Deutsche Sauna-Akademie®	**Deutsche Sauna-Akademie**
Titel	How Much Sauna Is Too Much?
Subtitel	Thermal load, safety reserve and load management with repeated sauna sessions and Aufguss
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Short answer: Thermal strain during sauna bathing is not determined by air temperature alone. It results from the combined effects of temperature, humidity and water-vapour pressure, thermal radiation, air movement, exposure time, body position, cooling, recovery, hydration and individual physiology. An Aufguss adds a short but potentially substantial thermal stimulus because the increase in humidity can reduce evaporative cooling and alter heat transfer at the skin; recent experimental data show that both sauna temperature and relative humidity independently contribute to increases in heart rate and core temperature. Repeated sauna rounds are therefore best understood as repeated thermal doses. Whether three, four, five or six Aufgüsse in one day are well tolerated cannot be decided by counting Aufgüsse alone. The relevant question is whether each exposure is followed by sufficient cooling and recovery and whether the next round begins with an adequate individual safety reserve.

A sauna visit is often counted in rounds: first sauna, second sauna, third sauna. In facilities with scheduled Aufgüsse, the day may instead be counted in events: three Aufgüsse, four, five, six or more. Both ways of counting are convenient, but neither directly measures physiological load.

The body does not count sauna sessions. It responds to heat transfer, body heat storage, cardiovascular demand, sweating, fluid loss and the degree to which these disturbances are reversed during cooling and recovery.

This article explains the model shown in the accompanying infographic. The figure is deliberately schematic: its coloured load zones and curves illustrate principles, not validated clinical thresholds. In particular, there is no evidence-based universal rule stating that a specific number of Aufgüsse per day is safe for every healthy adult. The scientifically stronger approach is to manage cumulative thermal dose and preserve an individual safety reserve.

1. What does 'thermal load' mean?

Thermal load is the external and internal challenge created when the body gains heat faster than it can dissipate it. Thermal strain is the physiological response to that challenge: rising skin and core temperature, cutaneous vasodilation, increasing heart rate, sweating and fluid loss.

In a sauna, several variables act simultaneously:

- Air temperature determines the temperature gradient between the cabin air and the body.
- Thermal radiation from the heater, walls and other hot surfaces transfers energy directly to the body.
- Humidity and water-vapour pressure determine how easily sweat can evaporate.
- Air movement changes convective heat transfer and the removal of water vapour from the skin.

- Exposure time determines how long the heat imbalance can accumulate.
- Bench height and position alter the local thermal environment.
- Individual factors such as body size, age, health, heat acclimation, hydration and medication influence the physiological response.

The same nominal cabin temperature can therefore produce different thermal loads. Conversely, a lower air temperature does not automatically mean a lower physiological burden if humidity is high, radiation is intense or exposure is prolonged.

2. The temperature curve during one sauna round

The temperature curve in the infographic represents a principle rather than a universal numerical trajectory. When a bather enters the sauna, skin temperature rises rapidly. Core temperature responds more slowly because heat must first be transferred into and redistributed through the body.

In a recent controlled study of 50 recreationally active healthy adults, four 10-minute Finnish sauna exposures produced an average increase in core temperature of approximately 0.4 °C and an average heart-rate increase of about 42 beats per minute. Individual responses varied. [1]

Other sauna studies have reported different core-temperature changes depending on temperature, humidity, duration and protocol. This variation is exactly why one fixed curve cannot represent every sauna bath. [2–4]

After leaving the cabin, external heat input falls. Cooling increases heat loss, but core temperature does not instantly return to baseline. Cardiovascular and fluid-regulatory recovery also take time.

3. Sauna without Aufguss: substantial heat load even in dry air

A dry-hot Finnish sauna already imposes a meaningful thermal challenge. High air temperature and thermal radiation heat the skin, while low water-vapour pressure allows sweat to evaporate comparatively effectively.

This evaporation is important because it is the body's principal active avenue of heat loss in a hot environment. Sweat that evaporates removes heat; sweat that merely accumulates or drips away uses only a fraction of its potential evaporative cooling capacity.

The dry climate therefore provides a physiological advantage: despite very high air temperature, evaporative cooling can remain effective as long as the water-vapour pressure gradient between wet skin and surrounding air is sufficiently large.

4. What changes during an Aufguss?

An Aufguss does not primarily work by making the sauna air dramatically hotter. Water placed on the hot stones evaporates and increases the water-vapour content and vapour pressure of the cabin air.

That change matters because evaporation of sweat depends on the vapour-pressure gradient between the moist skin surface and the environment. As the surrounding vapour pressure rises, the gradient becomes smaller and evaporative heat loss can fall.

At the same time, water vapour and local condensation phenomena can modify heat transfer at the skin. Air movement produced by towel techniques redistributes the hot, humid air and changes local convective conditions.

The subjective result can be striking: the same cabin can suddenly feel much hotter even when the measured air temperature changes little.

5. Humidity is not merely a comfort variable

The importance of humidity is now supported by recent experimental evidence. Laatikainen-Raussi and colleagues studied 50 healthy adults during four 10-minute Finnish sauna sessions in which participants were free to throw water on the stones. Both temperature and relative humidity were independently associated with increases in heart rate and core temperature. [1]

The study does not provide a simple conversion such as 'one Aufguss equals X degrees'. Nor does it establish a universal safe humidity threshold. It does, however, support an important operational conclusion: humidity must be considered part of the thermal dose rather than treated as a purely sensory feature.

This is also consistent with older physiological work showing that humid heat can markedly increase thermal strain compared with dry heat under some sauna conditions. [3,4]

6. Why a relative-load bar chart must remain schematic

The infographic visually compares dry sauna, sauna with Aufguss and a very intensive Aufguss. Such a comparison is useful pedagogically, but the heights of the bars must not be interpreted as validated physiological ratios.

There is no general scientific basis for saying, for example, that a standard Aufguss is exactly twice as stressful as dry sauna or that a show Aufguss produces a fixed multiple of thermal load.

The actual increment depends on water quantity, cabin volume, ventilation, stone temperature, air mixing, fanning technique, seating position, duration and the bather's physiology.

The scientifically defensible message is qualitative: an Aufguss can increase acute thermal strain, and a more intense Aufguss can reduce the remaining safety margin more rapidly.

7. What is a 'safety reserve'?

Safety reserve is a useful professional concept, but it is not a single measurable medical variable. It describes the distance between the bather's current physiological strain and the point at which continuing exposure becomes poorly tolerated or unsafe.

This reserve is influenced by multiple systems at once: thermoregulation, circulation, fluid balance, subjective symptoms and the capacity to recover.

A large reserve means that the person is comfortably tolerating the current dose and can readily restore thermal and cardiovascular balance. A small reserve means that additional heat, humidity, time or another Aufguss may move the person closer to dizziness, marked discomfort, hypotension, excessive hyperthermia or other heat-related problems.

The concept is therefore best used dynamically: safety reserve can shrink during heating and increase again during adequate cooling and recovery.

8. Safety reserve cannot be read from the thermometer

Two guests sitting next to each other experience almost the same cabin climate but may have very different reserves. One may be rested, hydrated and accustomed to sauna. The other may be fatigued, mildly dehydrated, taking medication, recovering from exercise or simply having a low-tolerance day.

Symptoms therefore matter. Marked dizziness, nausea, weakness, headache, confusion, chest discomfort, unusual shortness of breath or a feeling that the heat has become uncontrollable are reasons

to end exposure. They should never be interpreted as evidence that the sauna is producing a stronger health effect.

Severe heat exposure can precipitate syncope, hypotension, heat illness and fluid or electrolyte disturbances in susceptible situations. [5]

9. Three sauna rounds: why recovery between rounds matters

The classic three-round model is useful because it illustrates intermittent rather than continuous heat exposure. Each warm phase is followed by cooling and recovery before the next thermal stimulus.

The key question is not whether the number three is biologically magical. It is whether the previous disturbance has been sufficiently reversed before the next exposure begins.

If cooling and recovery are adequate, the next sauna round begins from a more stable state. If recovery is incomplete, residual heat, cardiovascular strain and fluid loss can carry forward into the next round.

Repeated exposure can therefore follow two very different patterns:

- Recovered repetition: heat stimulus → cooling → recovery → renewed stimulus.
- Cumulative strain: heat stimulus → insufficient cooling/recovery → renewed stimulus while residual strain remains.

Only the first pattern represents controlled repeated thermal dosing.

10. Three Aufguss rounds within one sauna stay

Some Aufgüsse are themselves divided into three rounds of water application and fanning. These should not be confused with three complete sauna sessions.

Within one uninterrupted cabin stay, the first, second and third Aufguss rounds occur while the guest is already warm. The physiological starting point before the third round is therefore different from the starting point before the first.

If each round increases humidity and perceived heat, the safety reserve may progressively narrow even if the same amount of water is used each time.

For this reason, professional load control should not rely on identical dosing alone. The sauna master should also consider the accumulated duration, guest responses, cabin climate and intensity of air movement.

11. The third round does not have to be the strongest

A common dramaturgical pattern is to make each Aufguss round hotter than the previous one. This can be effective entertainment, but it is not a physiological requirement.

From a health-oriented perspective, the opposite logic can sometimes be more appropriate: once guests are already hot and sweating heavily, maintaining or even reducing additional intensity may preserve controllability.

A crescendo is therefore an artistic choice, not a biological law.

12. What changes when a guest attends several Aufgüsse in one day?

The question 'How many Aufgüsse per day are safe?' sounds simple but contains several hidden variables.

Six mild Aufgüsse separated by long periods of cooling, rest, food and fluid intake are not physiologically equivalent to six highly intensive Aufgüsse attended in rapid succession. Likewise, three long, humid and aggressively fanned events may create more cumulative strain than a larger number of short, restrained sessions.

Counting events therefore provides administrative information, not a thermal dose.

13. Three, four, five, six or more: what can science actually say?

Current sauna research does not provide a validated universal daily maximum number of Aufgüsse for healthy adults. It would therefore be misleading to label three as scientifically 'safe', five as 'for experienced users' or six as inherently unsafe.

What research does support is that thermal strain depends on exposure conditions and that repeated heat exposures require attention to recovery. The 2026 Finnish study, for example, used four 10-minute sauna sessions separated by 30-minute recovery periods in healthy recreationally active adults. Repeated sessions did not meaningfully increase the heart-rate response, and differences in core-temperature response between sessions were small under that specific protocol. [1]

That is useful evidence, but it is not a licence for four, five or six arbitrary Aufgüsse. The participants were healthy, the exposures were only 10 minutes, recovery was 30 minutes, and the environmental conditions were measured. The result should not be extrapolated to a full day of intensive event Aufgüsse.

14. A better way to classify repeated Aufguss exposure

Instead of fixed daily numbers, the International Sauna Academy can use a cumulative-load model:

Pattern	Thermal characteristics	Recovery	Interpretation
Low cumulative load	short/moderate exposures; restrained humidity and air movement	complete cooling and unhurried recovery	large reserve likely to be preserved in healthy, tolerant bathers
Moderate cumulative load	several sauna/Aufguss exposures across the visit	recovery remains complete; hydration and symptoms monitored	compatible with controlled repeated bathing for many healthy experienced bathers
High cumulative load	longer, hotter, more humid or strongly fanned exposures; events close together	recovery becoming incomplete	safety reserve may progressively narrow
Excessive individual load	continued exposure despite marked symptoms or inadequate recovery	physiological disturbance persists	stop further heat exposure; number of previous Aufgüsse is irrelevant

15. The interval between Aufgüsse matters

A schedule that offers an Aufguss every hour does not mean that a guest should attend every hour. The relevant interval is the guest's recovery interval, not the facility timetable.

Cooling should first remove excess heat. Recovery should then allow heart rate, breathing, thermal sensation and general well-being to stabilise. Fluid losses should be considered over the entire visit.

A new heat exposure should not be started merely because the next Aufguss is about to begin.

16. Hydration and cumulative sweat loss

Repeated sauna use also means repeated sweating. The amount varies widely with climate, body size, acclimation and duration. The immediate loss in body mass during sauna is predominantly water.

As fluid loss accumulates, plasma volume can fall and cardiovascular compensation can become more demanding. Dehydration can therefore reduce the reserve available for later exposures.

This is another reason why 'six Aufgüsse' cannot be assessed without knowing the duration of the visit, fluid intake, sweat loss and recovery conditions.

17. Cooling restores reserve—but cold is also a physiological stimulus

Cooling is essential to the complete sauna procedure because it reverses the direction of heat transfer and helps return the body toward thermal balance.

However, more cold is not automatically better. Cold water causes cutaneous vasoconstriction and can rapidly change cardiovascular loading. The goal is controlled cooling, not replacing heat overload with cold overload.

Fresh air, showering and—where appropriate—a brief cold-water immersion can be arranged progressively. The intensity should remain compatible with the individual bather.

18. Load management in practice

A practical load-control system should use variables that can actually be observed or controlled:

- Cabin temperature and the bather's bench position.
- Amount of water used during Aufguss and cabin volume.
- Humidity or, preferably for technical assessment, water-vapour content/vapour pressure.
- Duration of the sauna stay.
- Intensity and duration of fanning.
- Number of previous heat exposures that day.
- Length and quality of cooling and recovery.
- Fluid loss and hydration.
- Subjective thermal comfort and warning symptoms.
- Individual health, medication, acclimation and previous sauna experience.

19. A simple decision rule before the next Aufguss

Before another Aufguss, the relevant question is not 'How many have I already done?' but 'Have I recovered from the previous one?'

A practical health-oriented check is:

- Do I feel thermally comfortable again rather than still overheated?
- Has marked sweating from the previous exposure subsided?
- Do I feel steady when standing and walking?
- Are breathing and heart sensation comfortable?

- Have I had sufficient time to rest?
- Have I replaced fluid appropriately over a long visit?
- Am I choosing the next Aufguss because it feels appropriate—or merely because it is scheduled?

If recovery is incomplete, skipping the next Aufguss is load management, not failure.

20. What the infographic should and should not communicate

The accompanying illustration is valuable because it makes three ideas immediately visible: Aufguss can increase thermal load; safety reserve changes dynamically; and repeated rounds require cooling and recovery.

For scientific use, however, the diagram should be read as a conceptual model. Exact relative-load numbers, exact core-temperature peaks and fixed categories such as '1–2 Aufgüsse very safe, 3 good, 4–5 for experienced guests, ≥6 intensive' are not established universal physiological thresholds.

If the figure is used in Academy publications, the strongest version would therefore replace fixed numerical safety categories with a continuum of cumulative load and explicitly state: 'No universal maximum number of Aufgüsse per day has been scientifically established.'

21. The central distinction: exposure count versus thermal dose

This distinction resolves most of the apparent problem.

Exposure count answers: How many sauna sessions or Aufgüsse did the guest attend?

Thermal dose asks: How much heat stress accumulated across those exposures, under which environmental conditions, with how much recovery?

Safety reserve asks: How much capacity remained before the next additional stimulus became poorly tolerated?

Only the last two questions are physiologically meaningful.

22. A health-oriented model for a full sauna day

A health-oriented sauna day should therefore not be programmed around a target number of Aufgüsse. It should be organised around alternating phases of stimulus and restoration:

HEAT / AUFGUSS → COOLING → RECOVERY → reassessment → optional next exposure

As long as recovery remains complete, repeated moderate stimuli may remain well tolerated. As soon as recovery becomes incomplete, the correct response is not to 'push through' the next scheduled event but to reduce or stop further thermal loading.

The number of Aufgüsse is therefore an outcome of individual tolerance and the day's thermal dose—not the target.

Conclusion

Sauna bathing is a controllable thermal procedure only when its load is understood as more than temperature.

A dry sauna already creates substantial heat stress. Aufguss can add to that stress by increasing humidity, altering evaporation and heat transfer, and—through fanning—changing local air movement. Repeated rounds add repeated thermal doses.

The concept of safety reserve provides a useful bridge between physics and practice. It reminds us that the same Aufguss can be easily tolerated early in a visit and excessive later, after residual heat, sweating and fluid loss have accumulated.

For three, four, five, six or more Aufgüsse per day, science does not provide a universal safe number. What can be controlled is the pattern: dose the heat, cool adequately, recover completely, reassess, and only then decide whether another exposure is appropriate.

The professional principle is therefore:

Do not count Aufgüsse as if they were equivalent doses. Manage the cumulative thermal load and preserve the bather's safety reserve.

References

[1] Laatikainen-Raussi I, Mikkola T, Ihalainen JK, Ahokas E. Temperature and humidity independently influence thermoregulatory responses during Finnish sauna bathing. Temperature. 2026;13(3):289-299. doi:10.1080/23328940.2026.2698162.

[2] Crandall CG, González-Alonso J. Cardiovascular function in the heat-stressed human. Acta Physiol (Oxf). 2010;199(4):407-423. doi:10.1111/j.1748-1716.2010.02119.x.

[3] Kukkonen-Harjula K, Oja P, Laustiola K, et al. Haemodynamic and hormonal responses to heat exposure in a Finnish sauna bath. Eur J Appl Physiol Occup Physiol. 1989;58(5):543-550. doi:10.1007/BF02330710.

[4] Pilch W, Szygula Z, Palka T, et al. Comparison of physiological reactions and physiological strain in healthy men under heat stress in dry and steam heat saunas. Biol Sport. 2014;31(2):145-149.

[5] Acute Heat Exposure-Related Illness: A Unified Emergency Medicine Framework for Hot Baths, Hot Springs, and Saunas - A Narrative Review. J Clin Med. 2026;15(5):1910. doi:10.3390/jcm15051910.

[6] Laukkanen JA, Laukkanen T, Kunutsor SK. Cardiovascular and Other Health Benefits of Sauna Bathing: A Review of the Evidence. Mayo Clin Proc. 2018;93(8):1111-1121. doi:10.1016/j.mayocp.2018.04.008.

[7] Hussain J, Cohen M. Clinical Effects of Regular Dry Sauna Bathing: A Systematic Review. Evid Based Complement Alternat Med. 2018;2018:1857413. doi:10.1155/2018/1857413.

[8] Gröning K. International Sauna Academy teaching materials: health-oriented sauna bathing, Aufguss, thermophysiology and load management. 2026.

Editorial note: The terms 'thermal load', 'thermal strain' and 'safety reserve' are used here to support practical risk management. Safety reserve is a conceptual operational term, not a validated clinical index. The coloured zones and curves in the accompanying infographic are schematic. No universal maximum number of sauna sessions or Aufgüsse per day has been established for all healthy adults. Individual tolerance and medical risk can vary substantially.