a traditional Finnish sauna, the body immediately confronts a thermoregulatory challenge. As environmental temperature rises, blood vessels near the skin dilate and cutaneous blood flow increases, allowing heat to move from the body’s core toward its surface. Maintaining circulation under these conditions requires an increase in cardiac output, while heart rate rises and sweating provides another route for dissipating heat.

These responses make sauna physiologically interesting. In an experimental study involving 102 adults with at least one cardiovascular risk factor, a 30-minute sauna session at approximately 73°C was followed by a reduction in mean systolic blood pressure from 137 to 130 mmHg and diastolic pressure from 82 to 75 mmHg. Carotid-femoral pulse-wave velocity, a measure of arterial stiffness, also fell immediately after the session. These findings demonstrate that sauna exposure can acutely alter vascular physiology, although an immediate post-sauna change should not be confused with a sustained reduction in cardiovascular risk.

There is nevertheless a plausible mechanism behind some of these findings. Repeated increases in skin blood flow expose blood vessels to changes in shear stress, an important stimulus for endothelial adaptation. Regular heat exposure may therefore act, at least in part, as a recurring vascular challenge. This is one reason comparisons with exercise are tempting: both exercise and heat can increase heart rate, cardiac output, skin blood flow and vascular shear stress.

The comparison with exercise should not be taken too far. Exercise also involves muscular contraction, mechanical loading and metabolic adaptations that passive heating cannot reproduce. Sauna may share certain cardiovascular features with exercise without being a substitute for it.

Heat also activates cellular stress responses, including heat-shock proteins such as HSP70. These proteins participate in the management of damaged or misfolded proteins and in broader pathways involving inflammation, cellular protection and adaptation to stress. Their involvement provides another biologically plausible route through which repeated heat exposure might influence health, but it is also an excellent example of how quickly plausible biology can become a much larger claim. Demonstrating that heat activates a cellular pathway is not the same as demonstrating that activating that pathway prevents cardiovascular disease, dementia or human ageing.

### **What the Human Evidence Shows**

The evidence that transformed sauna from a cultural practice into a longevity story came principally from Finland. One of the most influential studies followed 2,315 middle-aged Finnish men from the Kuopio Ischaemic Heart Disease Risk Factor Study. Sauna frequency was assessed at baseline, and participants were followed for a median of 20.7 years.

The results were striking. Compared with men who reported one sauna session per week, those reporting four to seven sessions had a substantially lower risk of sudden cardiac death, fatal coronary heart disease, fatal cardiovascular disease and death from any cause. After adjustment for conventional cardiovascular risk factors and other potential confounders, the hazard ratio for sudden cardiac death among the most frequent sauna users was 0.37. Longer individual sauna sessions were also associated with lower cardiovascular mortality.

A later analysis of 1,688 Finnish men and women, followed for a median of 15 years, found a similar inverse association between sauna frequency and cardiovascular mortality, extending the observation beyond the original middle-aged male cohort.

The associations extend beyond cardiovascular mortality. In a prospective study of 1,628 Finnish men and women without a previous stroke, 155 strokes occurred during a median follow-up of 14.9 years. Compared with people using a sauna once weekly, those reporting four to seven sessions per week had an adjusted hazard ratio for stroke of approximately 0.38.

Dementia produced another striking signal. In the original 2,315-man cohort, frequent sauna bathing was associated with lower rates of dementia and Alzheimer's disease. A separate Finnish cohort of 13,994 men and women also reported an association with later dementia risk, offering some independent support for the observation.

Hypertension may provide one possible pathway. Among 1,621 Finnish men without hypertension at baseline, greater sauna frequency was associated with a lower incidence of hypertension during long-term follow-up, broadly consistent with the acute vascular effects seen experimentally.

Taken together, the observational evidence is unusually consistent: several outcomes point in the same direction, some associations are large, and plausible physiological mechanisms exist. But consistency does not solve the central problem of causality.

### **The Intervention Evidence**

Controlled trials provide a useful counterweight to the epidemiology. If sauna itself produces very large reductions in cardiovascular disease, repeated exposure should improve at least some of the physiological pathways thought to mediate that benefit. Some trials do, but the overall picture is considerably more modest than the cohort headlines suggest.

A randomized controlled trial published in 2022 examined 47 relatively sedentary adults with at least one cardiovascular risk factor. Participants were assigned to exercise plus post-exercise sauna, exercise alone, or a control condition for eight weeks. Adding regular sauna exposure to exercise produced favourable changes in cardiorespiratory fitness and some cardiovascular risk markers compared with exercise alone, providing useful experimental evidence that repeated heat exposure can influence cardiovascular physiology rather than merely producing a transient response during a single session.

Other controlled work has been less convincing. In a randomized trial involving adults with stable coronary artery disease, regular Finnish sauna exposure produced evidence of heat acclimation but did not significantly improve several vascular outcomes compared with the control condition. Small trials of heat therapy in other populations have generated a mixture of positive and neutral findings, complicated by differences in temperature, exposure time, study population and the type of passive heating used.

‘Passive heat therapy’ is also not a single intervention. Traditional Finnish sauna, infrared sauna, Waon therapy and hot-water immersion differ in temperature and heat transfer, so positive findings from one modality should not automatically be attributed to all of them.

The broader randomized evidence reinforces the need for caution. A 2025 systematic review and meta-analysis examined 20 randomized controlled trials of repeated passive heating lasting approximately two to 15 weeks. Across the pooled evidence, investigators did not find significant improvements in most cardiometabolic and vascular outcomes examined, including flow-mediated dilation, pulse-wave velocity, resting heart rate, heart-rate variability, glucose, HbA1c, cholesterol, triglycerides and C-reactive protein. There was, however, a potential signal for reduced systolic blood pressure with whole-body heating, particularly among people with cardiovascular risk or established cardiovascular disease.

A sustained fall of even a few millimetres of mercury in systolic pressure could matter clinically. It is nevertheless a very different finding from demonstrating the 50–60% reductions in major outcomes sometimes inferred from observational sauna studies; no large randomized trial has established such an effect.

### **Where Signal Becomes Noise**

The sauna story contains genuine signal: heat changes cardiovascular physiology, repeated exposure can produce adaptation, prospective cohorts associate frequent sauna use with lower cardiovascular and neurological risk, and controlled experiments suggest favourable effects on selected measures. The problem begins when these findings are treated as interchangeable forms of evidence.

The extrapolation begins when those observations are compressed into a single causal sequence: sauna activates beneficial stress pathways, those pathways improve cardiovascular function, improved cardiovascular function prevents disease, and therefore frequent sauna use extends human life. Each step

is plausible, but plausibility is not the same as proof, and evidence supporting one step does not automatically validate the next.

The mortality studies are observational. Participants were not assigned to decades of frequent or infrequent sauna use; researchers recorded existing habits and followed outcomes. Adjustment for smoking, alcohol, activity, socioeconomic circumstances and cardiovascular risk strengthens the findings, but cannot eliminate every unmeasured difference between frequent and infrequent users.

That matters particularly in Finland, where sauna is woven into everyday social and cultural life. Frequent users may differ in stress, leisure, social connection or baseline health, and reverse causation is possible: people in poorer health may simply use or tolerate sauna less often.

Much of the most dramatic evidence also comes from Finnish cohorts and overlapping research groups. This does not invalidate it, but replication across different populations would strengthen the causal argument.

Perhaps the most interesting tension is the difference in magnitude between the observational and randomized evidence. Long-term cohort studies suggest remarkably large reductions in major clinical outcomes among frequent sauna users, while short-term randomized trials generally show smaller and less consistent changes in intermediate cardiovascular markers. The two bodies of evidence are not necessarily incompatible—existing trials may simply be too small and too short to capture long-term benefits—but the gap between them is precisely where caution is warranted.

### **What About “Detox”?**

The idea that sauna “detoxifies” the body illustrates another common route from signal to noise. Human sweat does contain measurable amounts of various substances, including metals such as arsenic, cadmium, lead and mercury. A systematic review examining toxic elements in sweat found evidence that these substances can indeed be excreted through perspiration, particularly among people with greater exposure or body burden.

That establishes a route of excretion, but it does not establish the much broader claim commonly implied by the word detox. To demonstrate clinically meaningful detoxification, we would need to know that sauna substantially reduces the total body burden of a relevant toxic substance and, importantly, that doing so improves a meaningful health outcome. The available literature is too heterogeneous and limited to establish sauna as a general detoxification therapy.

In other words, detecting a substance in sweat is not the same as demonstrating a clinically important detoxification therapy. It is a useful example of an interesting physiological observation being asked to support a much larger claim.

### **Does It Matter Clinically?**

There is enough evidence to take sauna seriously as more than relaxation. The physiological effects are real, the cardiovascular associations are unusually consistent, and intervention studies suggest possible benefits for selected measures such as blood pressure. What remains uncertain is the size of any long-term clinical benefit.

What we cannot currently say is that someone who begins frequent sauna bathing will reproduce the enormous reductions in mortality reported in Finnish observational cohorts. Nor should sauna be presented as an alternative to interventions with far stronger causal evidence. Regular physical activity, smoking cessation, blood-pressure control, lipid management and appropriate treatment of diabetes have established effects on cardiovascular risk that sauna has not yet demonstrated.

The most reasonable interpretation is therefore that sauna may be a useful adjunct for someone who already addresses conventional cardiovascular risk and enjoys heat exposure—not a replacement for established prevention.

### **Risks & Trade-offs**

For most healthy adults, sensible sauna bathing appears to be well tolerated. Heat nevertheless produces vasodilation and changes in blood pressure, which can lead to light-headedness, hypotension or occasionally syncope. Fluid loss through sweating also makes dehydration increasingly relevant as sessions become longer or repeated, particularly when fluid intake is inadequate.

Alcohol is an important practical concern. Combining substantial alcohol consumption with intense heat exposure can amplify hypotension, impair judgement and increase the risk of falls or other accidents. People with unstable cardiovascular disease, severe symptomatic hypotension or other conditions that impair normal responses to heat should seek individualized medical advice rather than assuming that sauna is universally benign.

There is also a less frequently discussed consideration for men actively trying to conceive. Testicular heat exposure can interfere with spermatogenesis. In a small longitudinal study of ten healthy men, repeated sauna exposure over three months was associated with reductions in sperm count and motility and with other measurable changes in spermatogenesis. These changes appeared reversible after sauna exposure ended. The study was far too small to determine the real-world effect on fertility, but the biological signal is credible enough that repeated intense heat exposure deserves consideration in men experiencing fertility difficulties.

Cost is another trade-off. Enjoying an available sauna requires a very different evidential threshold from spending thousands of dollars on a home installation because one expects it to prevent dementia or prolong life.

### **What We Still Don't Know**

Several basic questions remain unresolved. We do not know the optimal temperature, duration or frequency for long-term health; commonly cited schedules largely reflect exposure patterns associated with better outcomes in Finnish cohorts rather than doses established in randomized trials.

Nor do we know whether traditional Finnish sauna, infrared sauna and other forms of passive heating have equivalent long-term effects. Their temperatures and mechanisms of heat transfer differ enough that evidence from one should not automatically validate another.

Most importantly, we do not know whether deliberately starting regular sauna use reduces heart attacks, strokes, dementia or premature death. Large, long-duration trials with meaningful clinical outcomes would be difficult, but they are what would move sauna from a promising practice toward an established preventive intervention.

### **The Practical Takeaway**

If you enjoy sauna, the evidence gives reasonable grounds to continue. Its physiological effects are real, sensible use appears well tolerated for most healthy adults, and the cardiovascular evidence is encouraging enough to regard sauna as a potentially beneficial addition to an otherwise healthy lifestyle.

What the evidence does not justify is treating sauna as a proven longevity intervention, a substitute for exercise or established cardiovascular prevention, or a validated method of general 'detoxification'. The striking Finnish findings remain observational associations rather than proof that prescribing sauna will reproduce those outcomes.

If someone asked me whether they should use a sauna they already enjoy, I would be comfortable saying yes, provided there is no medical reason to avoid substantial heat exposure. I would be more cautious about a major financial investment made specifically to prevent dementia or add years to life. The science is promising, but it has not taken us that far.

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